
**EVALUATION OF THE POTENTIAL FOR EXPANSION OF THE
TRAILL RURAL WATER DISTRICT'S GROUND-WATER SUPPLY
IN THE NORTHERN PART OF THE PAGE/GALESBURG AQUIFER,
PHASE I - COMPILATION AND EVALUATION OF EXISTING DATA**

**By
Rex P. Honeyman**

**North Dakota Ground-Water Studies
Number 115
North Dakota State Water Commission
Dale L. Frink, State Engineer**

**Prepared by the
North Dakota State Water Commission
In cooperation with Trill Rural Water District**



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2005

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INTRODUCTION

Trail Rural Water District (TRWD) currently obtains rural water from the northeast portion of the Page/Galesburg aquifer. The well field is located in Section 29 and Section 32 in Township 146 North, Range 053 West in Trail County (fig. 1). TRWD currently holds two water permits which are approved to appropriate a total of 644 acre-feet from ground water with a maximum withdrawal rate of 1,070 gallons per minute. TRWD is planning to expand their existing ground-water supply which would include serving the cities of Mayville and Hillsboro. Mayville currently has an allocation of 640 acre-feet from the Goose River and Hillsboro has an allocation of 430 acre-feet from the Hillsboro aquifer. The projected water requirements for the proposed expansion are an additional 1,016 acre-feet with an additional pumping rate of 905 gallons per minute for a total appropriation of 1,660 acre-feet at a pumping rate of 1,975 gallons per minute.

In a February 3, 2004 meeting, TRWD requested the State Water Commission provide a cost estimate and time table to complete a feasibility study for the proposed ground-water supply expansion. TRWD identified potential point of diversion areas where production wells could be installed. Based on the locations of these potential points of diversion, a study area was defined which covers approximately 138 square miles (fig. 1).

The water supply study will be conducted in three phases. Phase I, which is presented in this report, consists of compiling and evaluating existing hydrogeologic data to describe the hydrogeologic setting in the northern part of the Page/Galesburg aquifer system and to determine the area(s), if any, where

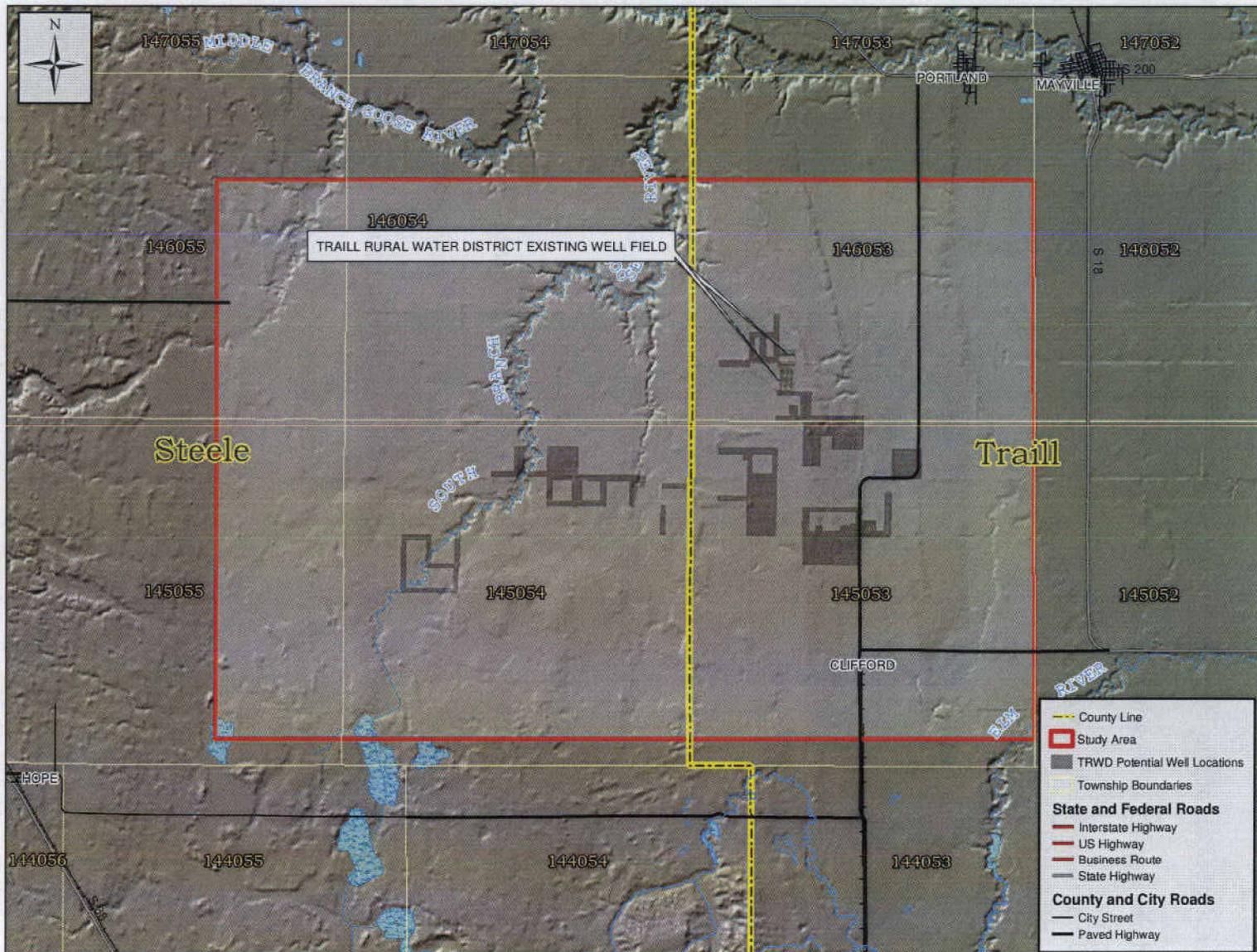


Figure 1. -- Trail Rural Water District proposed production well locations and study area

the potential exists for development of the proposed ground-water supply expansion.

If areas are identified that are suitable for the proposed water-supply expansion, a Phase II Investigation will be recommended to describe the local hydrogeologic settings with particular emphasis on estimating maximum well yields and evaluating water-quality. The Phase II Investigation will involve test drilling, observation well construction, water-chemistry analysis and water-level measurements.

If areas are identified where estimated well yields appear sufficient to meet the needs of the proposed water-supply expansion and there are no water-quality limitations, a Phase III Investigation will be recommended. The Phase III Investigation will involve the construction and analysis of a test well(s) to determine aquifer hydraulic properties and sustained well yields, and to provide a basis for well field design.

Purpose and Objectives

The purpose of this Phase I Investigation is to determine an area(s), if any, in the northern part of the Page/Galesburg aquifer system where the potential exists for the expansion of the ground-water supply as proposed by TRWD.

The objectives of the Phase I Investigation are to:

- 1) Evaluate the occurrence and movement of ground water in the northern part of the Page/Galesburg aquifer system
- 2) Determine the geometry (thickness and areal extent) of the aquifer(s)

- 3) Estimate aquifer hydraulic properties (transmissivity, hydraulic conductivity and storativity) and potential well yields
- 4) Evaluate the water quality of the aquifer system

Location-Numbering System

Wells and test holes referred to in this report are numbered according to public land classification of the United States Bureau of Land Management. The system is illustrated in figure 2. The first numeral denotes the township north of a base line, the second denotes the range west of the fifth principal meridian, and the third numeral denotes the section in which the well or test hole is located. The subsequent letters A, B, C, and D designate, the northeast, northwest, southwest, and southeast quarter-section (160-acre tract), quarter-quarter-section (40-acre tract), quarter-quarter-quarter section (10-acre tract). For example, well 14505315ADD is located in the SE1/4 SE1/4 NE1/4 Section 15, Township 145 North, Range 053 West. Consecutive terminal numerals are added if more than one well or test hole is located within a 10-acre tract.

Previous Work

Simpson (1929) briefly describes the geology and ground-water resources of Steele and Traill Counties. Abbott and Voedisch (1938) assembled water-quality data from selected municipal wells throughout the state, including wells within Steele and Traill counties. Dennis and Akin (1950) completed a progress report in association with the county ground water studies in an area near the city of

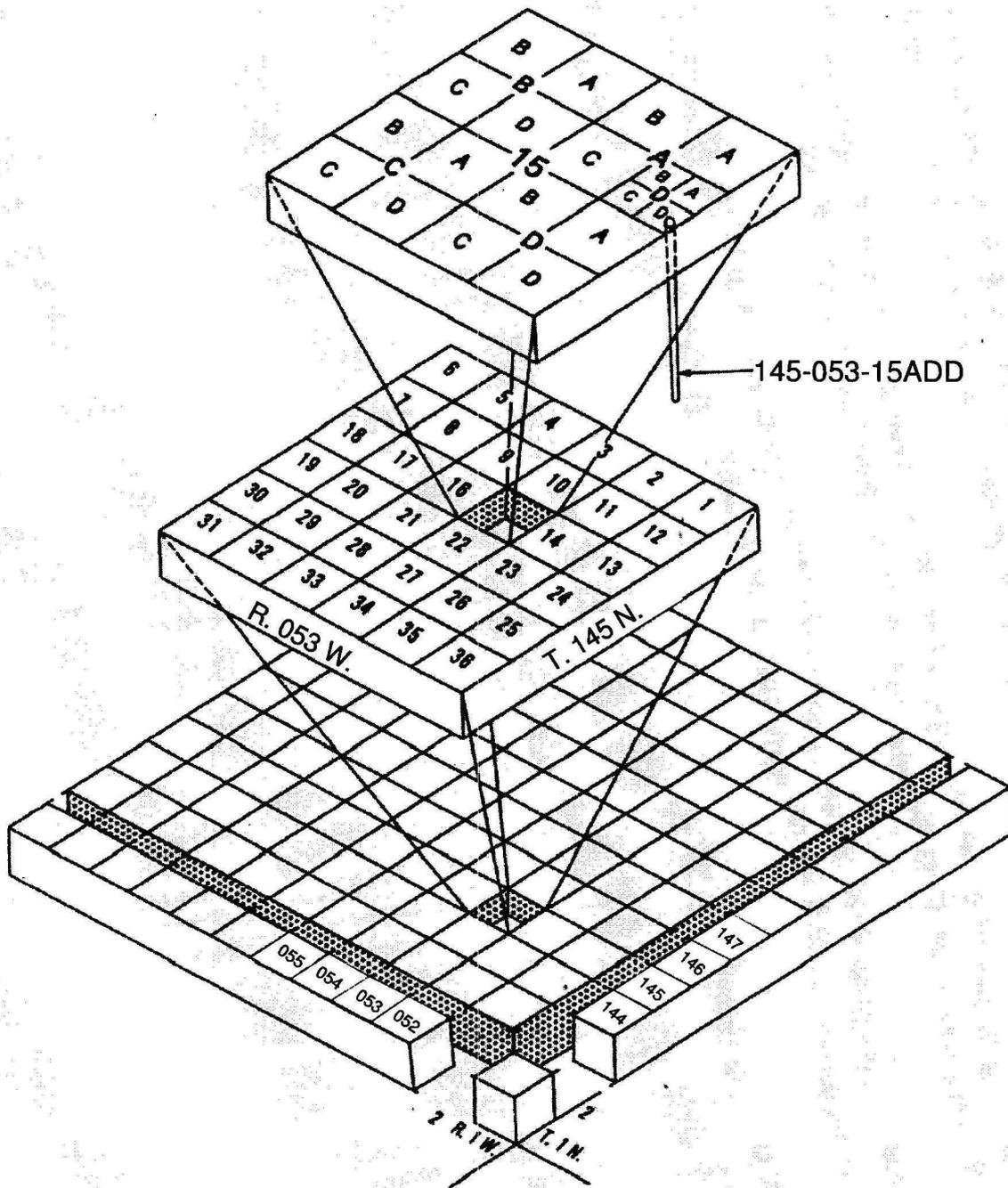


Figure 2. -- System of numbering wells, test holes, and other data points

Portland, ND. This report includes some water quality information from wells within the study area.

The geology and ground-water resources of Traill, Steele, and Cass Counties are described in a three-part report for each county. Part I describes the geology of the respective county (Bluemle, 1967 ; Bluemle, 1975; and Klausing, 1968), Part II presents the ground-water data (Jensen, 1967; Downey, 1973, and Klausing, 1966), and Part III (Jensen and Klausing, 1971; Downey and Armstrong, 1977; and Klausing, 1968) describes the ground-water resources.

The soils of Traill and Steele Counties, including the study area are described in the county soil survey by Prochnow (1977) and Murphy and others (1997) respectively. In 1973 and 1974, C. A. Simpson & Son Drilling completed several wells and test holes in the Page/Galesburg aquifer near the TRWD well field. Two pumping tests for which data are available, were completed in this area during the winter of 1974.

DESCRIPTION OF THE STUDY AREA

Physiography

The study area is located in the east-central part of North Dakota. The eastern two-thirds of the study area is within the Lake Agassiz Plain district and the western third of the study area is within the Drift Prairie district of the Central Lowland physiographic province (fig. 3). The study area can be divided into five landforms, which include a lake plain, beach ridges, a delta plain, a stream valley, and a till plain. The eastern part of the study area consists of a broad, flat, and

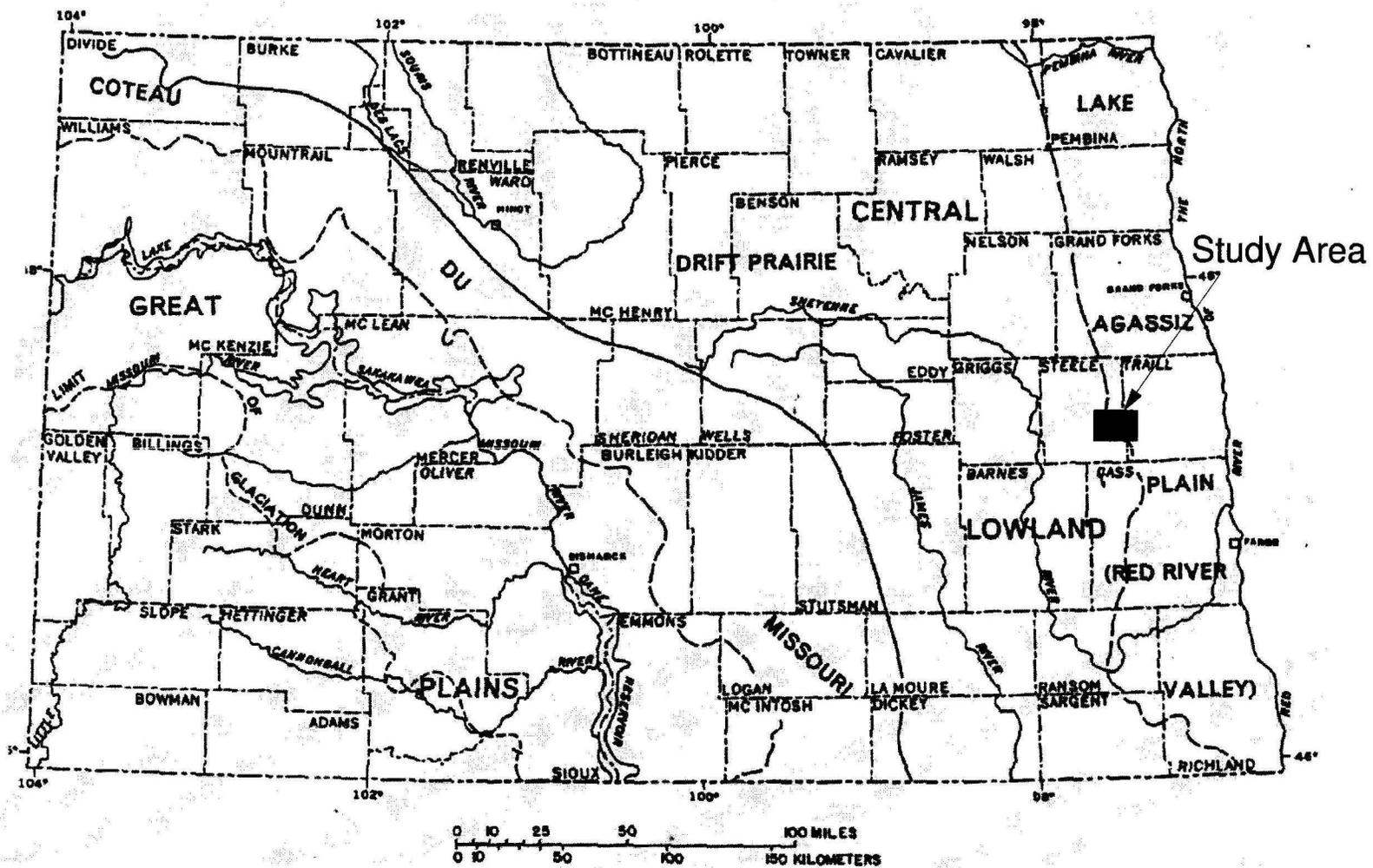


Figure 3. -- Physiographic divisions in North Dakota and location of study area

fertile lake plain, associated with Glacial Lake Agassiz. The elevation of this plain ranges from 970 feet (in the northeast of the study area) to 1,000 feet (in the southeast of the study area) above sea level.

Beach ridges exist near the western boundary of the lake plain. These ridges reach several feet to nearly 35 feet above the surrounding lake plain and are nearly level to gently rolling. They generally trend north to south and represent the former shorelines of Glacial Lake Agassiz.

The delta plain rises approximately 30 to 100 feet above the lake plain and makes up approximately 60 percent of the study area. The delta plain is gently undulating and consists mostly of the sands and silts that were deposited by a large river entering Glacial Lake Agassiz.

The South Branch of the Goose River dissects the delta plain from the southwest to the north central portion of the study area. The South Branch of the Goose River is an underfit stream located in a valley that was originally formed by glacial melt-water.

The till plain in the southwest corner of the study area consists of a nearly level to gently rolling ground moraine. The elevation of the till plain ranges from approximately 1130 feet to 1155 feet above sea level.

Climate

The climate of the study area is subhumid. The mean annual precipitation at Mayville from 1911-1987 was 19.11 inches and at Colgate from 1949-2001 was 18.07 inches (Hydrosphere, 2003). Annual precipitation and the five-year moving average

at Mayville for 1911-1987 and at Colgate from 1949-2001 are illustrated in figures 4 and 5. The driest period of record occurred during the 1930s and the wettest period of record occurred during the mid-1990s. Precipitation falls mainly during the growing season and is normally heaviest in late spring and early summer (Murphy et. al, 1997).

The mean annual temperature at Mayville from 1911-1987 was 40.5°F. Over the period of record, temperatures at Mayville ranged from -41°F to 114°F (Hydrosphere, 2003).

Geology of the TRWD Study Area

The surface geology of the study area is characterized by the Pleistocene Coleharbor Formation (Bluemle, 1975). The Coleharbor Formation is comprised of a till facies, a sand and gravel facies, and a silt and clay facies.

The till facies is a non stratified mixture of sand, gravel, and boulders in a silty clay matrix. The coarser fraction of the till consists of shales, carbonates, granitics and basal igneous rocks. The shale was derived from the local bedrock formations. The carbonate was derived from a Paleozoic carbonate sequence from southern Canada and the granitics and the basal igneous rocks from the Canadian Shield (Bluemle, 1975).

The sand and gravel facies consist primarily of deltaic sediments which were deposited by glaciofluvial processes during the Pleistocene. Rivers of glacial melt-water entered Glacial Lake Agassiz from the west forming deltas along its shoreline. These sediments consist of lenticular deposits of sand and gravel

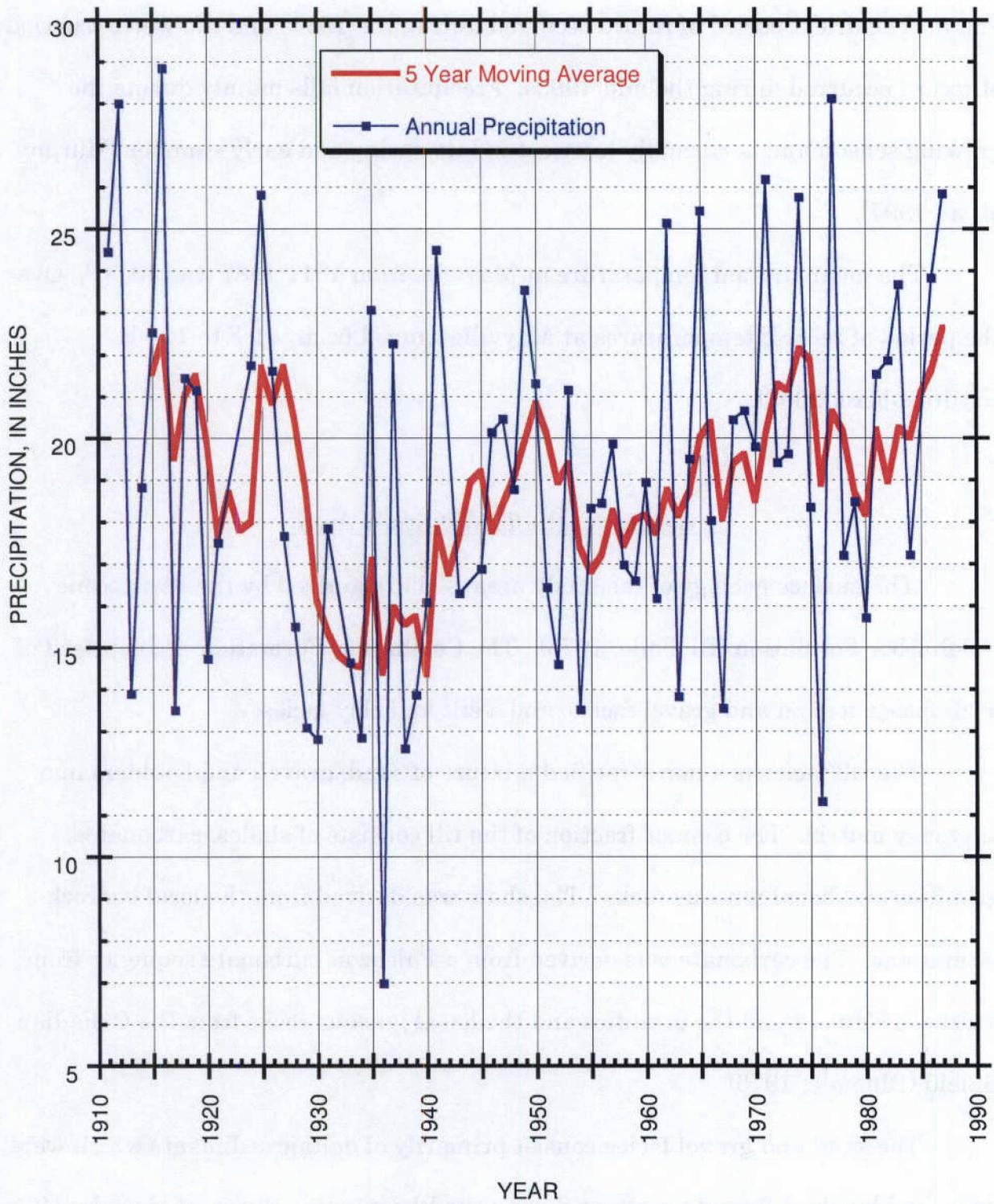


Figure 4. -- Annual precipitation and 5-year moving average at Mayville from 1911-1987

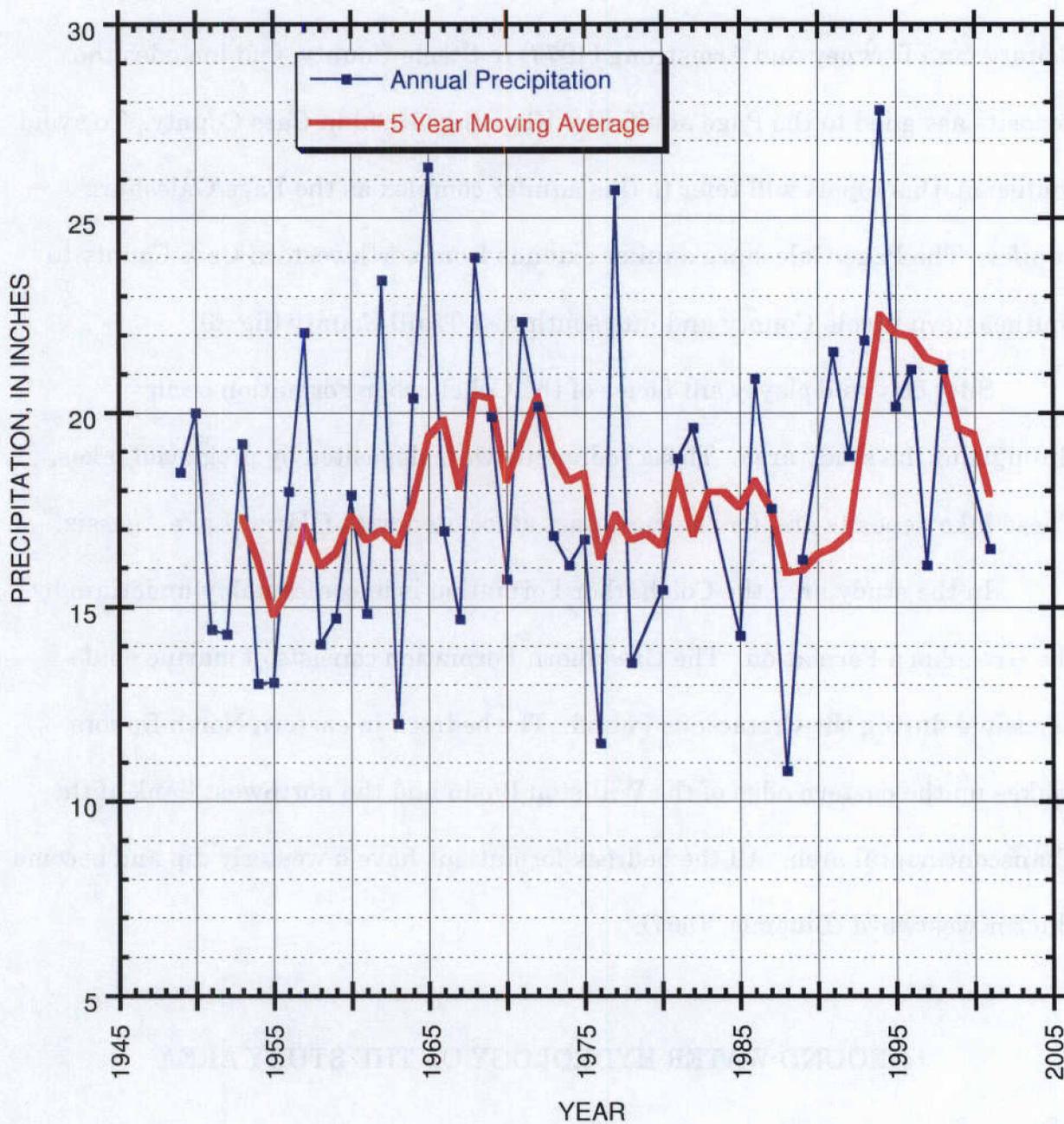


Figure 5. -- Annual precipitation and 5-year moving average at Colgate from 1949-2001

interbedded with clay and silt (Downey and Armstrong, 1977). These deposits form what is referred to as the Galesburg aquifer by Bluemle (1967) in Traill County, and Downey and Armstrong (1977) in Steele County, and includes the deposits assigned to the Page aquifer by Klausing (1968) in Cass County. To avoid confusion, this report will refer to this aquifer complex as the Page/Galesburg aquifer. The Page/Galesburg aquifer extends from northwestern Cass County to southeastern Steele County and into southwest Traill County (fig. 6).

Silty clay and clayey silt facies of the Coheharbor Formation occur throughout the study area. These sediments were deposited by proglacial lakes. These lake deposits are, for the most part associated with Glacial Lake Agassiz.

In the study area the Coleharbor Formation is unconformably underlain by the Greenhorn Formation. The Greenhorn Formation consists of marine shale deposited during the Cretaceous Period. The bedrock in eastern North Dakota makes up the eastern edge of the Williston Basin and the northwest flank of the Transcontinental arch. All the bedrock formations have a westerly dip and become thicker westward (Bluemle, 1967).

GROUND-WATER HYDROLOGY OF THE STUDY AREA

Description of Aquifer Units and Occurrence and Movement of Ground-Water

Within the study area, the Page/Galesburg aquifer complex is divided into three units referred to as aquifer unit A, B, and C (Fig. 7). The aquifer units were

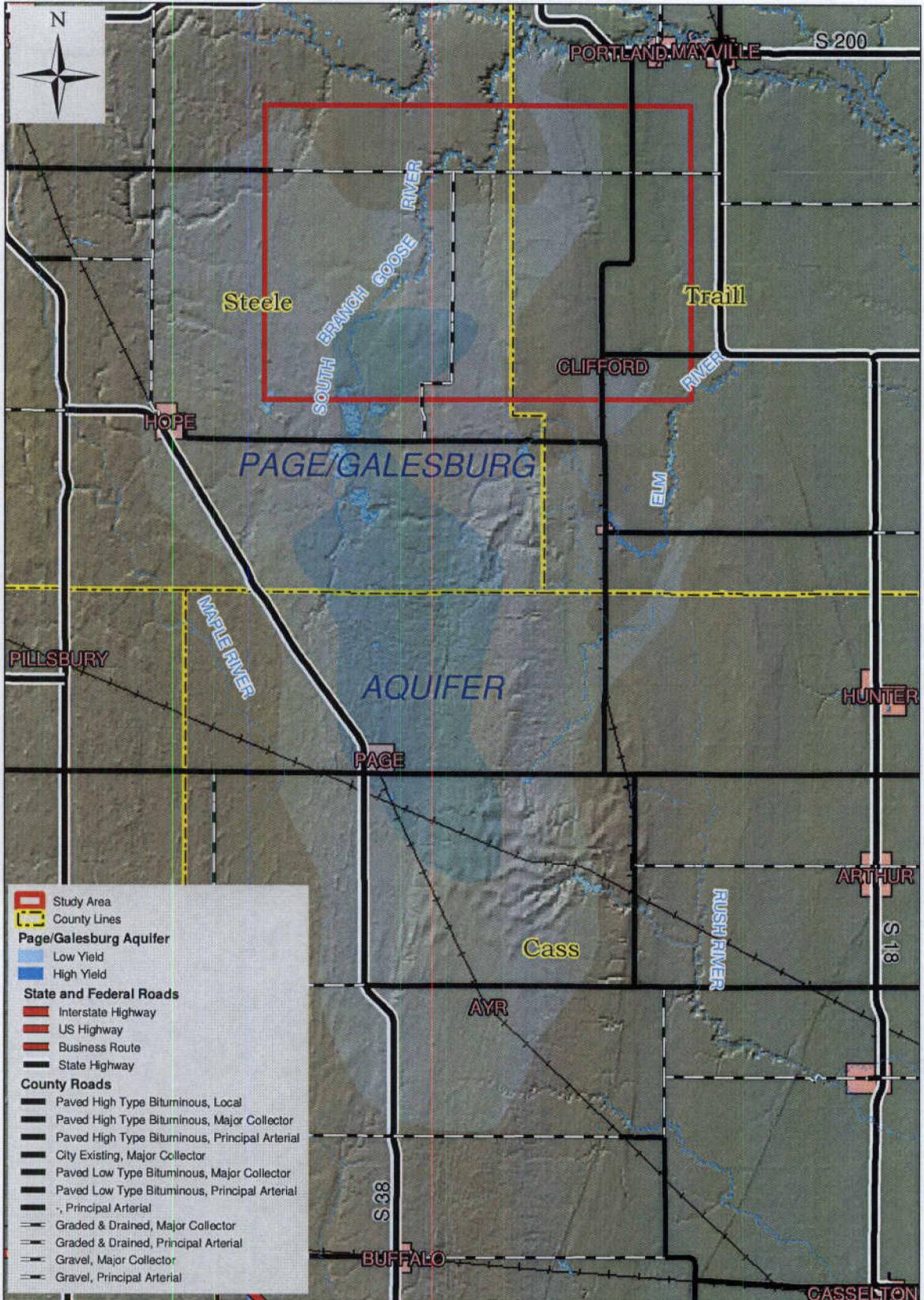


Figure 6. -- Page/Galesburg aquifer boundary and study area

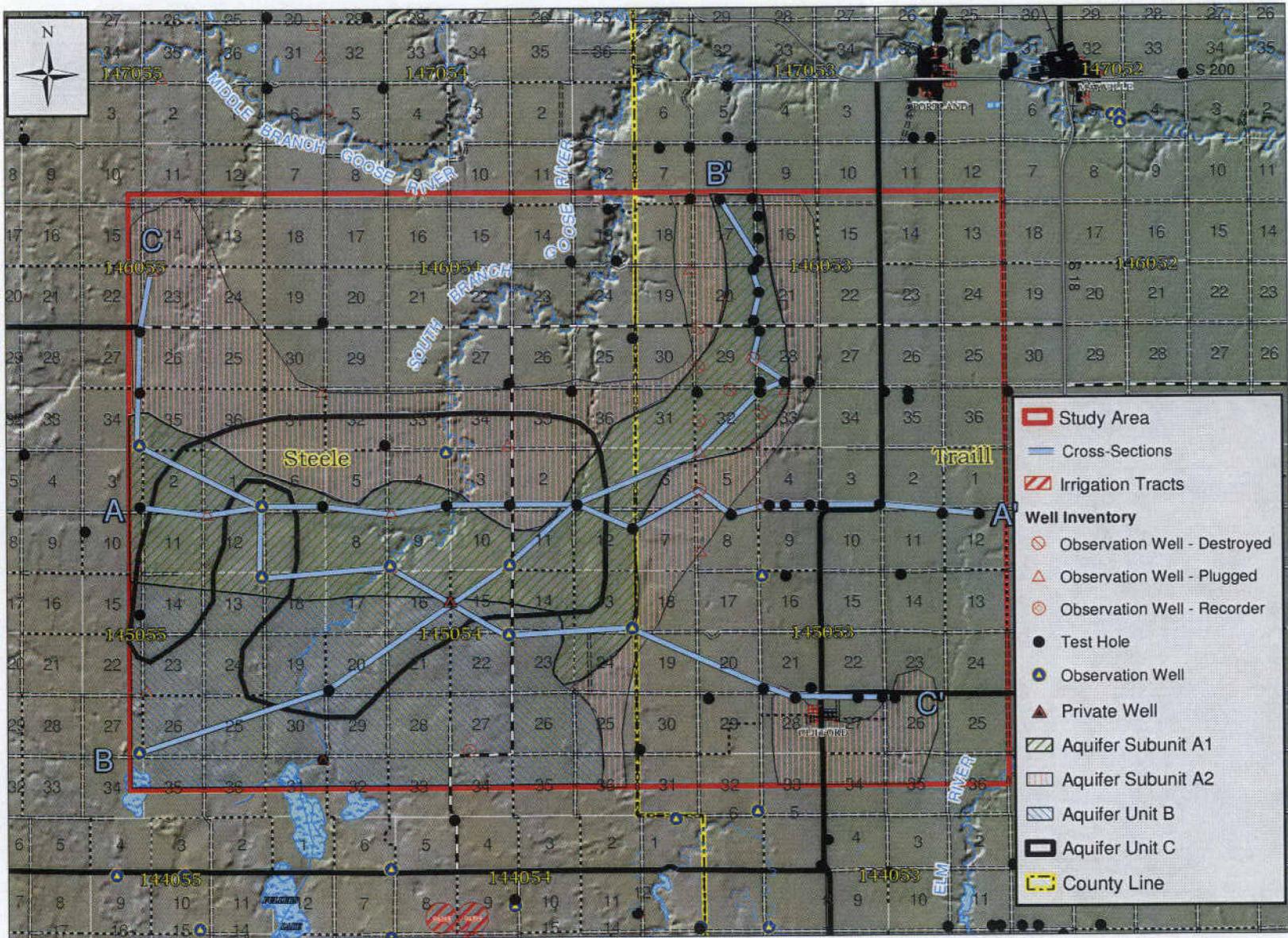


Figure 7. -- Sand and gravel aquifers within the study area

differentiated based on texture (grain size) of the aquifer matrix, saturated thickness, stratigraphic position, and whether the aquifer is confined or unconfined.

Aquifer unit A is divided into two subunits based on differences in texture and saturated thickness. Aquifer subunit A1 is unconfined and is a relatively narrow deposit of very fine to coarse sand that extends from the west central and central part of the study area to the northeast part of the study area (fig. 1). West of sections 11 and 14 (Township 145 North, Range 054 West) aquifer subunit A1 consists of fine to medium sand (figs. 8-11). Northeast of observation wells 14505410DDD and 14505413DDD2, aquifer subunit A1 consists of very fine to fine sand with the exception of the TRWD well field area where aquifer subunit A1 consists of fine to coarse sand. Based on completion reports for 13 production wells within the TRWD well field, the average saturated thickness is 57 feet (fig. 8). Outside of the TRWD well field the average saturated thickness of aquifer subunit A1 is 40 feet (fig. 8). Saturated thickness is based on the lowest water level measured for the period of record. Aquifer subunit A2 is an unconfined aquifer that is located along the north and east flanks of aquifer subunit A1 (fig. 7). Aquifer subunit A2 is composed of a very fine to fine sand with an average saturated thickness of 22 feet (fig. 8). Based on the very fine to fine texture and relatively small saturated thickness of aquifer subunit A2, estimated individual well yields are too small for the proposed TRWD water supply expansion. Therefore, it was important to delineate aquifer subunit A2 to omit this area from further investigation.

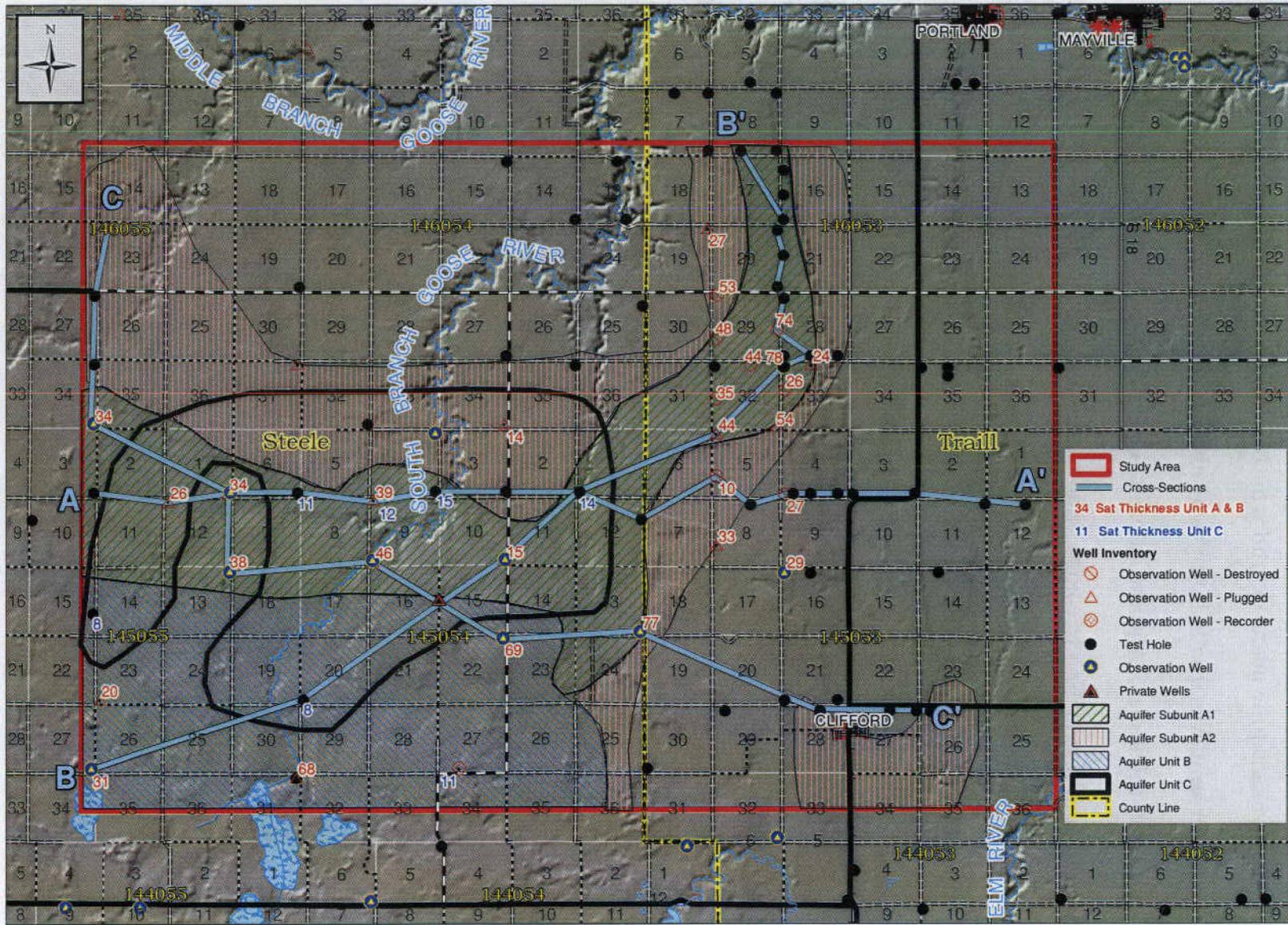


Figure 8. -- Saturated Thickness of aquifer units within the study area (in feet)

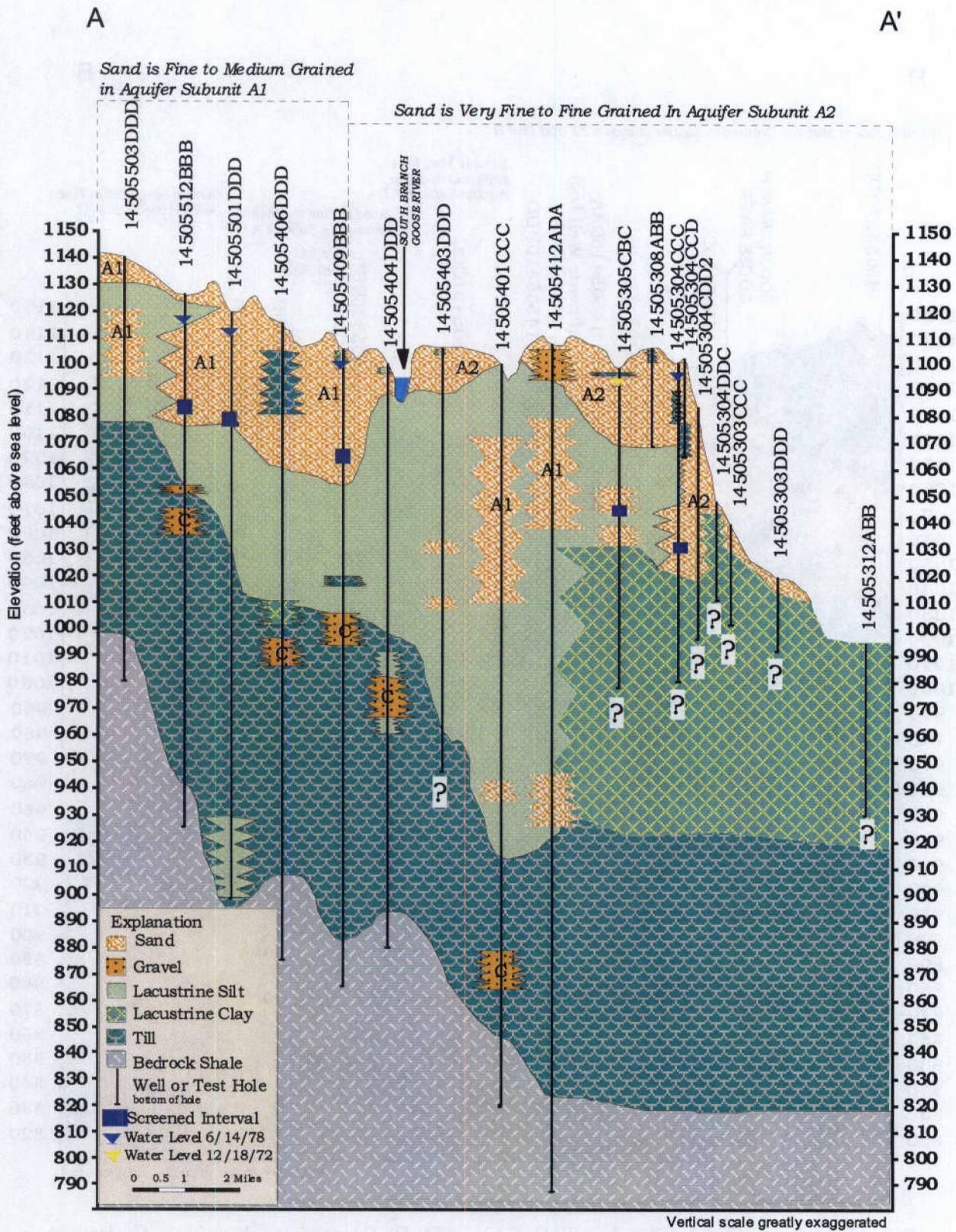


Figure 9. -- Geohydrologic Section A-A' Showing Aquifer Subunits A1 and A2, and Aquifer Unit C

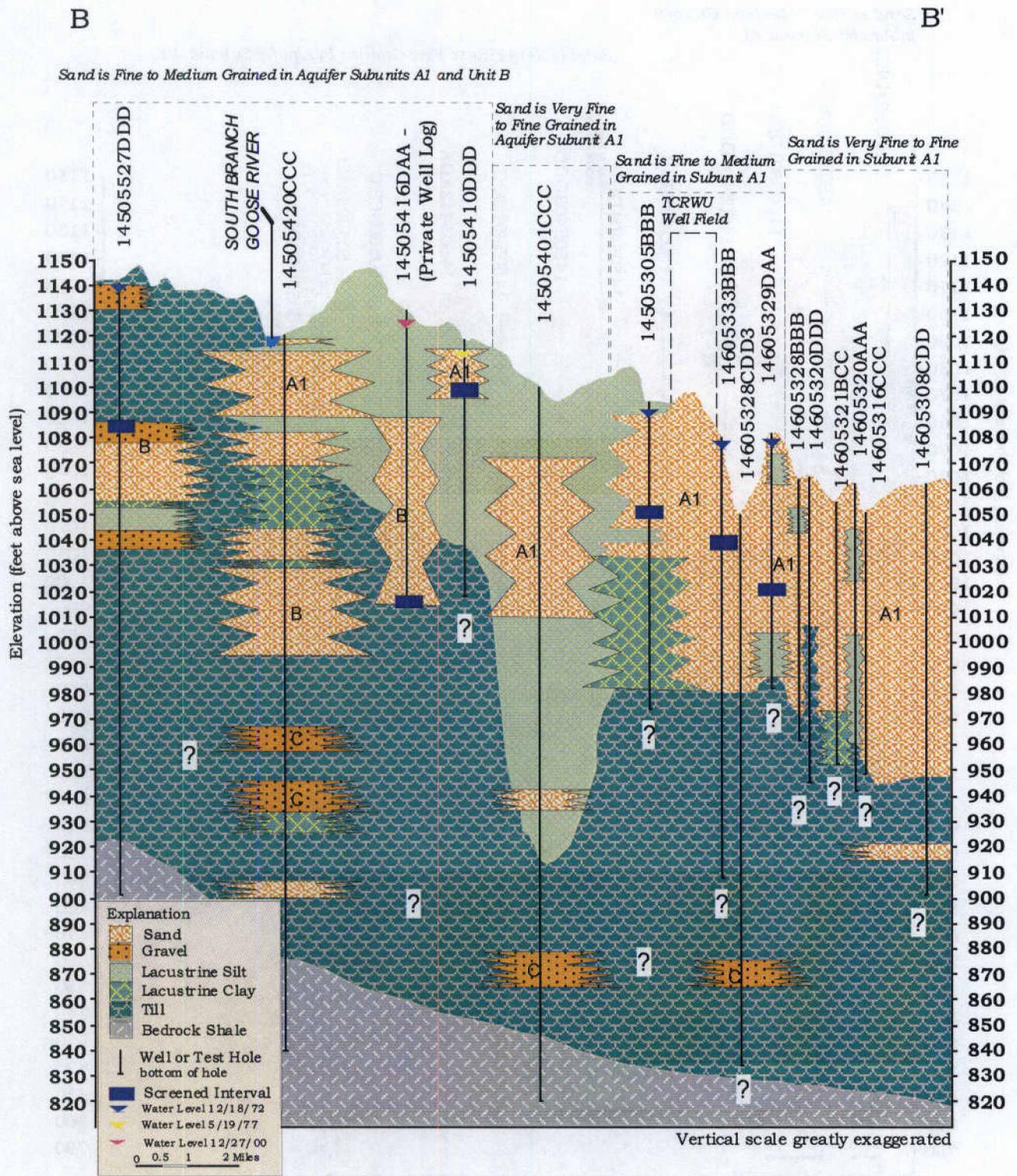


Figure 10. -- Geohydrologic Section B-B' Showing Aquifer Subunit A1 and Aquifer Units B and C

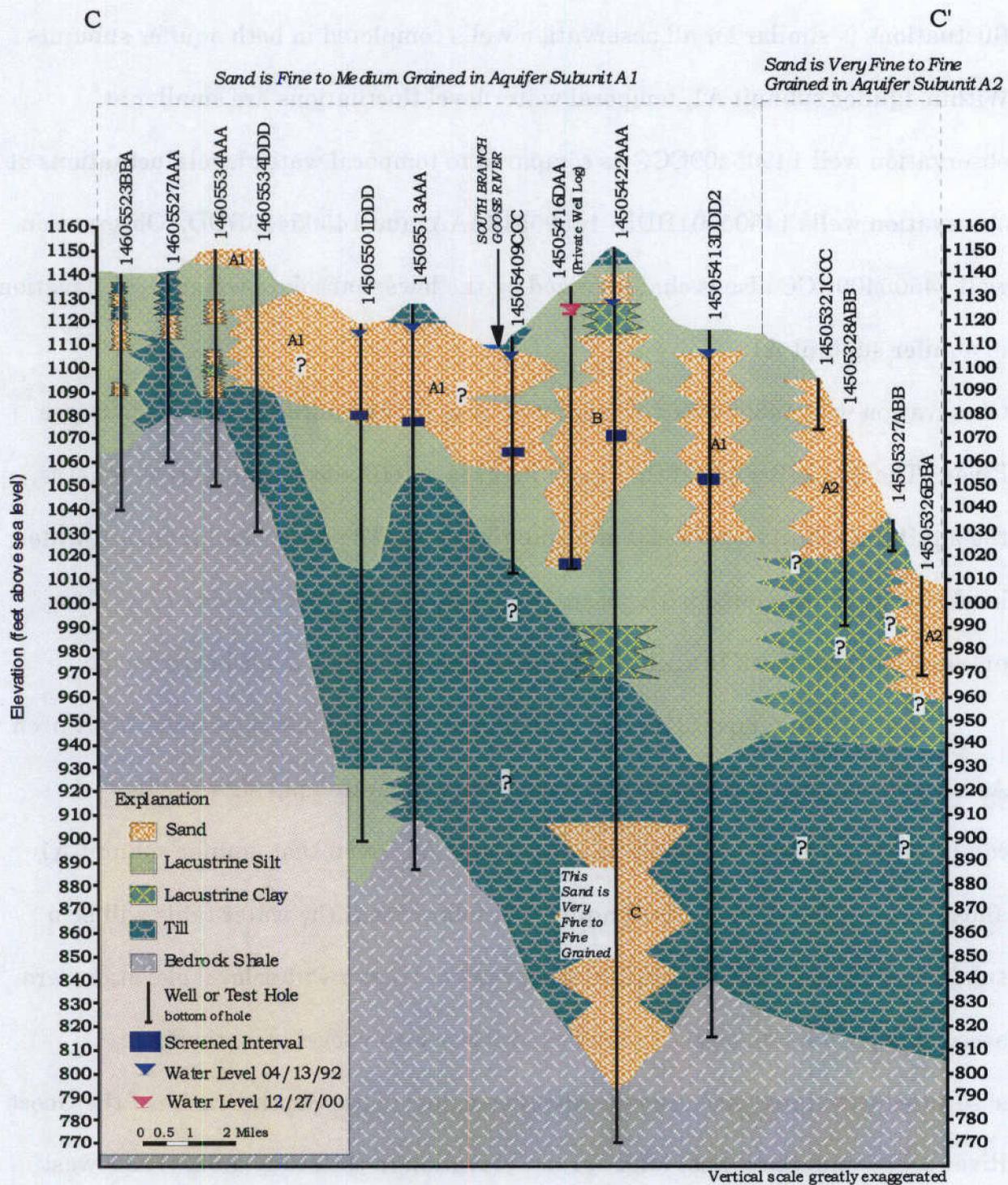


Figure 11. -- Geohydrologic Section C-C' Showing Aquifer Subunits A1 and A2, and Aquifer Units B and C

Water-level data for existing, destroyed, and plugged wells completed in aquifer subunits A1 and A2 are illustrated in figure 12. The pattern of water-level fluctuations is similar for all observation wells completed in both aquifer subunits. Within aquifer subunit A1, temporal water-level fluctuations are smaller at observation well 14505409CCC as compared to temporal water-level fluctuations at observation wells 14505501DDD, 14505513AAA, and 14505410DDD. Observation well 14505409CCC also is characterized by the lowest absolute water-level elevation in aquifer subunit A1.

Observation well 14505409CCC is located close to the South Branch of the Goose River. The South Branch of the Goose River is an effluent (gaining) river, that is, the aquifer discharges ground water into the river. The dampened temporal water-level elevation associated with observation well 14505409CCC is due to its close proximity to the South Branch of the Goose River which is a discharge area.

Spatial and temporal water-level data are rather limited over the study area. As a result, it is not possible to construct a very accurate map showing the configuration of the water table in aquifer unit A. Given that aquifer subunit A1 and A2 are surficial, unconfined aquifers it follows that the water table will be a subdued replica of the land-surface topography. Higher water-level elevations are associated with land-surface uplands and lower water-level elevations are associated with land surface lowlands. The valley of the South Branch of the Goose River represents the lowest land-surface elevation in the study area. The lowest water-level elevations in aquifer subunits A1 and A2 are from observation wells 14505409CCC and 14505404AAA both of which are located nearest to the South

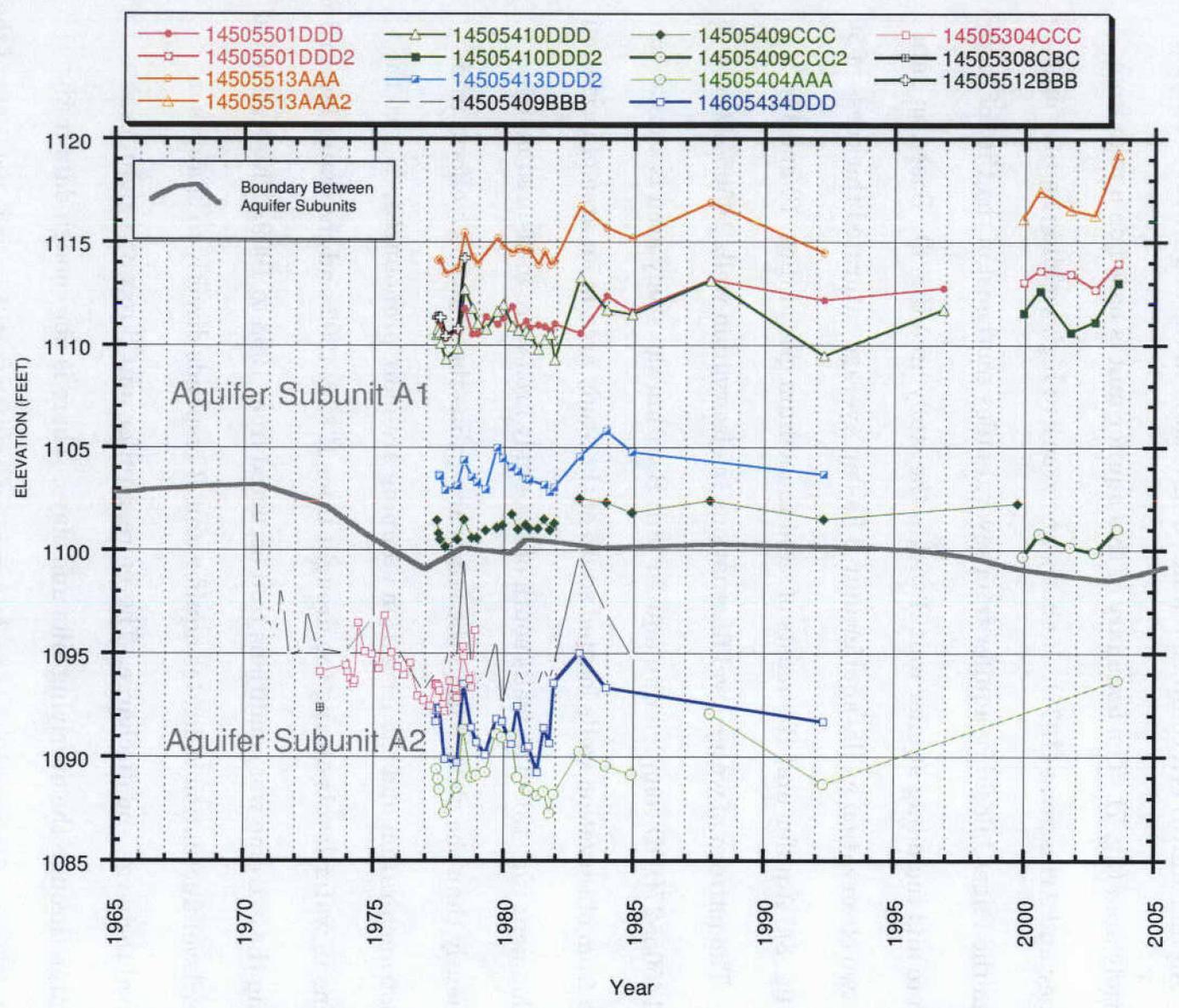


Figure 12. -- Water-level fluctuations within subunit A1 and subunit A2

Branch of the Goose River. Over a large part of the study area, the direction of ground-water flow in aquifer unit A is toward the South Branch of the Goose River.

Aquifer unit B is a confined aquifer unit located in the southwest portion of the study area (fig. 7). The boundary of this aquifer unit is based on a map from Downey and Armstrong (1977). It shows an extensive high-yielding aquifer unit within the Page/Galesburg aquifer from several miles southeast of the City of Page north to and including aquifer unit B within the study area (fig. 6). Based on data from two observation wells, aquifer unit B has an average saturated thickness of 50 feet (fig. 8). Aquifer unit B consists of sand to medium gravel (figs. 10 and 11).

The pattern of water-level fluctuations in observation wells 14505422AAA and 14505527DDD completed in aquifer unit B within the study area is similar to those from observation wells located south of the study area in an area of irrigation development (fig. 13). The wells south of the study area were measured more frequently than the wells within the study area, thus the drawdown effects from evapotranspiration and the irrigation pumping are more pronounced. Notice the decline in water-levels during the drought from 1988 to 1992 and the water level rise during the extreme wet conditions that occurred from 1993 to 1999. This pattern of water-level fluctuation indicates aquifer unit B responds directly to changes in natural recharge and discharge. Therefore, aquifer unit B receives significant recharge through the overlying silts and clays. There is not enough data in the south portion of the study area to determine if aquifer unit B is, or is not, part of the more extensive aquifer described by Downey and Armstrong (1977). Only a few wells and test holes have been completed into aquifer unit B. Additional

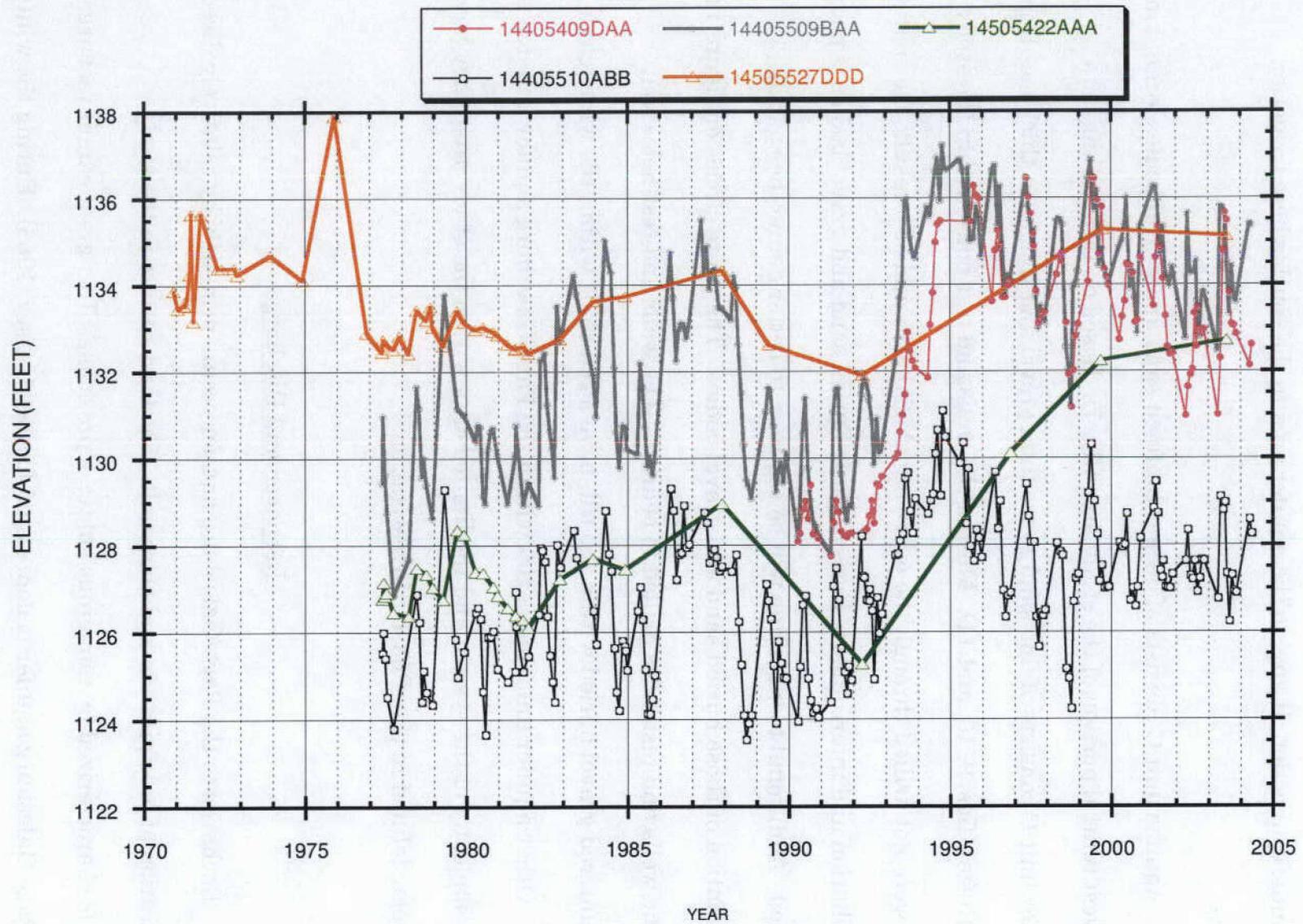


Figure 13. -- Water-level fluctuations in aquifer unit B and wells south of the study area

exploration of aquifer unit B will be required to determine the nature of the hydraulic connection, if any, to the aquifer area to the south where irrigation occurs.

Aquifer unit C consists of deeper confined sand and gravel bodies located in the west central portion of the study area (fig. 7). Based on test drilling data aquifer unit C consists of fine sand to medium gravel and ranges in thickness from 8 to 15 feet (figs. 9, 10, and 11). Most of the wells and test holes within the study area were not drilled through the overlying glacial drift and as a result, the spatial distribution and interconnectedness of these buried sand and gravel bodies is poorly defined. Additional test drilling will be required to better define the spatial distribution of these buried sand and gravel bodies. The white circles on figure 14 are the wells and test holes drilled to bedrock. The wells and test holes that encountered gravel buried within the till, have a red circle within the white circle.

Other aquifer units may exist within the Page/Galesburg aquifer, but due to the complexity of the system and the limited data within the study area, they have not been defined in this Phase I Investigation.

Recharge and Discharge

Recharge to the Page/Galesburg aquifer occurs primarily by relatively direct infiltration of precipitation and snowmelt. The land surface in the study area is characterized by numerous subtle depressions. To a great extent recharge to the Page/Galesburg aquifer is depression focused (Lissey, 1968). During the winter, a frost zone develops at or near the water table. Snow accumulates in depressions

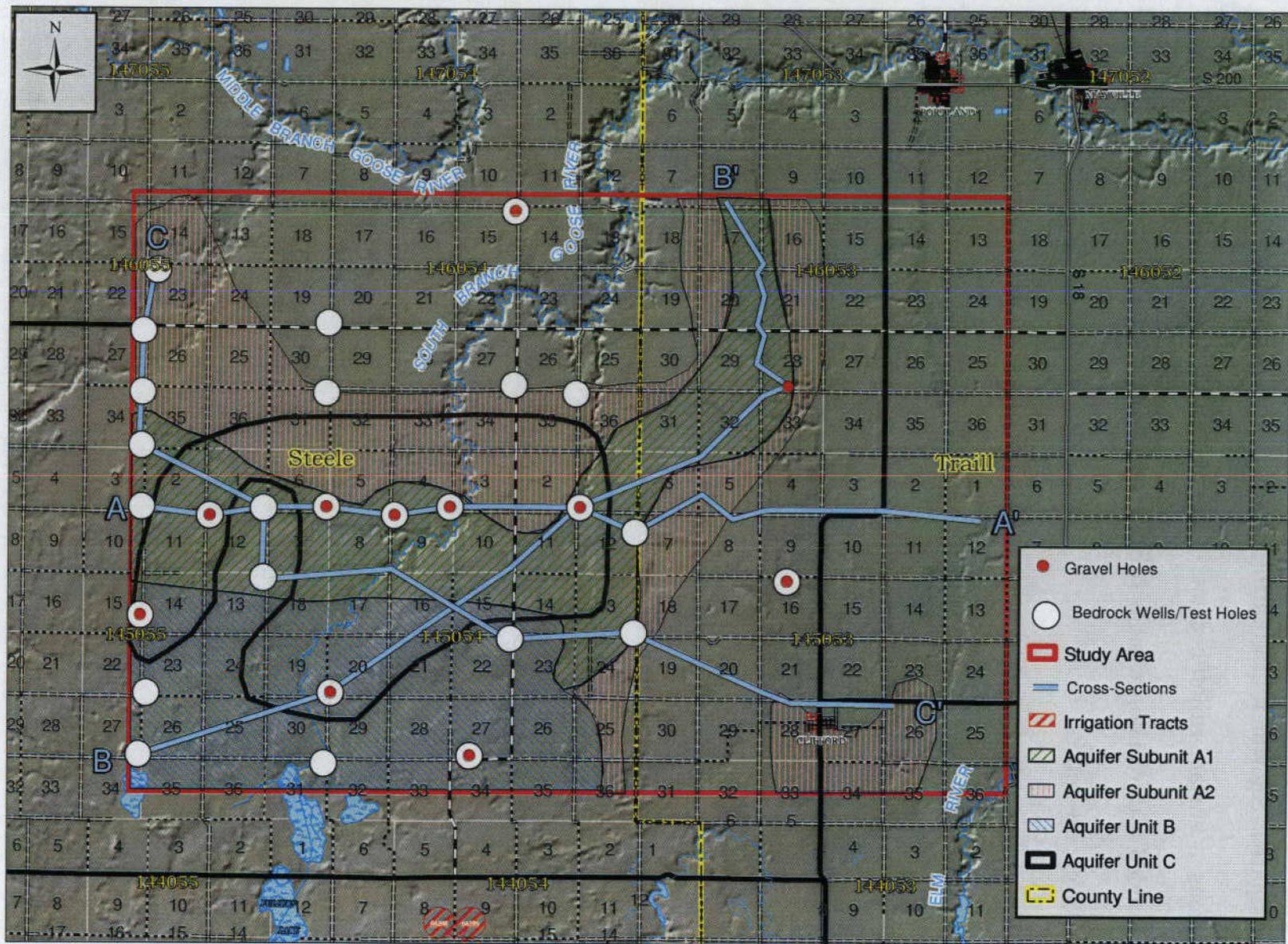


Figure 14. -- Wells/test holes containing a gravel interval and wells/test holes drilled to bedrock

and on adjacent topographic-high areas. In the spring, snow melts before the frost zone dissipates. Snowmelt originating in the upland areas is redistributed to the depressions as surface runoff because of the inability to infiltrate through the frost zone. Pondered water in depressions infiltrates downward to the saturated zone after the frost zone dissipates.

Recharge to the Page/Galesburg aquifer occurs primarily during the spring. Although soil-moisture-holding capacities are relatively small and permeabilities are relatively large, recharge, for the most part, is significantly less during the summer months because potential evapotranspiration exceeds precipitation. At times, summer precipitation events are of sufficient intensity and duration to overcome soil-moisture deficits and generate recharge, particularly in local depression areas. During the fall, potential evapotranspiration decreases significantly and precipitation events can be large enough to generate recharge. Even when recharge does not occur during the fall, soil-moisture deficits can be reduced significantly, affecting an increase in the magnitude of the following spring recharge event(s).

Discharge in the aquifer within the study area occurs as outflow to the South Branch of the Goose River, evapotranspiration, springs, pumping from the TRWD well field, and small capacity domestic/stock wells.

Aquifer Hydraulic Properties

C.A. Simpson and Son Drilling conducted two pumping tests within one mile of the TRWD well field. Two test wells were constructed by C.A. Simpson and Son

Drilling in December 1973 and pumped in February and March 1974. Analysis of pumping-test data are used to determine aquifer hydraulic properties (transmissivity, hydraulic conductivity, and storativity), evaluate boundary conditions (barriers, leakage, etc.), and determine maximum sustained pumping rates.

Plots of log of time versus arithmetic pumping level for the two pumping tests conducted near the TRWD well field are shown in figures 15 and 16. Due to the casing storage effect, aquifer properties cannot be calculated using the early time data for these pumping tests. When pumping begins, water in the casing is removed first. Therefore, the rate of change in drawdown is large which results in the calculation of an erroneously small transmissivity.

After about 10 to 12 minutes of pumping, the rate of change in drawdown becomes relatively small, which when applied to a Jacob analysis, will result in the calculation of an erroneously large transmissivity (figs. 15 and 16). The small rate of change in drawdown after about 12 minutes of pumping is due to the effects of delayed yield. Both pumping tests were not run long enough for the effects of delayed yield to dissipate. Delayed yield is caused by slow drainage of soil water from pores above the water table. Various investigators have developed tables relating aquifer texture and hydraulic conductivity. A table prepared by Reed and Pisken (date unknown) for unconsolidated Pleistocene sediments in Nebraska is used to estimate hydraulic conductivity and associated aquifer transmissivity in the study area. Using this table, the hydraulic conductivity of a moderately sorted fine

**PRODUCTION WELL #1 - PRODUCTION WELL DATA
PUMP TEST DATA (2/21/74)
Static Water Level = 18.68 ft. bmp
Average Rate (Q) = 25 gpm**

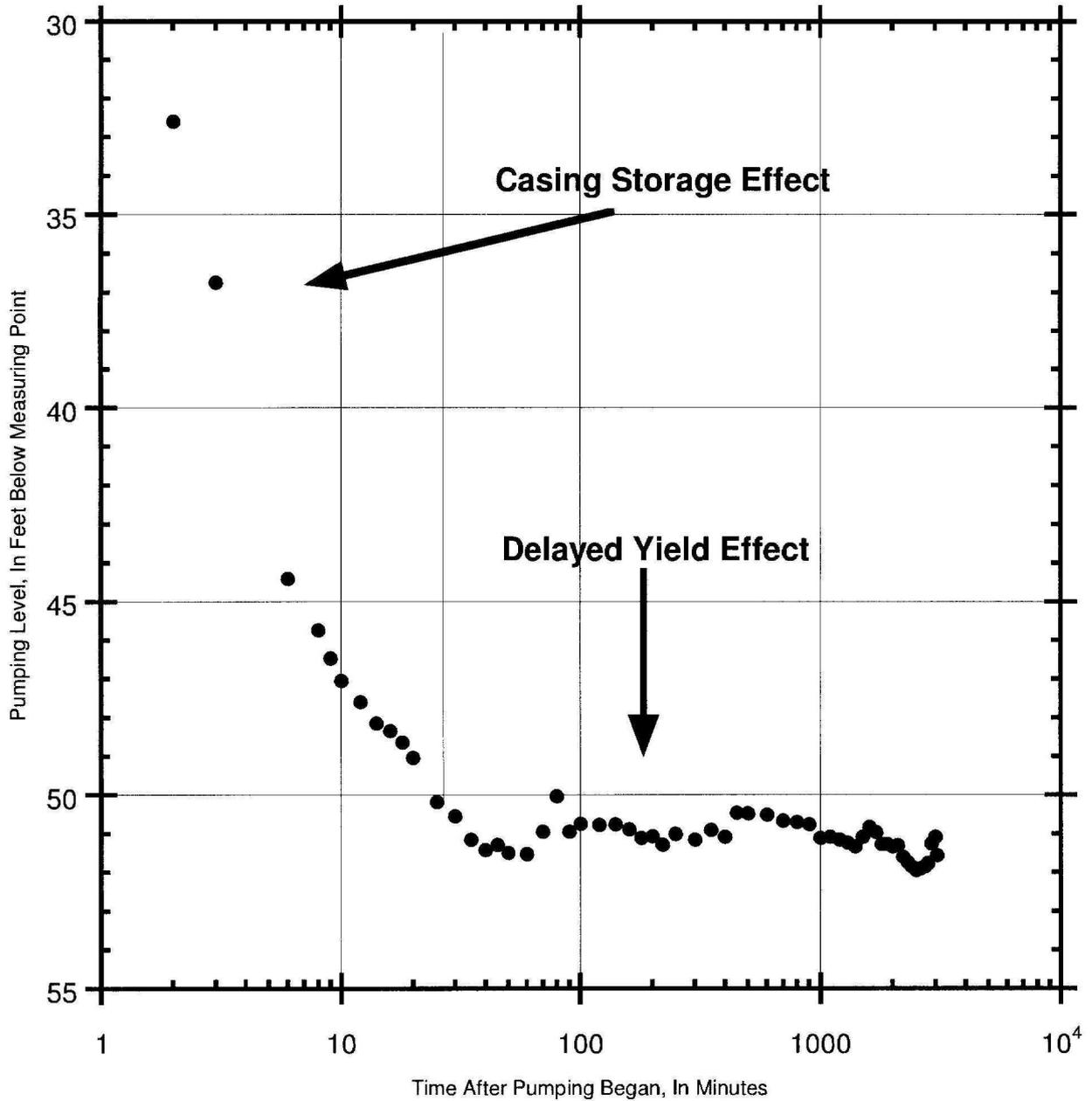
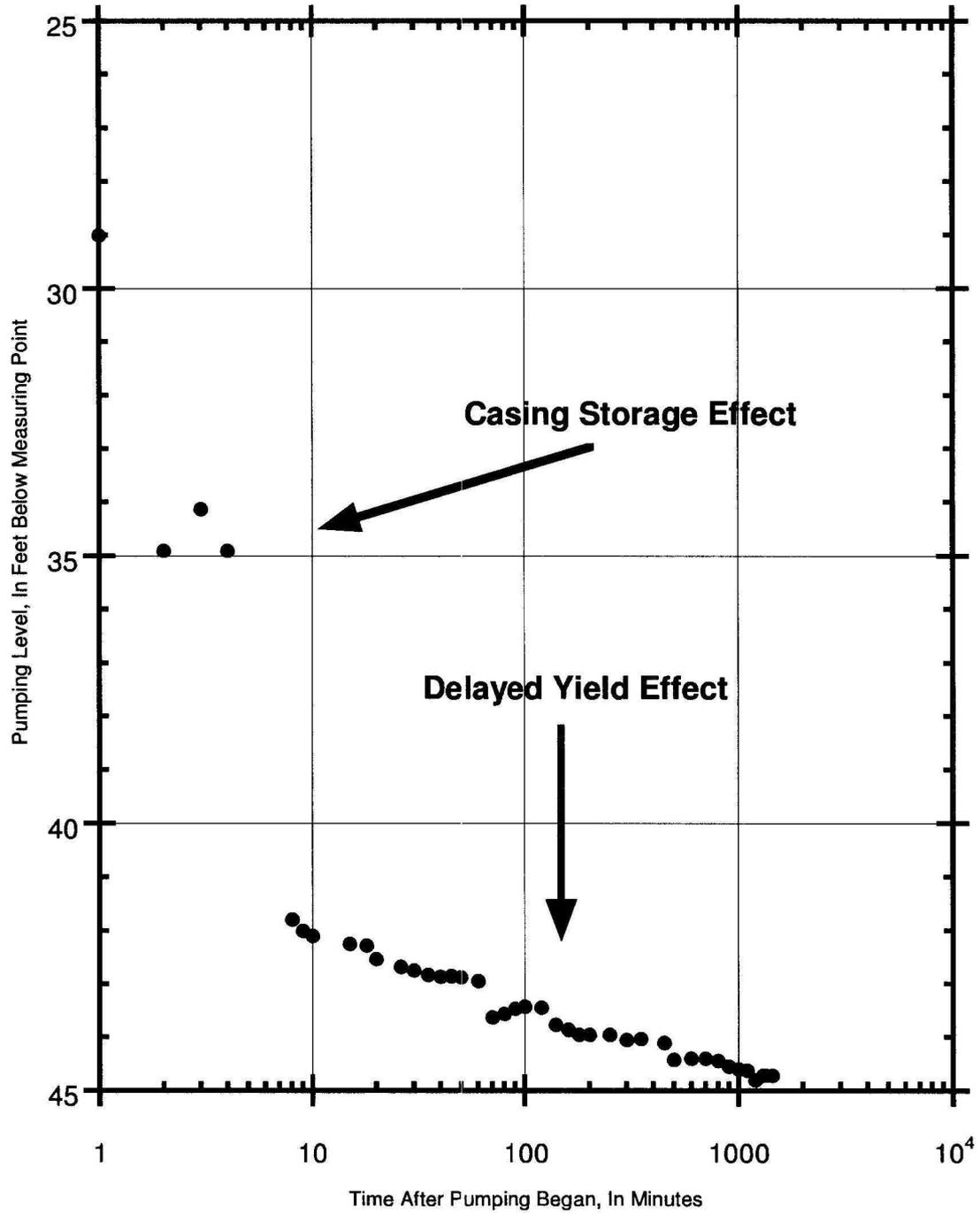


Figure 15. -- Plot of log of time versus arithmetic pumping level in Production Well #1 14605332DDD

**PRODUCTION WELL #2 - PRODUCTION WELL DATA
PUMP TEST DATA (3/17/74)
Static Water Level = 10.05 ft. bmp
Average Q = 52 gpm**



**Figure 16. -- Plot of log of time versus arithmetic pumping level
in Production Well #2 14605329DC**

to coarse sand is about 50 feet per day. Based on an average saturated thickness of 41 feet near the TRWD well field, transmissivity is about 2,050 ft²/day. However, this value seems high when comparing it to the individual well yields of TRWD production wells which average 35 gallon per minute (gpm) and specific capacity values which average 2 gpm/ft measured when the production wells were installed. These low pumping rates and specific capacities suggest a transmissivity in the range of 500 to 1,000 ft²/day. Smaller well yields and associated smaller specific capacities may be the result of inefficient wells, a misinterpretation of the aquifer grain size when the wells were drilled, or a misinterpretation of the aquifer thickness when the wells were drilled.

Water Quality

Chemical analyses of 70 ground-water samples collected from 35 wells completed in the Page/Galesburg aquifer provide the basis for evaluating water chemistry (Table 1). The samples were collected and analyzed over the period from 1965 through 2003. The range and mean values of selected ions, dissolved solids, and hardness and USEPA secondary maximum contaminant levels (SMCL) are shown in Table 2. SCMLs are non-enforceable recommended standards. Values exceeding SMCL are not considered a health hazard.

Ground water in the Page/Galesburg aquifer commonly exceeds SMCL for iron and manganese and dissolved solids. Although there is no federal limit for the SMCL for hardness, ground water in the Page/Galesburg aquifer would be considered very hard.

Table 1 -- Chemical Analysis from Wells Completed in the Page/Galesburg Aquifer within the Study Area

Location	Date Sampled	Screen Interval	(milligrams per liter)																	Hardness CaCO ₃ NCH SAR	% Na pH	Spec. Cond.	
			SiO ₂	Ca	Mg	K	Na	F	HCO ₃	CO ₃	SO ₄	Cl	NO ₃	B	Fe	Mn	TDS						
14505305BBB	9/29/1994	42-45	28	130	34	11	47	0.2	522	0	150	7.3	4.0	0.3	3.8	0.5	673	460	37	1.0	18	7.92	1020
14505305CBC	7/13/1972	52-55	27	171	37	12	64	0.1	461	0	353	2.5	1.0	0.1	0.1	1.1	896	579	201	1.2	19	7.6	1240
14505308CBC	7/12/1972	37-40	25	326	227	18	203	0.1	723	0	1490	9.4	1.0	0.5	0.0	1.0	2660	1750	1160	2.1	20	7.5	3180
14505308CBC	9/29/1994	37-40	23	430	120	22	180	0.1	626	0	1400	13	5.5	0.3	15.0	1.7	2520	1600	1100	2.0	20	7.63	3030
14505404AAA	6/30/1972	87-90	27	106	40	5.2	12	0.2	424	0	122	0	1.0	0.2	0.2	0.7	523	431	83	0.3	6	7.5	765
14505404AAA	7/17/1986	87-90	27	110	46	5.7	12	0.2	351	0	180	2.7	1.0	0.1	4.2	0.4	562	460	180	0.2	5	7.85	836
14505404AAA	9/1/1999	87-90		100	44	4.6	13	0.2	367	0	140	4.3	0.1		3.9	0.5	492	430	130	0.3	6	7.72	821
14505409BBB	6/23/1970	38-41	28	108	55	6.7	32	0.4	375	0	261	1.1	0.0	0.2	0.0	0.7	677	498	191	0.6	14	7.7	980
14505409CCC	6/29/1972	47-50	25	162	52	7.7	18	0.2	383	0	342	0	2.0	0.1	0.0	1.0	799	618	304	0.3	6	7.7	1120
14505409CCC	6/9/1977	47-50	24	120	36	6.2	15	0.1	364	10	160	3.1	2.0	0.1	1.1	0.9	558	450	130	0.3	7	8.5	906
14505409CCC	6/16/1977	47-50	22	120	39	6.1	16	0.1	382	14	160	5.6	1.0	0.0	0.4	0.9	573	460	120	0.3	7	8.4	827
14505409CCC	7/17/1986	47-50	28	110	30	7	14	0.2	362	0	110	2.1	1.0	0.1	2.5	0.6	483	400	100	0.3	7	7.96	726
14505410DDD	6/29/1972	17-20	25	128	46	5.3	15	0.1	428	0	192	0	2.5	0.0	0.1	0.1	625	508	461	0.3	6	7.8	941
14505410DDD	6/16/1977	17-20	22	100	39	4.8	11	0.1	337	21	120	5	1.0	0.0	0.2	2.1	492	410	99	0.2	5	8.6	746
14505410DDD	7/17/1986	17-20	25	100	39	6.2	12	0.1	328	0	150	2.2	1.0	0.1	3.5	2.1	503	410	140	0.3	6	7.74	772
14505410DDD2	12/8/1999	15-20		120	40	5.3	12	0.1	402	0	160	5.2	0.8		0.7	1.0	543	460	130	0.2	5	7.94	839
14505413DDD2	6/9/1977	62-68	23	180	46	8.9	63	0.1	451	9	390	6	1.0	0.1	4.1	1.7	955	640	260	1.1	17	8.4	1450
14505413DDD2	7/17/1986	62-68	24	150	50	12	63	0.1	418	0	380	9.3	1.0	0.4	12.0	1.1	909	580	240	1.1	19	7.55	1260
14505413DDD2	9/1/1999	62-68		160	53	11	62	0.1	428	0	360	5.4	0.1		8.8	1.1	873	620	270	1.1	18	7.62	1300
14505413DDD2	7/31/2003	62-68	29.1	168	57.8	11.7	64.6	0.1	439	<1	398	5.4	0.1		8.0	1.1	924	658	298	1.1	17	7.71	1310
14505422AAA	7/17/1986	78-81	24	150	37	11	20	0.1	325	0	300	7.6	1.0	0.2	11.0	0.7	723	530	260	0.4	7	7.54	990
14505422AAA	9/1/1999	78-81		150	39	11	21	0.1	338	0	310	4.8	0.1		7.8	0.9	712	540	260	0.4	8	7.58	1060
14505423CCC	7/28/1970	0-0	26	168	70	7.7	20	0.2	418	0	414	4	3.9	0.0		0.8	920	706	363	0.3	6	7.9	1290
14505431AAA2	6/6/1977	38-44	22	140	36	5.7	47	0	369	15	250	16	1.0	0.3	1.4	0.6	717	500	170	0.9	17	8.7	1070
14505501DDD	6/23/1970	38-41	28	177	41	7	58	0.1	381	0	385	15	0.0	0.0	0.3	1.0	899	611	299	1.0	17	7.8	1230
14505501DDD	7/17/1986	38-41	28	180	46	9.2	57	0.1	351	0	420	16	1.0	0.2	0.9	1.1	932	640	350	1.0	16	7.8	1300
14505501DDD	9/1/1999	38-41		180	42	9.3	65	0.1	368	0	400	20	0.6		0.2	1.1	899	620	320	1.1	18	7.53	1320
14505501DDD2	12/8/1999	36-41		170	46	7.2	56	0.2	402	0	400	17	0.1		0.3	1.2	896	610	280	1.0	16	7.79	1250
14505513AAA	6/27/1972	48-51	27	121	31	8.1	60	0.1	371	0	263	4.1	1.0	0.1	0.0	1.1	699	431	127	1.3	23	7.8	1000
14505513AAA	7/17/1986	48-51	29	120	29	9.2	55	0.1	357	0	240	5.8	1.0	0.2	1.4	0.8	667	420	130	1.2	22	7.91	967
14505513AAA	9/1/1999	48-51		110	29	8.2	56	0.2	358	0	210	8.4	0.4		0.6	0.8	600	390	100	1.2	23	7.66	947
14505513AAA2	12/8/1999	46-51		120	34	8.1	60	0.2	394	0	250	13	0.1		0.1	1.0	680	440	120	1.2	22	7.96	983
14505527DDD	11/11/1970	57-63	22	68	24	11	257	0.2	481	0	388	26	1.0	1.3	0.9	0.0	1040	268	0	6.8	67	7.8	1540
14605319AAA	7/10/1972	77-80	28	116	32	11	37	0.1	417	0	180	0	1.0	0.4	0.2	0.7	611	421	79	0.8	16	8	930
14605319AAA	9/29/1994	77-80	30	130	32	14	38	0.2	428	0	200	4.4	3.8	0.1	0.2	0.7	665	460	110	0.8	15	7.69	930
14605329BBB	7/10/1972	37-40	31	71	24	9.3	37	0.1	370	0	50	4.7	0.2	0.2	0.0	1.1	411	275	0	1.0	22	7.8	658
14605329CBC	9/20/1972	37-40	24	79	23	1.6	4.1	0.2	306	0	44	0	2.0	0.2	1.5	0.4	331	292	41	0.1	3	7.4	533
14605329DAA	9/21/1972	57-60	25	58	15	5.4	5	0.2	244	0	18	0	1.0	0.2	0.1	0.4	248	208	8	0.2	5	7.9	402
14605332ABB	9/20/1972	57-60	27	74	22	2.7	5.2	0.2	308	0	28	0	1.0	0.1	1.2	0.9	314	276	23	0.1	4	7.7	523
14605332CBB	9/20/1972	32-35	27	142	31	8.3	36	0.1	536	0	138	0.5	1.0	0.3	0.6	0.7	649	481	41	0.7	14	7.7	991
14605332DDD	9/29/1994	57-60	28	86	22	3.4	6	0.2	361	0	28	3	0.9	0.0	0.2	0.7	356	310	9	0.1	4	8.21	564
14605333BAA	9/20/1972	37-40	27	84	18	6.7	28	0.2	381	0	32	0.5	1.0	0.3	0.2	0.6	387	286	0	0.7	17	7.9	631
14605333BBB1	7/11/1972	42-45	27	77	22	4.7	9.6	0.1	342	0	37	0	1.0	0.4	0.0	0.3	347	283	0	0.3	7	7.9	558
14605333BBB1	7/8/1988	42-45	25	63	18	3.2	5.5	0.2	289	2	14	3.6	1.0	0.2	0.0	0.5	278	230	0	0.2	5	8.3	433
14605333BBB1	8/1/2001	42-45		64	18	2.4	6	0.2	280	0	28	0	0.1		1.3	0.5	258	230	4	0.2	5	7.87	460
14605333BBB1	8/15/2002	42-45		60	18	1.7	5	0.2	255	0	34	0	0.3		1.1	0.4	247	220	15	0.1	5	8.06	438
14605333BCC	9/21/1972	32-35	21	56	16	2	5.4	0.2	216	0	30	0	1.0	0.3	0.0	0.3	238	206	29	0.2	5	7.8	401
14605405BCC	8/26/1972	32-35	19	104	40	18	50	0.4	443	0	129	30	1.0	0.3	0.7	1.0	611	424	61	1.1	20	7.2	1010
14605424CC	7/22/1971	0-0	17	160	53	9.9	42	0.6	334	0	397	11	2.5	0.2	1.4	0.0	860	619	345	0.7	13	7.8	1210
14605424CCC	7/22/1970	0-0	22	150	64	7.4	56	0.1	425	0	410	10	0.0	0.1	0.6	0.0	929	639	290	1.0	16	7.7	1300
14605426DD	5/5/1970	0-92	12	83	30	13	11	0.1	313	0	81	8.1	26.0	0.0	0.1	0.0	418	330	73	0.3	6	7.7	687
14605431AAA	6/27/1972	27-30	28	114	34	7	34	0.1	377	0	182	6.7	1.0	0.4	0.1	0.4	593	424	115	0.7	15	7.8	883
14605431ABA	8/6/1970	0-18	24	90	40	4.6	20	0.4	270	0	123	9.6	70.0	0.1	0.0	0.0	515	390	168	0.4	10	7.8	806
14605434DDD	6/28/1972	67-70	28	160	40	15	145	0.1	443	0	419	77	1.0	2.1	1.9	1.3	1110	564	201	2.7	35	8	1690
14605434DDD	9/28/1994	67-70	24	150	35	16	69	0.1	359	0	300	65	7.7	0.3	1.7	1.0	847	520	220	1.3	22	7.59	1200
14605534DDD	11/12/1970	48-51	25	155	58	9.2	77	0.1	294	0	485	27	1.0	0.1	1.9	0.0	984	625	384	1.3	21	7.7	1360

Table 2 - Range and mean values of selected ions, dissolved solids, and hardness, in the Page/Galesburg aquifer, and USEPA secondary maximum contaminant levels

	Range (mg/L)	Mean (mg/L)	SMCL (mg/L)
Calcium	41-430	125.2	N/A
Magnesium	12-227	40.3	N/A
Sodium	3.6-257	41.8	N/A
Potassium	1.6-22	8.0	N/A
Bicarbonate	185-723	375.5	N/A
Sulfate	14-1490	247.0	250
Chloride	0-77	8.5	250
Iron	0-15	1.8	0.3
Manganese	0-2.2	0.8	0.05
Dissolved Solids	219-2660	684.5	500
Hardness	150-1750	479.5	N/A

The distribution of total dissolved solids (TDS), sulfate (SO₄), and hardness determined from the most recent sampling period are shown in figures 17, 18, and 19, respectively. The TDS and sulfate concentrations in the vicinity of TRWD well field are lower than the rest of the study area. The TRWD well field is a local upland and appears to be a net recharge area.

Analysis of water-chemistry data can provide additional insight into the nature of the ground-water flow system. As previously described, the Page/Galesburg aquifer was divided into three separate aquifer units. The water-chemistry data may also provide a basis for identifying these aquifer units. Ground water in the Page/Galesburg aquifer within the study area is calcium-bicarbonate to calcium-sulfate type (fig. 20). Figures 21, 22, and 23 show the relative distribution of major ions for aquifer subunit A1, aquifer subunit A2, and aquifer unit B, respectively. Since no wells have been completed in aquifer unit C, there is no water quality data from this unit. The relative distribution of major ions is very

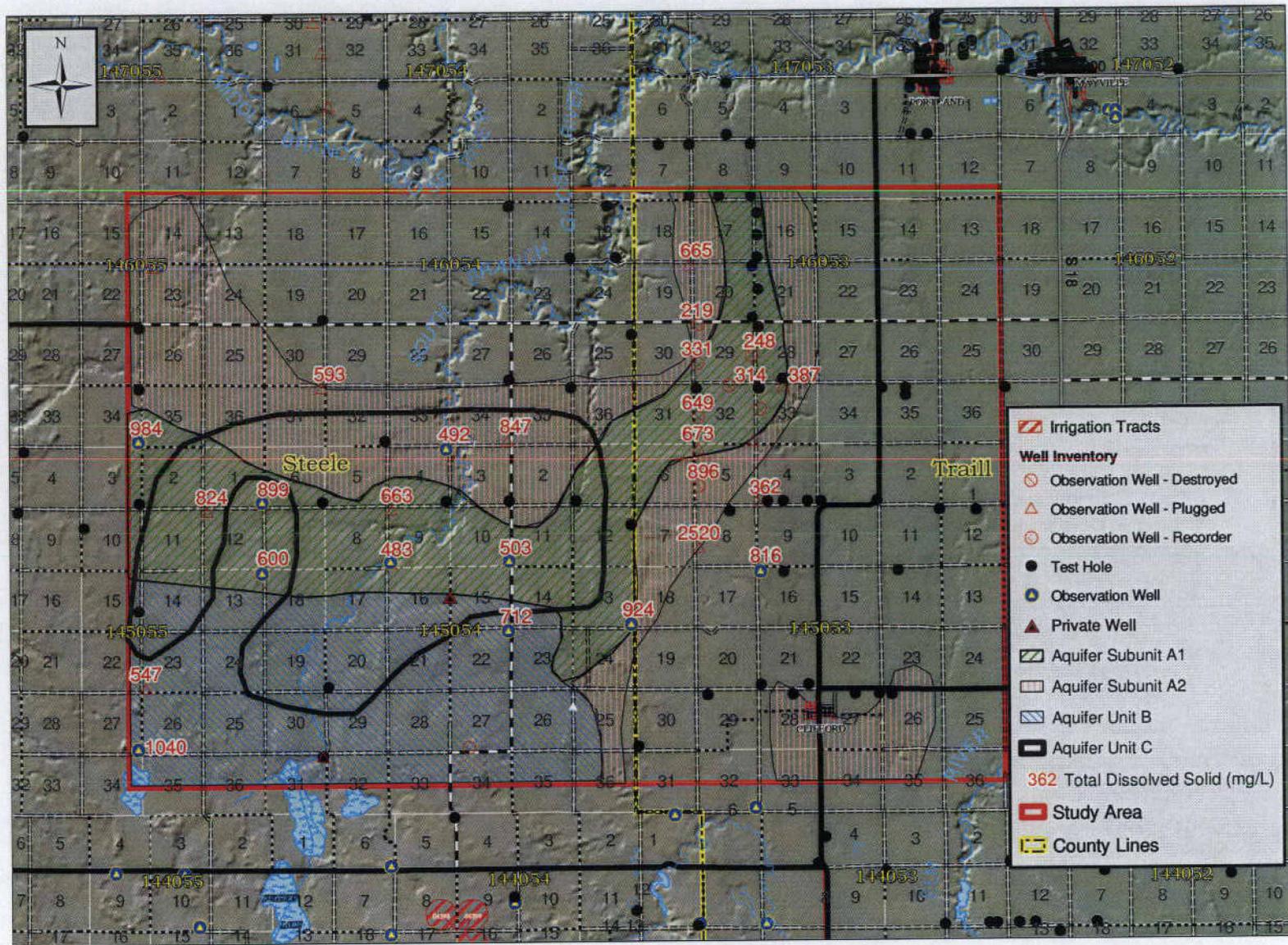


Figure 17. -- Distribution of Total Dissolved Solids Concentration within the study area

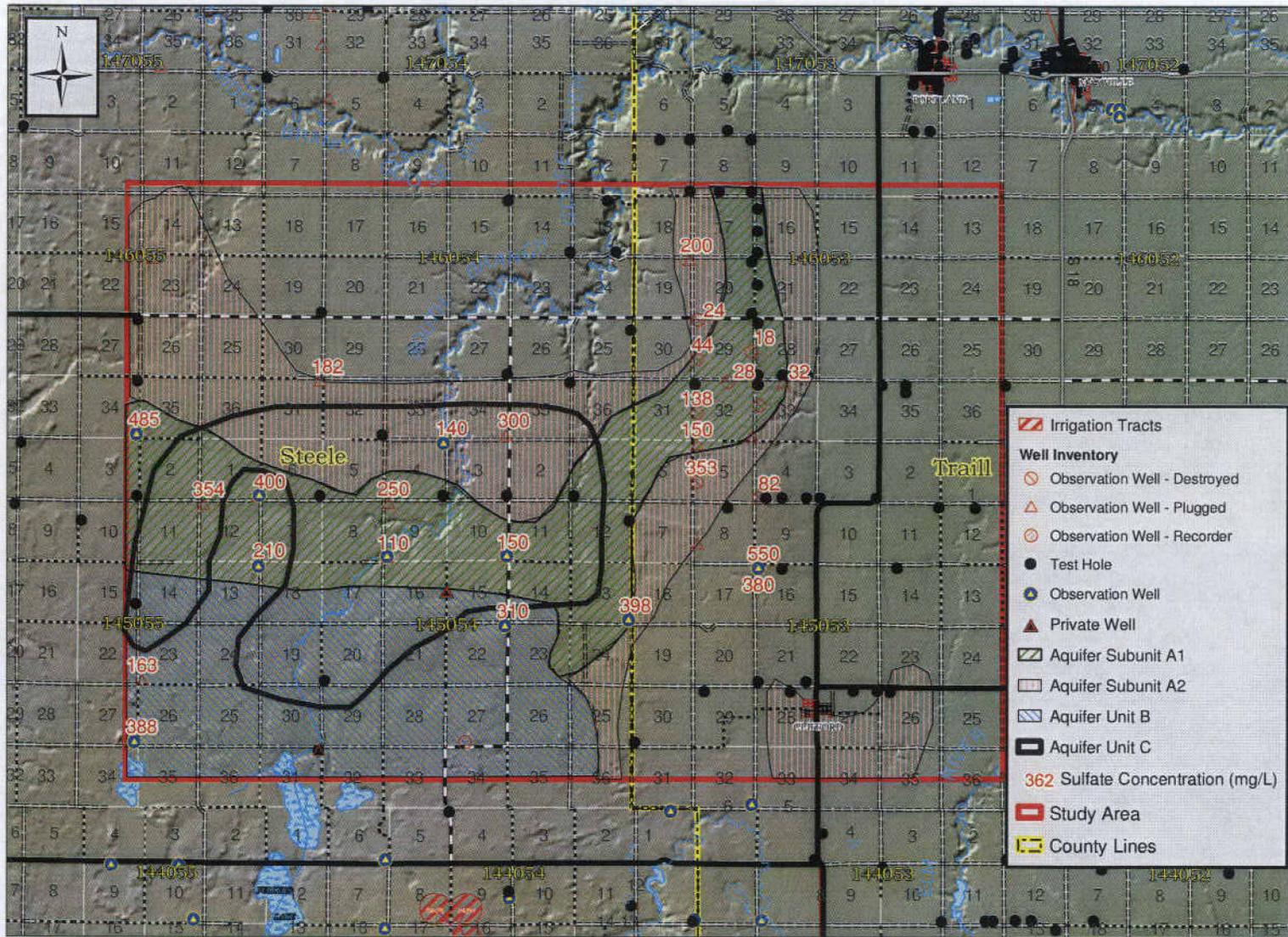


Figure 18. -- Distribution of Sulfate Concentrations within the study area

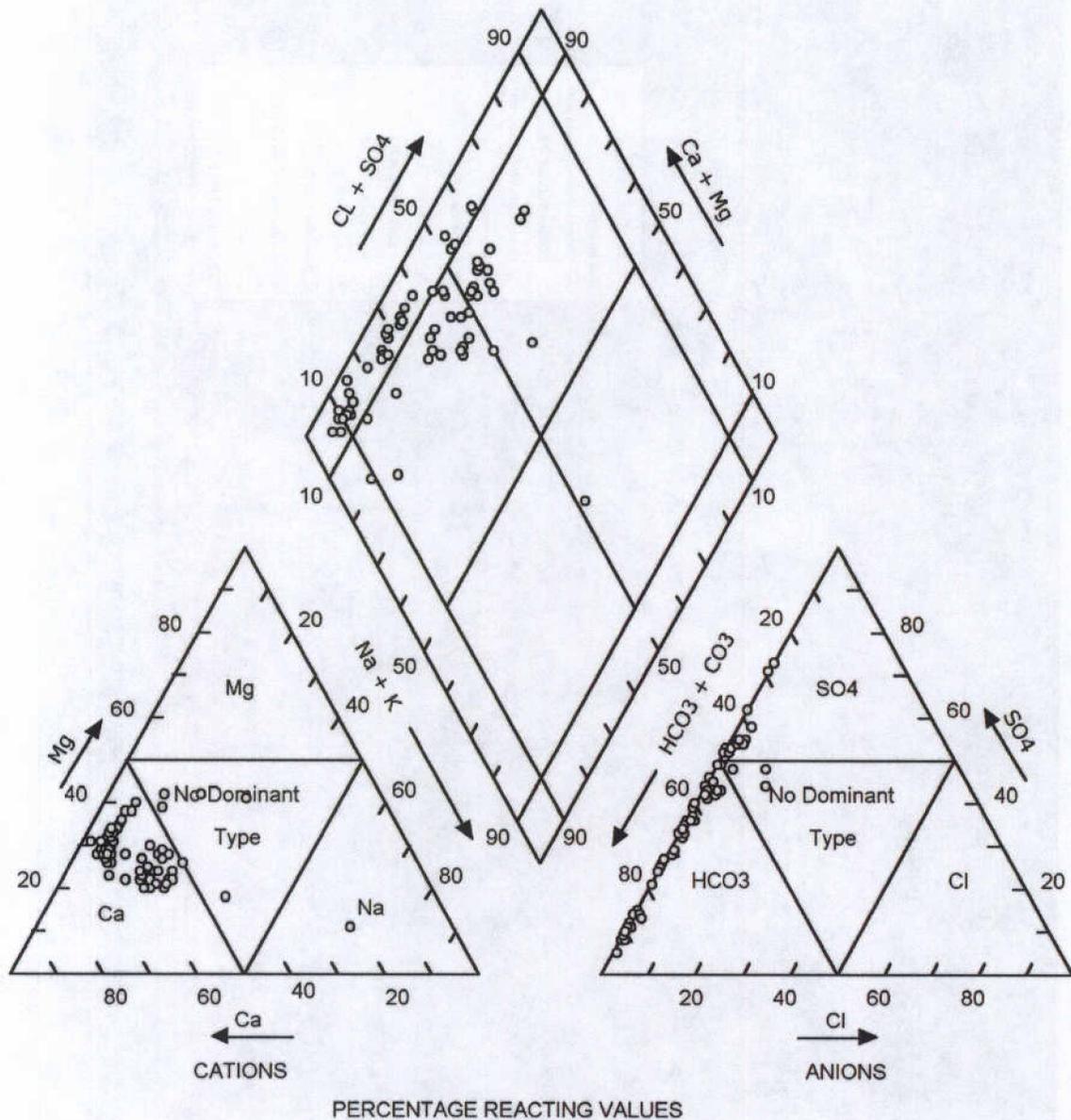


Figure 20. -- Relative distribution of major ions in the Page/Galesburg aquifer within the study area

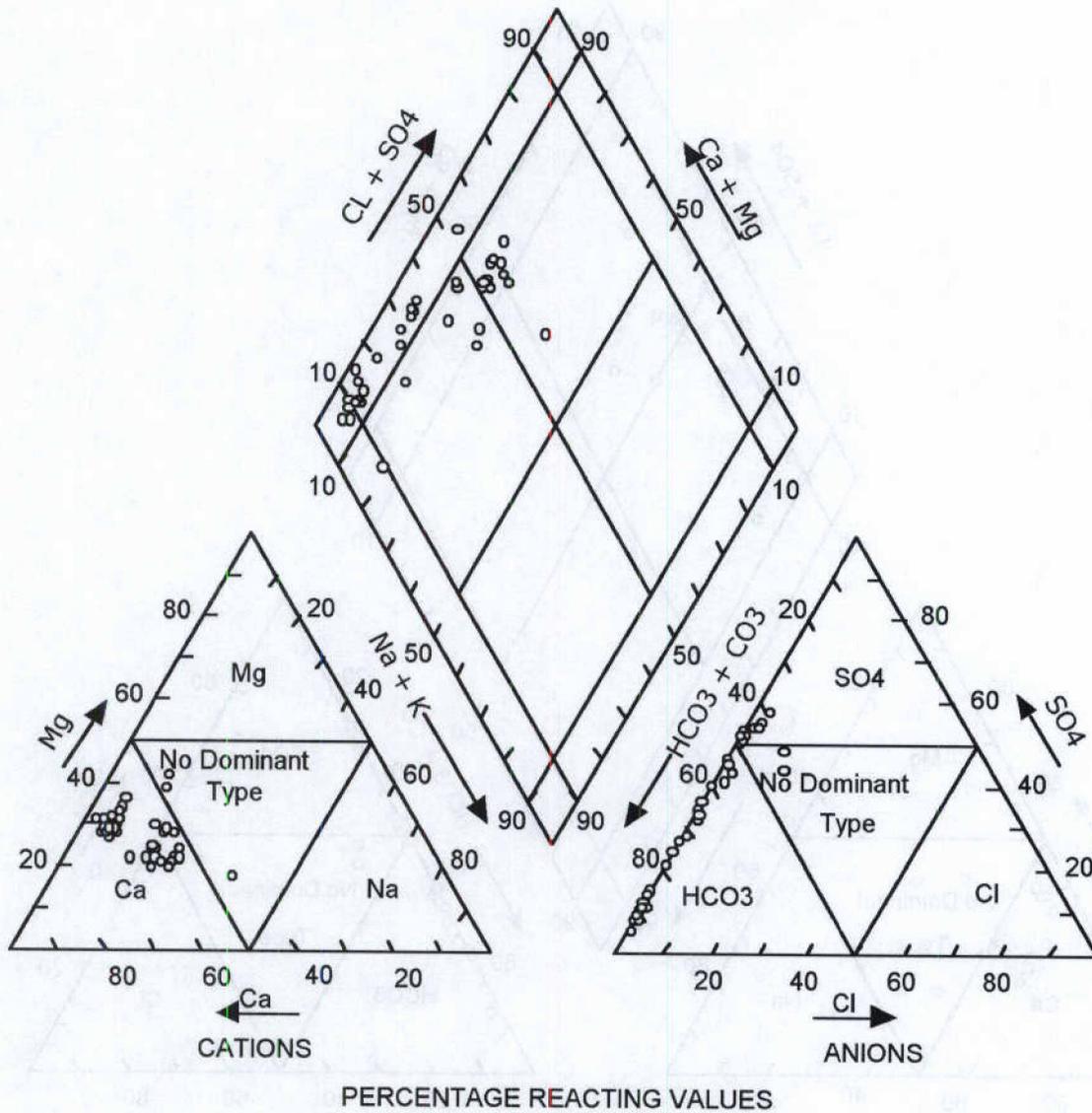


Figure 21. -- Relative distribution of major ions in aquifer subunit A1

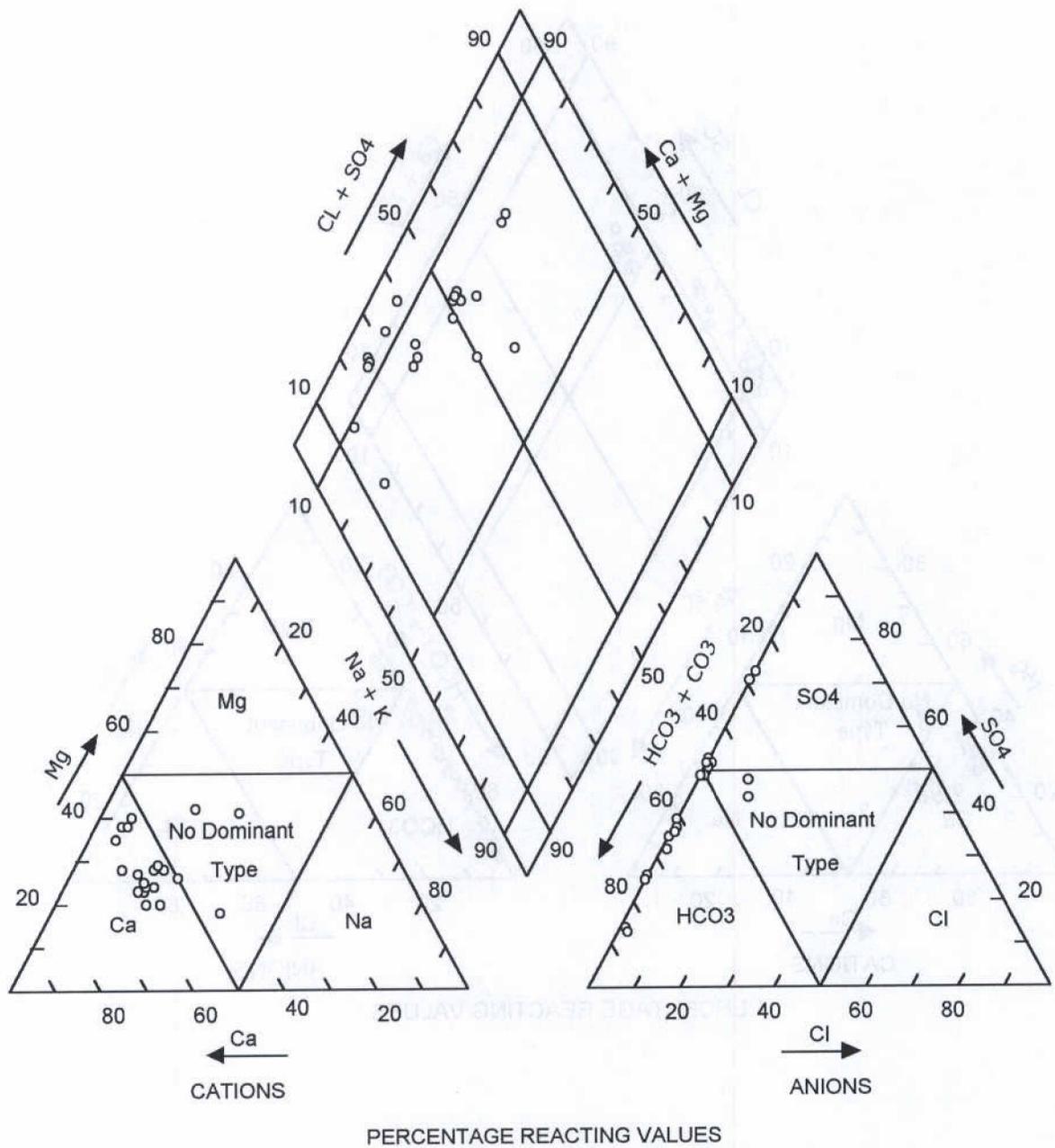


Figure 22. -- Relative distribution of major ions in aquifer subunit A2

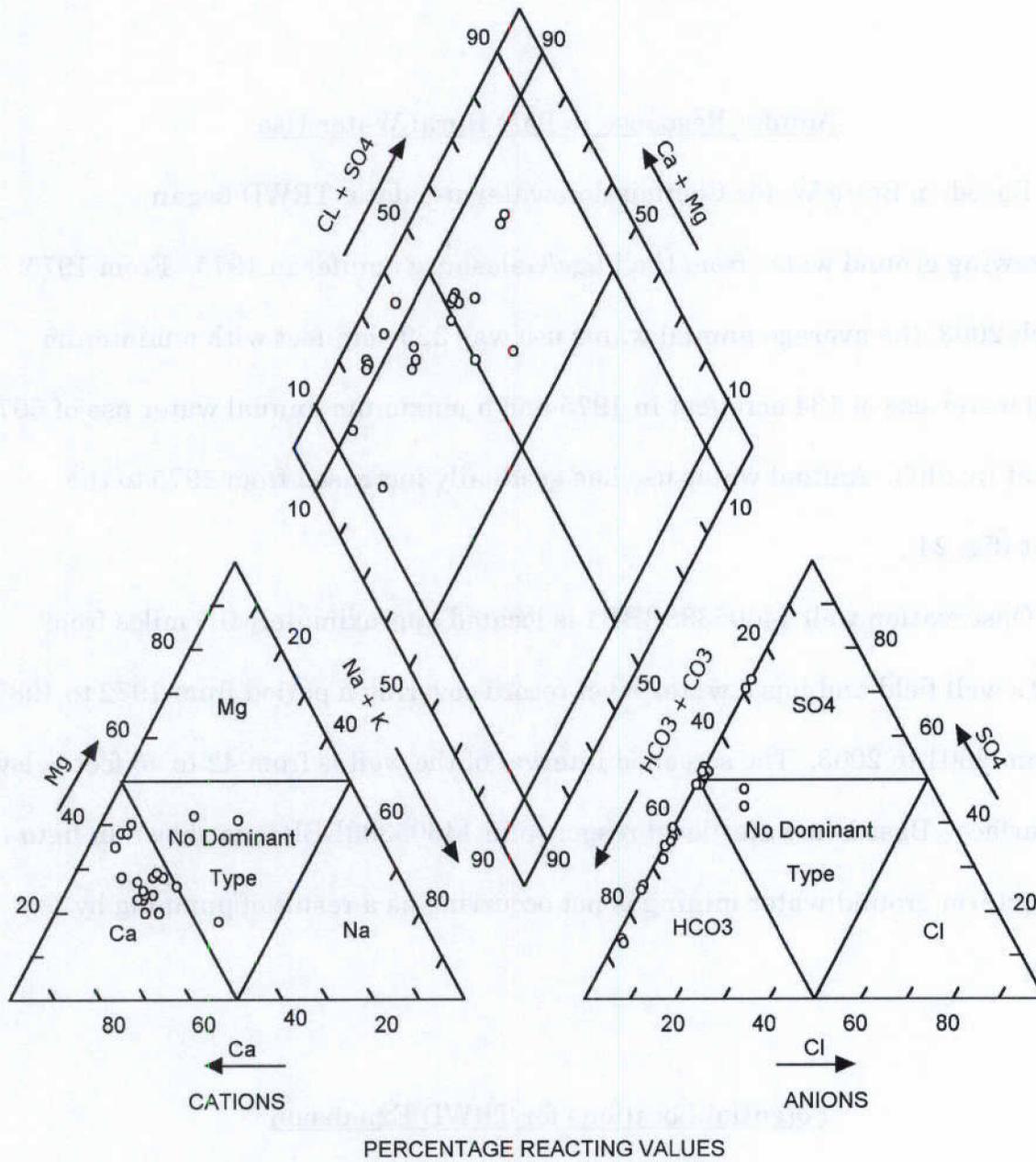


Figure 23. -- Relative distribution of major ions in aquifer unit B

similar for the three aquifer units and as a result, the relative distribution of major ions is not useful in differentiating aquifer units.

Aquifer Response to Past Rural Water Use

Based on State Water Commission water-use data, TRWD began withdrawing ground water from the Page/Galesburg aquifer in 1975. From 1975 through 2003, the average annual water use was 329 acre-feet with a minimum annual water use of 134 acre-feet in 1975 and a maximum annual water use of 507 acre-feet in 2003. Annual water use has gradually increased from 1975 to the present (fig. 24).

Observation well 14605333BBB1 is located approximately 0.5 miles from TRWD's well field and has a water-level record covering a period from 1972 to 1987 and from 2001 to 2003. The screened interval of the well is from 42 to 45 feet below land surface. Based on water-level response in 14605333BBB1, as shown in figure 24, long-term ground-water mining is not occurring as a result of pumping by TRWD.

Potential Locations for TRWD Expansion

Analysis of available hydrogeologic data indicates there is potential for additional appropriation of ground water for TRWD in the study area. Aquifer subunit A1 has the greatest potential for the additional appropriation. It has

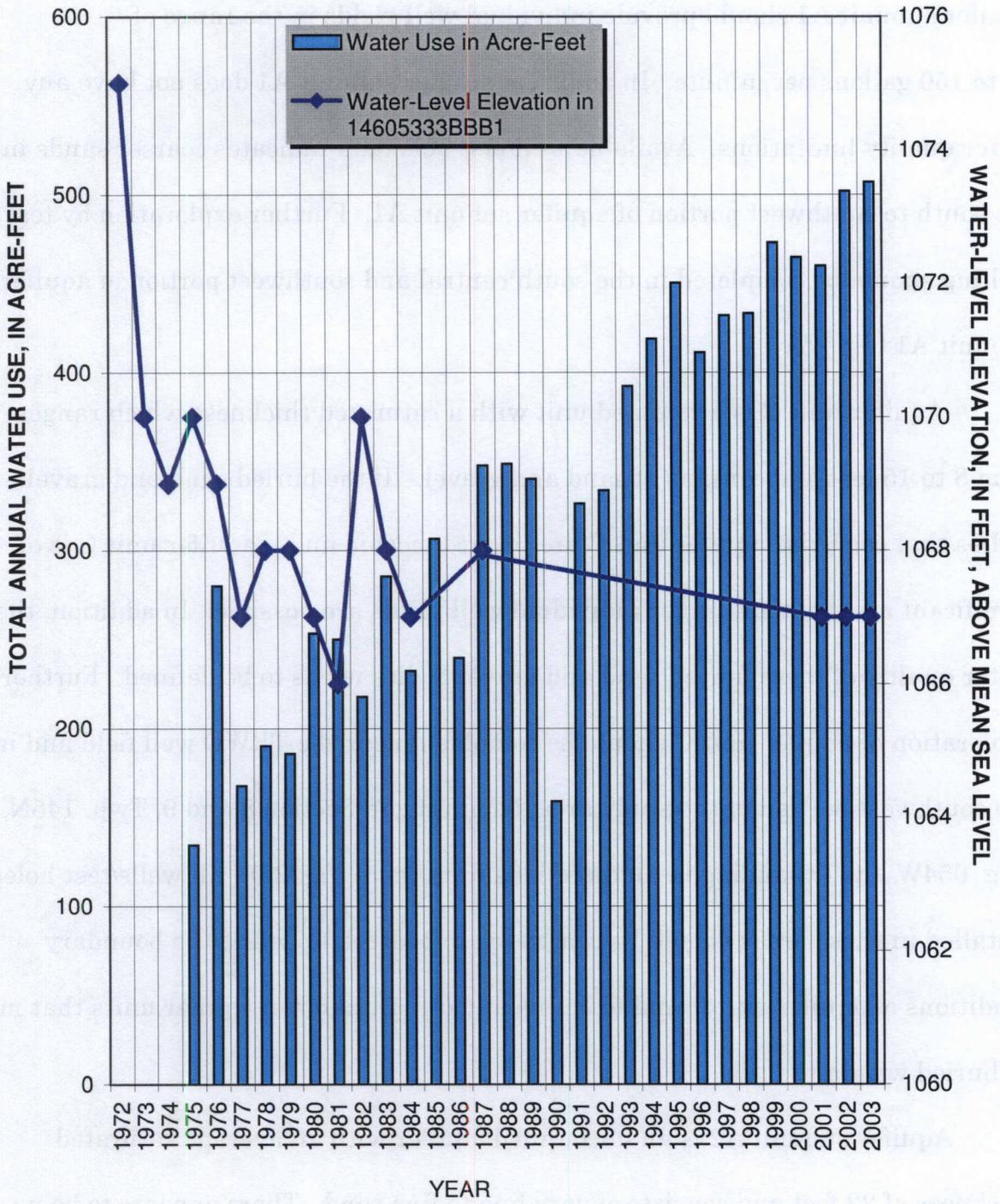


Figure 24 -- Comparison of water-levels in observation well 14605333BBB1 and annual water use for TRWD

an average saturated thickness of 40 feet outside of TRWD well field area and the texture is fine to medium sand. Based on the saturated thickness and texture, aquifer subunit A1 should provide individual well yields in the range of 60 to 150 gallons per minute. In addition, aquifer subunit A1 does not have any water quality limitations. Available well/test hole data indicates coarser sands in the south to southwest portion of aquifer subunit A1. Further exploration by test drilling should be completed in the south-central and southwest portion of aquifer subunit A1 (fig. 25).

Aquifer unit C is a confined unit with a saturated thickness which ranges from 8 to 15 feet and consists of sand and gravel. If the buried sand and gravel bodies that comprise aquifer unit C are interconnected and if aquifer unit C is of significant areal extent, larger individual well yields are possible. In addition, the water quality of these buried sand and gravel bodies needs to be defined. Further exploration of aquifer unit C should be completed near the TRWD well field and in the southwest portion of the study area, beginning in Section 8 and 9, Twp. 145N, Rng. 054W and expanding in all directions from there (fig. 25). All wells/test holes installed in these areas should be completed to bedrock to define the boundary conditions of aquifer unit C and to define any other unknown aquifer units that may be buried within the till.

Aquifer subunit A2 is an unconfined aquifer with an average saturated thickness of 22 feet and consists of very fine to fine sand. There appears to be no water quality limitations with respect to aquifer subunit A2. The relatively small saturated thickness coupled with a very fine to fine grained texture will severely

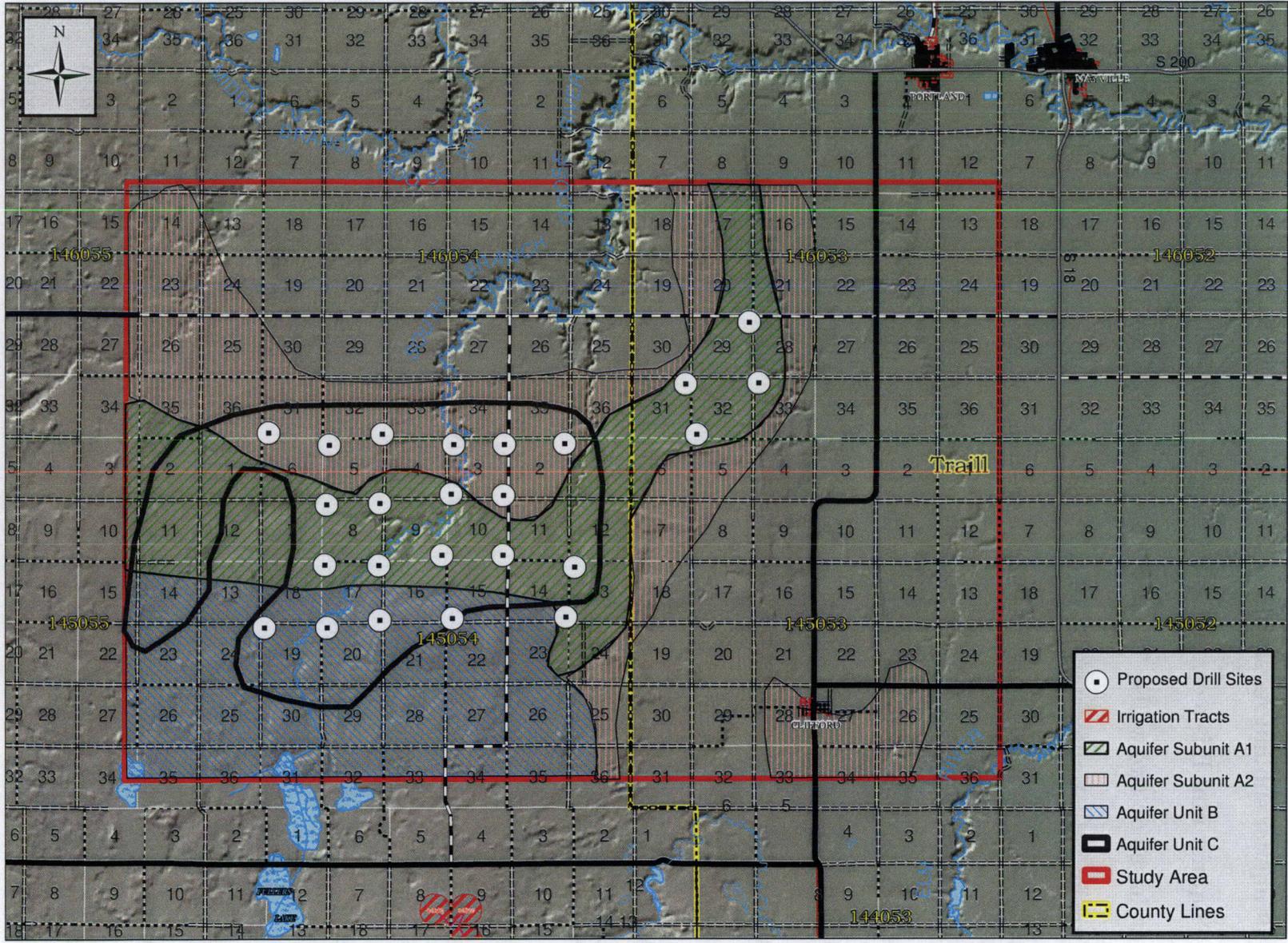


Figure 25. -- Proposed drilling sites for the Phase II Investigation

limit individual well yields which are estimated at 20 to 60 gallons per minute. As a result aquifer subunit A2 should not be considered in the water supply expansion.

Aquifer unit B is a confined unit that has an average saturated thickness of 50 feet, based on two wells. The texture of this unit ranges from fine sand to medium gravel. Aquifer unit B would produce estimated individual well yields of 80 to 200 gallons per minute and there appears to be no limitations with respect to water quality. However, in order to appropriate ground water from this unit, the degree of interconnectedness, if any, with the aquifer unit to the south must be identified. A comprehensive investigation of the relationship of aquifer unit B and the aquifer to the south must be completed before any water can be appropriated from aquifer unit B, because of its potential impact on prior appropriators to the south. Due to its complexity, this investigation will not be completed during this water supply study.

SUMMARY AND CONCLUSIONS

TRWD currently is allocated an annual ground-water appropriation of 644 acre-feet and a withdrawal rate of 1,070 gallons per minute from the Page/Galesburg aquifer. TRWD utilizes 18 wells in Sections 29 and 32 in Township 146 North, Range 053 West. The average yield from these wells is approximately 35 gallons per minute. TRWD is planning to expand their existing operations which would include serving the cities of Mayville and Hillsboro. The projected water requirements for the proposed expansion are an additional 1,016 acre-feet with an additional pumping rate of 905 gallons per minute.

The Page/Galesburg aquifer in the study area is made up of primarily very fine to coarse sand that was deposited in a near shore deltaic environment. The Page/Galesburg aquifer was divided into three aquifer units (A, B, and C) as illustrated in figure 7. Aquifer unit A was subdivided into aquifer subunits A1 and A2. Larger individual well yields can be obtained from aquifer subunit A1, due to the larger saturated thickness and coarser grained texture. There are no water quality limitations associated with aquifer subunit A1. Although there are no water quality limitations associated with aquifer subunit A2, the small saturated thickness and fine grained texture will limit individual well yields. As a result of the low well-yield capacity, aquifer subunit A2 will not be considered for the TRWD water supply expansion.

Aquifer unit C consists of buried sand and gravel bodies, the geometry of which is poorly defined. If these buried sand and gravel bodies are interconnected and the aquifer is of sufficient areal extent, larger individual well yields are possible. In addition, the water quality needs to be evaluated to determine if any limitations exist. Additional test drilling, observation well construction, and water sampling will be required to determine if aquifer unit C is a viable source of ground water for TRWD.

Aquifer unit B can accommodate sufficiently larger well yields and there are no apparent water quality limitations. However, the hydraulic connection between this aquifer unit and the aquifer to the south where irrigation development occurs is poorly defined. Appropriate definition of this complex hydrogeologic setting would require a comprehensive analysis that is outside the scope of this study. As a

result, aquifer unit B will not be considered for the TRWD water supply expansion at this time.

Recommendations - Phase II Investigation

The Phase I Investigation has determined there is potential for the expansion of the ground-water supply in the Page/Galesburg aquifer. Aquifer subunit A1 and aquifer unit C indicate potential for TRWD water supply expansion. However, no water samples collected within the study area have been analyzed for trace elements, so the concentration of arsenic, which is a common trace constituent in glacial drift aquifers, is unknown. In addition, the geometry and areal extent of aquifer subunit A1 and aquifer unit C are not well defined, thus further test drilling/observation well construction will be required.

Based on the data compilation and analysis of this Phase I Investigation, a Phase II Investigation is recommended. The purpose of a Phase II Investigation is to further define the hydrogeology of aquifer subunit A1 and aquifer unit C and assess their capability to support the future water supply needs for TRWD. The objectives of the Phase II Investigation should be to:

- 1) Further define the occurrence and movement of ground water in aquifer subunit A1 and aquifer unit C,
- 2) Better define the geometry (thickness and areal extent) of aquifer subunit A1 and aquifer unit C,
- 3) Further evaluate the water quality of aquifer subunit A1 and aquifer unit C,

- 4) Locate specific areas in aquifer subunit A1 and aquifer unit C, if any, to conduct an aquifer test(s) for the purpose of determining aquifer hydraulic properties, sustained well yields, and well design.

These objectives will be met by installing test holes utilizing a hydraulic forward mud rotary drill rig. Nearly all test holes will be completed to bedrock. If significant saturated aquifer material is encountered, the test holes will be completed as observation wells. Multiple observation wells may be installed at one location if more than one aquifer unit is encountered. At these sites, subsequent test holes would be drilled and observation wells constructed to determine the water-level and water-quality in each aquifer unit. The proposed drilling locations are shown in figure 25.

Elevations will be established for the top of the observation well and at land surface. The elevation at the top of the casing will be the reference for the ground-water level. Elevations will be established to the third order of accuracy using differential leveling or by conducting a global positioning survey. Surveying may be contracted to a surveying firm or accomplished by State Water Commission personnel.

Water levels in each observation well will be measured periodically during the first 3 months. Measurements will be made biweekly to monthly. However, in some instances an increased measuring frequency may be desirable. Water levels will be recorded after measurement and eventually stored in the SWC Well Inventory Database.

Water samples for chemical analysis will be collected from the new observation wells using a bailer, a bladder pump, or a centrifugal pump. The samples will be transported to the North Dakota Department of Health Laboratory where they will be analyzed for the major cations and anions and selected trace elements. Water samples will also be collected for chemical analysis from existing observation wells within the study area.

The results of the Phase II investigation will be presented to TRWD in a published report. The Phase II Investigation will define an area(s), if any, to conduct an aquifer test (Phase III Investigation). The Phase III Investigation will involve the construction and analysis of a test well(s) to determine aquifer hydraulic properties and sustained well yields, and to provide a basis for well design.

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APPENDIX I

Lithologic Logs of Wells and Test Holes Completed Within the Study Area

145-053-03CCC
NDSWC 152

Date Completed: 1960 Purpose: Test Hole
L.S. Elcvation (ft): 1039
Depth Drilled (ft): 37

Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Sandy, gray
2-10	SAND	Fine
10-15	CLAY	Sandy, brown
15-30	CLAY	Silty and sandy, gray
30-37	CLAY	Smooth, gray

145-053-03DDD
NDSWC 156

Date Completed: 06/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 1019
Depth Drilled (ft): 27
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, gray
1-5	SAND	Fine, light-brown
5-18	CLAY	Smooth, light-brown
18-25	CLAY	Gray, with fine and medium sand and gravel
25-27	CLAY	Smooth, gray

145-053-04CCC
NDSWC 8383

Date Completed:	07/10/1972	Purpose:	Observation Well -
Destroyed			
L.S. Elevation (ft):	1100	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	67-70	Data Source:	

Completion Info:

Remarks: destroyed 12DEC78

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Silty, sandy, clay loam grayish-black
1-10	SAND	Silty, very fine to medium-grained, subrounded, well sorted, oxidized throughout
10-12	SILT	Clayey, moderate yellowish-brown, slightly cohesive, oxidized, crumbly
12-23	SILT	Slightly sandy, clayey, medium gray, slightly cohesive, crumbly, highly calcareous
23-31	SAND	Very fine to medium-grained, subrounded, well sorted, subrounded, shaley
31-53	SILT	Slightly clayey, medium gray, slightly cohesive, slightly plastic
53-80	SAND	A few silty clay layers, slightly clayey, silty, very fine to medium-grained (mostly fine), subangular to rounded, well sorted, shaley, lignitic, no water loss
80-120	CLAY	Silty, medium gray to olive gray, moderately cohesive, highly plastic, highly calcareous, a few lignite fragments

145-053-04CCD
NDSWC 149

Date Completed: 05/31/1960 Purpose: Test Hole
L.S. Elevation (ft): 1102
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, black
1-10	SAND	Fine, light-brown, clayey
10-25	SAND	Very fine, gray, clayey
25-37	CLAY	Smooth, gray

145-053-04CDD2
NDSWC 150

Date Completed: 05/31/1960 Purpose: Test Hole
L.S. Elevation (ft): 1083
Depth Drilled (ft): 87
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-3	TOPSOIL	Sandy, black and fine sand and gravel
3-25	SAND	Fine, light brown
25-65	SAND	Very fine, gray, silty and clayey
65-87	CLAY	Smooth, gray

145-053-04DDC
NDSWC 151

Date Completed: 05/31/1960 Purpose: Test Hole
L.S. Elevation (ft): 1048
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-3	TOPSOIL	Sandy, black
3-5	SAND	Fine
5-10	CLAY	Sandy, brown to orange
10-25	CLAY	Smooth, brown to orange
25-37	CLAY	Smooth, gray

145-053-05BBB
NDSWC 8381

Date Completed: Plugged	6/1972	Purpose:	Observation Well
L.S. Elevation (ft):	1094	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	42-45	Data Source:	

Completion Info:

Remarks: Well plugged by SWC drill rig, on 9/29/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam grayish-black
1-5	SILT	Clayey, sandy, moderate yellowish-brown, slightly cohesive, crumbly, oxidized
5-50	SAND	Very slightly clayey, silty, very fine to coarse-grained (mostly fine to medium), subrounded, well sorted, shaley, lignitic, taking some water "clean-looking sand"
50-55	SILT	Clayey, sandy, olive gray, very slightly cohesive, slightly plastic, highly calcareous
55-61	SAND	Silty, slightly clayey, very fine to fine-grained, subrounded, moderately well sorted, lignitic, shaley
61-112	CLAY	Very silty, olive gray with some light olive gray laminae, slightly cohesive, plastic, calcareous
112-120	CLAY	Silty, moderately sandy, pebbly, olive gray, cohesive, crumbly, calcareous (till)

145-053-05CBC
NDSWC 8382

Date Completed:	7/1972	Purpose:	Observation Well - Destroyed
L.S. Elevation (ft):	1098	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	52-55	Data Source:	

Completion Info:

Remarks: Well field checked 4/28/93, could not find. Checked again 10/4/1994, reported destroyed.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clay loam, grayish-black
1-3	CLAY	Very silty, dusky yellow, slightly cohesive, crumbly (oxidized)
3-29	SAND	Slightly clayey, silty, very fine to medium-grained (mostly fine), subrounded, moderately well sorted, shaley, lignitic
29-45	SILT	Slightly clayey, medium gray, slightly cohesive, highly calcareous, moderately cohesive
45-55	SAND	Very slightly clayey, very fine to coarse-grained (mostly fine), subangular to rounded, well sorted, shaley, lignitic
55-59	SILT	Clayey, medium gray, slightly cohesive, slightly plastic, calcareous
59-67	SAND	Slightly silty, slightly clayey, very fine to medium-grained, subrounded, well sorted, shaley lignitic
67-120	CLAY	Very silty to silty, medium gray to olive gray, moderately cohesive, plastic, highly calcareous

145-053-08ABB
NDSWC 148

Date Completed: 05/31/1960 Purpose: Test Hole
L.S. Elevation (ft): 1106
Depth Drilled (ft): 37

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Sandy, black
1-5	CLAY	Light-brown with fine sand and gravel
5-20	SAND	Fine, light-brown, clayey
20-37	SAND	Fine, gray, clayey and silty

145-053-08CBC
NDSWC 8387

Date Completed: 07/11/1972 Purpose: Observation Well -
Plugged
L.S. Elevation (ft): 1100 Well Type: 1.25 in. - PVC
Depth Drilled (ft): 120 Aquifer: Page
Screen Int. (ft.): 37-40 Data Source:

Completion Info:

Remarks: Well plugged by SWC drill rig, on 10/5/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Sandy, silty, clay loam, grayish-black
1-6	SILT	Clayey, sandy, moderate yellowish-brown, slightly cohesive, slightly plastic, oxidized
6-41	SAND	Slightly clayey, very fine to medium-grained, subangular to rounded, well sorted, lignitic, shaley, taking water
41-60	SILT	Moderately clayey, a few thin sand layers, give gray to medium gray, slightly cohesive
60-120	CLAY	Silty, olive gray, plastic, moderately cohesive, highly calcareous

145-053-10CCC1
Albert H. Newman

Date Completed:	0/0	Purpose:	Stock Well
L.S. Elevation (ft):	1047	Well Type:	3 in. - Steel
Depth Drilled (ft):	0	Aquifer:	Undefined
Screen Int. (ft.):	0-165	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-053-11AAA
NDSWC 154

Date Completed: 1960 Purpose: Test Hole
L.S. Elevation (ft): 993
Depth Drilled (ft): 22
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-053-12ABB
NDSWC 153

Date Completed: 06/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 995
Depth Drilled (ft): 65
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-10	CLAY	Dark brown
10-30	CLAY	Smooth, brown to orange
30-65	CLAY	Light gray

145-053-14BAB
NDSWC 155

Date Completed: 6/1960 Purpose: Test Hole
L.S. Elevation (ft): 1020
Depth Drilled (ft): 27
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-20	CLAY	Smooth, light-brown with thin stringer of gravel
20-25	CLAY	Sandy, gray
25-27	CLAY	Smooth, gray

145-053-16BAA
NDSWC 2371

Date Completed: 7/1965 Purpose: Test Hole
 L.S. Elevation (ft): 1060
 Depth Drilled (ft): 525
 Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-8	TOPSOIL	Sand, moderately well sorted, angular to rounded, quartz, lignite, dolomitic, igneous, average size 1/4 to 1/3 mm, oxidized
8-10	SAND	As above unoxidized
10-14	SILTY CLAY	Sandy, dark greenish gray, moderately soft, moderately cohesive, lignite flakes, shale(?), calcareous, unoxidized, occasional layers of more cohesive clay, and less sandy
14-61	CLAY	Dark greenish gray, soft, moderately cohesive, lignite flakes, calcareous, unoxidized, silty plastic, sticky
61-123	TILL	Sandy, olive gray to dark greenish gray, soft, moderately cohesive, mostly dolomite, some lignite flakes, quartz, shale, igneous, mostly angular mostly less than 1/2 mm, plastic, becomes moderately hard downwards
123-145	TILL	Above interbedded with sandy gravel layers or lenses, poorly sorted, angular to rounded, dolomite, shale, quartz, igneous, size up to about 6 mm
145-163	CLAY	Olive gray with a shade of dark greenish gray, moderately hard, cohesive, calcareous, unoxidized
163-171	GRAVEL	Poorly sorted, subrounded (mostly) to angular, mostly shale fragments, dolomite, lignite, quartz, igneous, grain size up to cobbles, clay layer in gravel, clay as above
171-182	TILL	Olive gray to dark greenish gray, slightly silty, moderately soft, cohesive, somewhat plastic, dolomite, shale, quartz, igneous, calcareous, unoxidized
182-212	TILL	Olive gray to dark greenish gray, hard, cohesive, compact, predominantly shale, some quartz, igneous, dolomite, calcareous unoxidized becomes sandy downwards

212-237	TILL	Gravelly, light olive gray, silty, moderately soft, cohesive, quartz, igneous, lignite flakes, shale, dolomite fragments are mostly less than 1/2 mm, very calcareous, unoxidized, shale boulders
237-238	DOLOMITE	Boulder
238-250	TILL	As above boulder
250-263	TILL	Dark greenish gray to olive gray, silty, moderately hard, cohesive, gravelly contains much shale, some dolomite, occasional fragments of igneous, calcareous unoxidized
263-370	BEDROCK	Olive gray, silty, moderately hard, cohesive, contains dolomite fragments and mica flakes, calcareous, unoxidized, fossiliferous, sandy in places, laminated in places. One cutting of clay bentonitic, medium bluish gray to dark greenish gray, moderately hard cohesive, non-calcareous dark colored flakes present
370-397	SILT	Clayey, light olive, moderately soft, cohesive, slightly sandy, mica, slightly calcareous
397-399	SILT	As above becomes cemented, olive gray in places, highly calcareous (limestone cement)
399-504	SAND	Clayey, olive gray, moderately soft, cohesive crumbly, quartz and other unidentified, non-calcareous, fragment size less than 1/2 mm
504-525	CLAY	Sandy, silt, olive gray to gray laminated, contains numerous lignite flakes, mica, quartz present, grain size less than 1/4 mm ñ downward becomes dark yellowish brown

145-053-16BBB
NDSWC 8386

Date Completed:	07/11/1972	Purpose:	Observation Well -
Plugged			
L.S. Elevation (ft):	1094.7	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	32-35	Data Source:	

Completion Info:

Remarks: SHOULD BE REPLACED VERY POOR PUMPER 1999. Well replaced by 145-053-16BBB2. Old plastic pipe and screen drilled out, and replaced by 16BBB2 constructed in the same hole.

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, silty, brownish-black
1-15	SAND	Silty, slightly clayey, very fine to medium-grained, moderately well sorted, oxidized, taking water
15-22	SILT	Moderately clayey, medium gray, slightly cohesive, slightly plastic, calcareous
22-39	SAND	A few thin clay layers, very fine to coarse-grained (mostly medium), subangular to rounded, moderately well sorted, lignitic, shaley, taking some water
39-52	SILT	Moderately clayey, medium gray with light olive gray laminae, slightly cohesive, slightly plastic, calcareous
52-60	SAND	Very clayey, very fine to fine-grained, subrounded, dirty
60-120	CLAY	Moderately silty to silty, olive gray to medium gray, moderately cohesive, plastic, highly calcareous

145-053-16BBB2
NDSWC 14452

Date Completed:	12/11/1999	Purpose:	Observation Well
L.S. Elevation (ft):	1094.58	Well Type:	2 in. - PVC
Depth Drilled (ft):	43	Aquifer:	Page
Screen Int. (ft.):	30-35	Data Source:	NDSWC

Completion Info: Well constructed with 4 bags of #10 sand around screen (30-35), 3 bags of grout pumped down 1 1/4" plastic, and finished with 5 bags of hole plug.

Remarks: This well replaces 145-053-16BBB. The well was established in the same drill hole.

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Silt, black clay
1-15	SAND	Fine to medium
15-22	CLAY	Gray silt
22-39	SAND	Fine to medium sand.
39-43	SAND	Fine gray.

145-053-17ADA

Bertel Nelson

Date Completed:	1957	Purpose:	Stock Well
L.S. Elevation (ft):	1095	Well Type:	36 in. - Steel
Depth Drilled (ft):	0	Aquifer:	Dakota Group
Screen Int. (ft.):	0-521	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-053-21CCC
NDSWC 158

Date Completed: 01/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 1095
Depth Drilled (ft): 21
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Sandy, black
1-20	SAND	Very fine, light brown, oxidized
20-21	SAND	Very fine, gray, silty and clayey

145-053-21DDC
NDSWC 160

Date Completed: 01/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 1062
Depth Drilled (ft): 22
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Sandy, black
1-3	SAND	Very fine to fine
3-10	SAND	Very fine to fine, tan to buff, very clayey
10-20	CLAY	Sandy, gray to dark-gray with some gravel
20-22	SAND	Very fine to fine, gray, very clayey and silty

145-053-26BBA
NDSWC 163

Date Completed: 1960 Purpose: Test Hole
L.S. Elevation (ft): 1011
Depth Drilled (ft): 42
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-15	SAND	Fine to very fine, brown, very silty, with some gravel
15-20	SAND	Very fine, dark brown, very silty
20-42	SAND	Very fine to fine, gray

145-053-27AAA
NDSWC 162

Date Completed: 06/03/1960 Purpose: Test Hole
L.S. Elevation (ft): 1038
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	SAND	Very fine to fine, dark-brown, clayey with some gravel
2-10	CLAY	Sandy, brown to gray
10-12	GRAVEL	
12-16	CLAY	Very sandy, gray
16-18	SAND	Very fine to fine, gray
18-37	CLAY	Sandy, gray

145-053-27ABB
NDSWC 161

Date Completed: 6/1960 Purpose: Test Hole
L.S. Elevation (ft): 1035
Depth Drilled (ft): 22
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-9	CLAY	Brown, slightly gravelly
9-13	CLAY	Gray

145-053-28ABB
NDSWC 159

Date Completed: 6/1960 Purpose: Test Hole
L.S. Elevation (ft): 1078
Depth Drilled (ft): 87
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Black
1-5	SAND	Very fine to medium, brown and dark-brown with some gravel
5-10	SAND	Very fine to fine, brown, clayey
10-60	SAND	Very fine to fine, gray to dark-gray
60-87	CLAY	Smooth, light-gray to gray

145-053-29BBA
NDSWC 157

Date Completed: 06/03/1960 Purpose: Test Hole
L.S. Elevation (ft): 1113
Depth Drilled (ft): 47
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, black
1-8	SAND	Very fine, light to dark-brown
8-15	CLAY	Sandy, light to dark-brown, oxidized
15-35	CLAY	Olive-gray to gray, with fine sand and fine to medium gravel
35-47	CLAY	Olive and blue-gray

145-053-30CCC1
NDSWC 223

Date Completed: 01/01/1961 Purpose: Test Hole
L.S. Elevation (ft): 1126
Depth Drilled (ft): 27
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black
2-17	CLAY	Yellow-brown, mottled, with some gravel, oxidized (till)
17-27	CLAY	Olive-gray (till)

145-053-30CCC2
NDSWC 224

Date Completed: 01/01/1961 Purpose: Test Hole
L.S. Elevation (ft): 1126
Depth Drilled (ft): 27
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, black
1-3	CLAY	Sandy, olive-gray (till)
3-7	CLAY	Yellow-brown, oxidized (till)
7-27	CLAY	Sandy, olive-gray

145-058-32DDD
NDSWC 8384

Date Completed:	1972	Purpose:	Observation Well
L.S. Elevation (ft):	1100	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	0	Aquifer:	Page
Screen Int. (ft.):	57-60	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-054-01CCC
NDSWC 3989

Date Completed: 06/09/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1100
 Depth Drilled (ft): 280

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Fine sandy loam, black
2-28	SILT	Clayey to slightly sandy, reddish brown, soft, slightly cohesive, crumbly, oxidized, heavily iron-stained
28-54	SAND	Very fine to fine, silty, sorted, lensed, loose to slightly cohesive, light olive gray, generally subrounded, predominantly quartz with siliceous shale and carbonates, sugary
54-91	SAND	Fine, varies from silt to medium sand, clayey, dirty, gray, thinly interbedded; drills easy, no noticeable loss of water
91-158	SILT	Clayey to sandy, interbedded, olive gray, moderately soft and crumbly to soft and moderately plastic; smooth easy drilling
158-166	SAND	Fine and medium, shaley, poorly sorted, subangular to subrounded, idirty
166-185	SILT	As above, olive gray
185-201	CLAY	Very sandy with pebbles and cobbles, light olive gray, moderately soft, crumbles under pressure, gritty, highly calcareous, sandy and fine gravelly lenses (Till)
201-222	CLAY	Silty with pebbles and occasional cobbles and boulders, olive to dark olive gray, slightly hard, stiff, tough (till)
222-236	GRAVEL	Fine, sandy, modcrately sorted, generally subangular, mostly carbonates
236-254	CLAY	Very sandy with occasional pebbles, light olive gray, moderately soft, gritty, highly calcareous (Till)
254-280	SHALE	Silty, dark brown and black, moderately soft, plastic, smooth, wavy, tight, calcareous. Siltstone layer at 275'

145-054-03DDD
NDSWC 8368

Date Completed: 06/29/1972 Purpose: Test Hole
L.S. Elevation (ft): 1106
Depth Drilled (ft): 160
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, pebbly, clay loam brownish-black
1-3	CLAY	Very silty, sandy, pebbly, moderately yellowish-brown, slightly cohesive, plastic, oxidized (Till)
3-18	SAND	Silty, very fine to medium grained, subrounded, well sorted, shaley, a few thin clay layers
18-73	SILT	Clayey, medium gray with light olive gray mottling, slightly cohesive, crumbly, highly calcareous
73-78	SAND	Silty, clayey, very fine to fine grained, subrounded, shaley
78-94	SILT	Clayey, medium gray, slightly cohesive, crumbly, highly calcareous
94-99	SAND	Silty, moderately clayey to clayey, very fine to medium grained, subrounded, moderately well sorted, shaley, lignitic
99-147	SILT	Clayey, a few thin sand layers, medium gray with light olive gray laminae, slightly cohesive, slightly plastic, highly calcareous
147-160	CLAY	Silty, moderately sandy, a few thin gravel layers, olive gray, moderately cohesive, plastic, calcareous (Till)

145-054-04AAA
NDSWC

Date Completed: 06/28/1972 Purpose: Observation Well
L.S. Elevation (ft): 1097 Well Type: 1.25 in. - PVC
Depth Drilled (ft): 140 Aquifer: Page
Screen Int. (ft.): 87-90 Data Source:

Completion Info: Surveyed by the NDSWC on 08/31/2004.

Remarks: 75 ft SOUTH OF INTERSECTION replace or take off sample list,
slow pumper 1 gpm

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clayey loam, grayish-black
1-15	CLAY	Sandy, silty, pebbly, moderate yellowish-brown, moderately cohesive, crumbly, oxidized (Till)
15-20	CLAY	Silty, moderately sandy, pebbly, olive gray, cohesive, crumbly, calcareous (Till)
20-43	SAND	Occasional thin clay layers, silty, very fine to medium grained, subrounded, shaley
43-47	SILT	Moderately sandy, medium gray with light olive gray laminae, slightly cohesive
47-54	SAND	Clayey, silty, very fine to medium grained, subangular to subrounded, moderately well sorted
54-65	SILT	Clayey, medium gray with light olive gray mottling, slightly to moderately cohesive, slightly plastic, calcareous
65-75	SAND	Silty, clayey, fine to medium grained, subrounded, moderately well sorted, lignitic
75-82	SILT	Sandy, medium gray, slightly cohesive, slightly plastic, calcareous
82-116	SAND	Silty, a few thin clay layers, very fine to medium grained, a few shale pebbles, subangular to rounded, well sorted, taking water lignitic
116-125	SILT	Clayey, medium gray, slightly cohesive, slightly plastic, calcareous
125-140	CLAY	Silty, moderately sandy, pebbly, olive gray, moderately cohesive, moderately plastic, calcareous (Till)

207-215	SHALE	Extremely silty to slightly sandy (very fine), very dark brown, moderately soft, very oily and sticky, contains many thin seams of aragonite; drills almost like gravel, very heavy oil on drilling fluid
215-220	SHALE	Black, moderately soft, smooth, tight, oil, waxy

145-054-06DDD
NDSWC 3994

Date Completed: 06/19/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1115
 Depth Drilled (ft): 240

Data Source:

Completion Info:
 Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Silty loam, black
2-11	SAND	Clayey to gravelly, reddish yellowish brown with nearly white marly clay from 2-4', poorly sorted, angular to rounded, heavily iron-stained, oxidized (Till?)
11-35	CLAY	Silty to sandy with pebbles and occasional cobbles, olive gray, moderately soft, cohesive, stiff, tightly compacted, pebbles mostly carbonates and shale (Till)
35-55	SAND	Medium with fine, light olive gray, loose, fairly well sorted and uniform, subangular and subrounded, mostly quartz with shale, nice
55-105	SILT	Clayey to sandy, interbedded, light olive gray, laminated, soft, crumbly to slightly cohesive, non- to slightly plastic, calcareous; easy drilling
105-114	CLAY	Silty to sandy with numerous coarse sand grains and pebbles, olive gray, moderately soft, cohesive, slightly brittle to slightly plastic, stiff, tightly compacted (Till)
114-119	CLAY	Olive gray, smooth, very stiff and tight, plastic
119-130	GRAVEL	Fine and medium, may be coarse, white, angular to subrounded, assorted, predominantly cream colored carbonates; rough drilling, may contain some till
130-186	CLAY	Silty and very sandy with many coarse sand grains and pebbles, also numerous cobbles, boulders and lenses of gravel made up mostly of carbonates, olive gray, moderately soft to slightly hard, stiff, tough tight (Till); rough rocky drilling
186-208	CLAY	Silty to very sandy with many coarse sand grains and pebbles, (mostly carbonates with rounded black siliceous shale), olive to dark olive gray, also contains blocks of oily bedrock sandy shale (Till)
208-240	SHALE	Extremely silty to very sandy, generally dark brown to brownish black, slightly hard, brittle, tight highly calcareous, oily, contains limestone or calcite layers

145-054-09BBB

NDSWC 3993

Date Completed:	06/19/1970	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1105.4	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	240	Aquifer:	Page
Screen Int. (ft.):	38-41	Data Source:	
Completion Info:			

Remarks: 100 ft SOUTH OF INTERSECTION; 9/23/99 KKKUNZ COULDN'T LOCATE WELL. IT'S BELEIVED THIS WELL HASBEEN DESTROYED BY FARMING.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty loam, black
1-6	CLAY	Very sandy, reddish yellow, soft, moderately cohesive, slightly plastic, oxidized, iron-stained (yellow and red)
6-22	SAND	Fine and medium, fairly well sorted, subangular and subrounded, predominantly quartz and granitic derivatives with shale and heavily iron-stained carbonates, reddish brown
22-52	SAND	Fine, varies from very fine to medium, gray, moderately well sorted, generally subrounded, mostly quartz, some shale and carbonates, little lignite, loose
52-86	SILT	Clayey to sandy, light olive to olive gray, soft, crumbly to slightly cohesive, non- to slightly plastic, calcareous
86-90	CLAY	Silty, olive gray, soft, smooth, cohesive, plastic, sticky
90-100	SILT	As above
100-112	GRAVEL	Fine, sandy, assorted, angular to subrounded, "dirty", mostly granitics and shale with iron-stained carbonates, moderately rough drilling, not really noticeable loss of water
112-196	CLAY	Silty to sandy with numerous coarse sand grains and pebbles with frequent cobbles and occasional boulders, generally olive gray, moderately soft, cohesive, slightly to moderately plastic, tightly compacted (Till)
196-223	TILL	As above with blocks and chunks of shaley to sandy bedrock, sandy, oily, tight
223-240	SHALES	Brownish gray to brownish black, very thinly interbedded with gray limestone and yellowish calcite or aragonite seams, tight, rocky, hard drilling, highly calcareous, oil

145-054-09CCC
NDSWC 8365

Date Completed:	06/28/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1113	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	47-50	Data Source:	

Completion Info:

Remarks: 75 ft EAST OF INTERSECTION. Well replaced by 145-054-09CCC2. Old plastic pipe and screen drilled out, and replaced by 9CCC2 constructed in the same hole.

Lithologic Log

Depth (ft)	Unit	Description
0-7	CLAY	Silty, pebbly, occasional cobbles, moderate yellowish-brown, slightly cohesive, crumbly, oxidized (Till)
7-25	SAND	Very fine to coarse grained (mostly fine to medium), subangular to rounded, well sorted, shaley, taking some water, occasional thin silty clay layers, oxidized to about 20'
25-29	SILT	Sandy, clayey, medium gray, slightly cohesive, samples washing out
29-58	SAND	Slightly clayey, very fine to medium grained, subrounded, well sorted, shaley, lignitic, taking water
58-70	SILT	Very sandy, clayey, olive gray to medium gray, slightly cohesive, crumbly, highly calcareous
70-95	SILT	Slightly sandy, olive gray with light olive gray laminae, slightly cohesive, slightly plastic, highly calcareous
95-100	CLAY	Silty, moderately sandy, pebbly, olive gray, moderately cohesive, plastic, calcareous (Till)

145-054-09CCC2
NDSWC 14449

Date Completed:	11/30/1999	Purpose:	Observation Well
L.S. Elevation (ft):	1110.4	Well Type:	2 in. - PVC
Depth Drilled (ft):	58	Aquifer:	Page
Screen Int. (ft.):	45-50	Data Source:	NDSWC

Completion Info: Well constructed with 5 bags of #10 sand around screen (30-35), 2 bags of grout pumped down 1 1/4" plastic, and finished with 5 bags of hole plug.

Remarks: This well replaces 145-054-09CCC. The well was established in the same drill hole.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	no description
1-7	CLAY	silty, yellowish, oxidized
7-25	SAND	fine to medium, gray
25-29	CLAY	silty, gray
29-58	SAND	fine to medium, gray

145-054-10DDD
NDSWC 8364

Date Completed:	06/28/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1118.2	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	17-20	Data Source:	

Completion Info:

Remarks: Well replaced by 145-054-10DDD. Old plastic pipe and screen drilled out, and replaced by 10DDD2 constructed in the same hole.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, pebbly, clay loam grayish-black
1-3	CLAY	Very silty, moderately sandy, pebbly, moderate yellowish-brown, slightly cohesive, crumbly, oxidized (Till)
3-24	SAND	Very slightly clayey, fine to coarse grained (mostly fine to medium), subangular to rounded, well sorted, shaley, taking some water
24-80	SILT	Moderately sandy, clayey, medium gray with light olive gray laminae, slightly cohesive, samples washing out
80-100	CLAY	Silty, moderately sandy, pebbly, olive gray, moderately cohesive, plastic, calcareous (Till)

145-054-10DDD2

NDSWC 14451

Date Completed:	12/01/1999	Purpose:	Observation Well
L.S. Elevation (ft):	1117.49	Well Type:	2 in. - PVC
Depth Drilled (ft):	23	Aquifer:	Page
Screen Int. (ft.):	15-20	Data Source:	NDSWC

Completion Info: Well constructed with 4 bags of #10 sand around screen (15-20), 1 bag of grout pumped down 1 1/4" plastic, and finished with 3 bags of hole plug.

Remarks: This well replaces 145-054-10DDD. The well was established in the same drill hole.

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	silty black clay
1-3	CLAY	silty, yellowish, oxidized
3-23	SAND	fine to medium, gray

145-054-12ADA
NDSWC 3988

Date Completed: 06/09/1970 Purpose: Test Hole
L.S. Elevation (ft): 1107
Depth Drilled (ft): 320
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Fine sandy loam, black
2-14	GRAVEL	Fine and medium, sandy, assorted, angular to subrounded, heavily iron-stained, mainly carbonates, granitics, and shale; drilled fair, no large loss of water, mixed 1 bag of mud
14-28	SILT	Light olive gray, soft, slightly cohesive to crumbly, partially oxidized, highly calcareous
28-70	SAND	Very fine to fine, silty, gray, loose to slightly cohesive, dirty, mostly quartz with shale
70-162	SILT	Clayey to sandy, variegated grays, laminated and interbedded, soft, chunky, loose to slightly cohesive, non- to slightly plastic, calcareous, smooth, easy drilling, drilling fluid very thick
162-182	SAND	Very fine to fine, silty, gray, loose, sorted, fairly uniform, subrounded, mostly quartz and shale
182-284	CLAY	Silty to very sandy with pebbles, cobbles, boulders and lenses of gravel, light olive gray to dark olive gray (Till) light olive gray till generally very sandy with few pebbles but many rock, most pebbles are limestone as well as gravel lenses, porous and highly calcareous, dark olive gray till usually clayey, tight, contains numerous shale pebbles but very few rock, all mixed up
284-320	SHALE	Silty, very dark brown to black, many light specks, moderately soft, plastic to slightly hard and brittle, carbonaceous highly calcareous

145-054-13DDD
NDSWC 8358

Date Completed: 6/1972 Purpose: Test Hole
L.S. Elevation (ft): 1115
Depth Drilled (ft): 140
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Silty, sandy, clay loam, grayish-black
1-10	CLAY	Very sandy, silty, a few pebbles, a few boulders, moderate yellowish-brown, slightly cohesive, crumbly, oxidized (Till)
10-90	SAND	Occasional thin clay layers, becomes more clayey lower 40 feet, very fine to coarse grained (mostly medium), subangular to rounded, lignitic, taking some water, caving slightly, oxidized to about 25' below land surface
90-140	SILT	Slightly clayey, slightly sandy, olive gray with some light olive gray mottling, slightly cohesive, samples washing out in mud

145-054-13DDD2
NDSWC 8358-A

Date Completed:	06/23/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1115	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	300	Aquifer:	Page
Screen Int. (ft.):	62-68	Data Source:	

Completion Info:

Remarks: Plugged 10/20/04, Replaced with 14505413DDD3

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam, grayish-black
1-10	CLAY	Very sandy, silty, a few pebbles, a few boulders, moderate yellowish-brown, slightly cohesive, crumbly, oxidized (Till)
10-90	SAND	Occasional thin clay layers, becomes more clayey lower 40 feet, very fine to coarse grained (mostly medium), subangular to rounded, lignitic, taking some water, caving slightly, oxidized to about 25 below land surface
90-185	SILT	Slightly clayey, slightly sandy, olive gray with some light olive gray mottling, slightly cohesive, samples washing out in mud
185-278	CLAY	Silty, moderately sandy to sandy, pebbly, occasional thin gravel layers, some cobbles and boulders, olive gray with brownish-gray mottling, moderately cohesive, slightly plastic, crumbly (Till)
278-300	SHALE	Clayey, brownish-black, highly calcareous, a few small white specks, talc-like feel, slight oily residue on drilling mud, moderately well indurated (Greenhorn Formation?)

145-054-20CCC
NDSWC 4298

Date Completed: 11/06/1970 Purpose: Test Hole
L.S. Elevation (ft): 1120
Depth Drilled (ft): 280

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Fine sandy loam, black
1-4	SAND	Fine, yellowish tan, sorted, subrounded, loose, oxidized
4-7	SILT	Slightly clayey, yellowish gray, soft, slightly cohesive, laminated, oxidized
7-14	SAND	Fine, tan, sorted, loose, subrounded, quartzose with carbonates, oxidized
14-19	SAND	Very fine, silty, light olive gray, soft, slightly cohesive, laminated
19-32	SAND	Very fine and fine, dark gray, loose, well sorted and uniform, subrounded, clean, mostly quartz with some shale and lignite
32-40	SILT	Slightly clayey to sandy, light olive to olive gray, soft, slightly cohesive, laminated calcareous
40-51	SAND	Very fine to medium, silty, interbedded, loose to slightly cohesive, dark gray, lignitic
51-76	CLAY	Silt and very fine sand in all combinations, interbedded and very lenticular, predominantly light olive gray, soft; drills easy, not much for accurate samples, thin organic streaks
76-87	SAND	Fine to medium dark gray, sorted, subrounded, quartzose, clean
87-92	CLAY	Very dark gray, smooth, waxy, flakey, crumbly
92-125	SAND	Very fine to very coarse, interbedded with clay and silty clay, lenticular, sorted in layers, finer sand mostly quartz, coarser sand mainly carbonates and granitics with shale; rocky in spots

125-151	CLAY	Very silty with sand grains and occasional pebbles, olive to dark olive gray, moderately soft to slightly hard, very cohesive, stiff, tough (washed? Till)
151-154	ROCK	Feldspathic granite (rock bit)
154-163	GRAVEL	Sandy, assorted, subangular and subrounded "dirty"
163-175	CLAY	Silty and sandy with pebbles and occasional cobbles, olive gray, moderately soft, cohesive, stiff (Till)
175-187	GRAVEL	Fine, sandy, moderately sorted, subrounded, predominantly carbonates with some granitics and shale
187-192	CLAY	Silty, olive gray, smooth, moderately soft, cohesive, slightly sticky
192-194	BOULDER	Limestone (yellow)
194-214	CLAY	Silty to sandy with pebbles, olive gray, moderately soft, cohesive, stiff, quite tight (Till)
214-221	SAND	Very fine to fine, clayey with coarse sand grains, very light olive gray, soft, crumbly, highly calcareous (Till)
221-244	CLAY	Silty with sand grains and pebbles, dark olive gray, moderately soft to slightly hard, cohesive, tightly compacted very oil and sticky (Till)
244-256	SHALE	Silty, very dark brown to black, smooth, massive, very tight, oily and carbonaceous
256-280	SILTSTONE	and Sandstone, Tans, light grays and pinkish, gypsiferous, pyrififerous, carbonaceous, tight

145-054-22AAA
NDSWC 3992

Date Completed:	06/18/1970	Purpose:	Observation Well
L.S. Elevation (ft):	1149	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	380	Aquifer:	Page
Screen Int. (ft.):	78-81	Data Source:	

Completion Info:

Remarks: SLOW PUMPER

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Silty loam, black
2-11	CLAY	Silty, grayish yellow, soft, cohesive, moderately plastic, oxidized
11-24	SAND	Medium with fine to coarse, reddish brown, loose, moderately sorted, subangular and subrounded, iron-stained, oxidized
24-38	CLAY	Silty, light olive bluish gray, soft, chunky, slightly to moderately cohesive, crumbly to slightly plastic, calcareous
38-55	SAND	Medium, gray, well sorted and uniform, subangular to subrounded, clean, lignitic
55-107	SAND	Fine and medium, silty, interbedded, gray, lignitic, sorted in lenses, subangular and subrounded, mostly quartz and shale with limestone and lignite; easy drilling, taking water
107-161	SILT	and Silty Clay, light olive to olive gray, soft, chunky, crumbly to moderately cohesive, non- to slightly plastic, laminated, highly calcareous
161-183	CLAY	Interbedded silt, light olive and olive gray, soft to moderately soft, cohesive, moderately plastic, light, large, chunky cuttings
183-193	CLAY	Sandy with pebbles and much fine to medium gravel, light olive to olive gray, moderately soft to slightly hard, cohesive, slightly brittle; rough drilling (Till)
193-227	CLAY	Silty to sandy with pebbles, olive to dark olive gray, moderately soft to slightly hard, cohesive, gritty, tight (Till); contains thin lenses of fine, carbonate and shale gravel, fairly well rounded
227-243	CLAY	Silty and sandy with occasional coarse sand grain or pebble, dark olive to brownish dark gray, slightly to moderately hard, stiff, chunky, very lightly compacted (Till?)

243-331	SAND	Very fine and fine, very silty, thinly interbedded, sorted in lenses, subangular to rounded, light olive gray, loose to slightly cohesive, predominantly quartz with shale; sample return fairly poor, most of it carrying through in drilling fluid. Occasional lense of coarse sand ñ mostly rounded carbonates with shale and granitics
331-358	SAND	Very fine to fine, clayey, brownish black, soft, moderately cohesive, slightly plastic, oily and carbonaceous, highly calcareous, angular to subrounded, mostly quartz; drills tight, oily on drilling fluid, possible thin shale seams (bedrock)
358-380	SHALE	Medium gray to brownish black with bluish tint, clay, thinly interbedded with sandstone and aragonite layers, oily, tight, slightly plastic to slightly brittle, smooth, sticky, calcareous

145-054-23CCC

Harry Olofson

Date Completed:	0/0	Purpose:	Stock Well
L.S. Elevation (ft):	1140	Well Type:	30 in. - Unknown
Depth Drilled (ft):	28	Aquifer:	Page
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-054-27CDC
NDSWC 3991

Date Completed: 06/10/1970 Purpose: Observation Well -
Recorder
L.S. Elevation (ft): 1145 Well Type: 4 in. - Steel
Depth Drilled (ft): 820 Aquifer: Newcastle
Formation
Screen Int. (ft.): 640-660 Data Source:

Completion Info:

Remarks: 4" well with a 1 1/4 pipe down inside the well it doesn't pump, replace or take off sample list,

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Pebbly silt loam, dark brownish black
2-20	CLAY	Silty to very sandy with heavily iron-stained pebbles, dusky yellowish gray to moderate olive brown, soft to moderately soft, slightly to moderately cohesive, oxidized (Till)
20-42	CLAY	Silty to sandy with limestone and shale pebbles, olive gray, moderately soft, cohesive, slightly plastic, fairly stiff (Till)
42-75	SILT	Clayey with very fine sand, light olive to olive gray, laminated, interbedded, soft, loose to moderately cohesive, non- to slightly plastic, calcareous
75-100	CLAY	Silty and clayey silt, olive gray, soft, moderately cohesive, slightly to moderately plastic, smooth, fairly sticky, calcareous, occasional limestone pebble
100-113	SAND	Medium, light olive gray, loose, sorted and uniform, generally subrounded, mostly quartz with shale and carbonates, very brittle lignite
113-156	SILT	Clayey to sandy, interbedded, laminated, olive gray with light olive gray streaks, soft, non- to moderately cohesive, non- to moderately plastic; clayey and tighter with depth
156-200	SAND	Fine to coarse with frequent clay and silt stringers and occasional gravel and cobbles, coarse sand and gravel mostly rounded, shale and limestone, finer sand mainly quartz with shale and carbonates; thinly interbedded; taking some water
200-227	CLAY	Silty with numerous sand grains and pebbles and occasional cobbles and boulders, olive gray, moderately hard, stiff, tightly compacted, chunky (Till) rough drilling

227-238	GRAVEL	Sandy with cobbles, assorted, subangular and subrounded, mostly limestone and shale with granitics; rough drilling, put on rock bit at 225
238-276	SHALE	Extremely silty to sandy (very fine), dark brown to black, soft to moderately soft, cohesive to slightly crumbly, highly calcareous oily and carbonaceous, numerous specks, contains thin seams of aragonite; oily film on drilling fluid (Greenhorn?)
276-297	SHALE	Sandy, dark brown, soft to moderately soft, crumbly, oily, calcareous; included numerous lenses of hard pyritiferous sandstone and highly calcareous aragonite or calcite; fairly rough drilling, hydrocarbon odor while burning, burns to a fine white powder, strong (Greenhorn?)
297-460	SHALE	Black, silty to sandy (very fine), slightly hard, brittle, smooth, waxy, oily, tight, highly calcareous, numerous specks and spots; aragonite or calcite seams, soft sandy and silty layers, very hard sandstone at 345', microfossils, blue micaceous bentonitic clay, pyrite crystals, shell fragments, carbonaceous (Belle Fourche?)
460-585	SILTSTONE	Clayey very fine grained sandstone, interbedded with clayey to sandy shale, variegated grays (usually light to medium) brittle to friable to indurated, calcareous, micaceous, idirty, muddy; pyrite crystals, sand fairly sharp or angular, thinly interbedded; drills easy except for indurated or pyritiferous layers (Mowry?)
585-620	SANDSTONE	Very fine to fine, gray dries white, 90% quartz, angular to subrounded, mostly subangular, slightly calcareous, indurated pyritiferous sandstone from 606' to 610' (Newcastle?)
620-665	SANDSTONE	Fine to coarse, predominantly medium, white, quartzose, predominantly subangular, loose; taking water (Skull Creek?)
665-678	SHALE	Very silty, variegated grays and greens, soft, moderately cohesive, smooth, tight, slightly calcareous Skull creek?)
678-692	SANDSTONE	Brownish pinkish gray, very fine to fine loose, subangular, sugary, calcareous
692-754	SANDSTONE	Fine to medium, grayish brown, quartzose, loose to pyritiferous and indurated, interbedded with shale, silty, variegated grays and greens, soft, occasionally oily and carbonaceous, non to slightly calcareous, sometimes chalky or marly, smooth
754-786	SANDSTONE	Loose, fine and medium, some very fine, dark gray, dries white, nearly pure quartz, sharp, sugary

- 786-812 SHALE (CLAY) White, gray and bright orange, soft to medium soft, smooth, stains and smears easily, non-calcareous, siliceous powder
10' of fine to medium, brownish gray, sharp sand at bottom
- 812-820 SHALE Hard, black, spotted, non-calcareous, very tight, smooth, tough

145-054-31AAA
NDSWC 9884

Date Completed: 06/01/1977 Purpose: Test Hole
L.S. Elevation (ft): 1121
Depth Drilled (ft): 240

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-9	SAND	Silty, clayey, dusky yellow, reddish brown stringers, oxidized
9-60	SAND	Fine to medium, predominantly medium, subangular to rounded, good sorting, 65-75% quartz, 10% carbonates, lignitic @ 24'-26', 35'-36' sand, silty, clayey, greenish black
60-72	SAND	Silty, clayey, greenish black, slightly cohesive
72-90	SILT	Clayey, pale greenish gray, cohesive
90-166	CLAY	Silty, sandy, pebbly, olive gray, cohesive (Till) @ 126'-131' sand, fine to medium, predominantly medium, as above
166-202	CLAY	Silty, sandy, pebbly, light brown, more sandy than above, slightly cohesive (Till)
202-217	CLAY	Silty, sandy, pebbly, olive gray, less sand than above, cohesive (Till)
217-224	SHALE	Macerated zone, black, greasy with light gray laminations which are calcareous
224-225	ROCK	
225-240	SHALE	As above but not macerated

145-054-31AAA2
NDSWC 9884A

Date Completed:	06/01/1977	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1115.6	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	0	Aquifer:	Page
Screen Int. (ft.):	38-44	Data Source:	

Completion Info:

Remarks: 9/23/99 KKKUNZ COULDN'T LOCATE WELL. IT'S BELIEVED
THIS WELL HAS BEEN DESTROYED BY ROAD
CONSTRUCTION.

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-054-34BAB
Roller Brothers

Date Completed:	1938	Purpose:	Domestic Well
L.S. Elevation (ft):	1151	Well Type:	30 in. - Unknown
Depth Drilled (ft):	45	Aquifer:	Page
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-055-01DDD
NDSWC 3995

Date Completed:	06/19/1970	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1118.6	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	220	Aquifer:	Undefined
Screen Int. (ft.):	38-41	Data Source:	

Completion Info:

Remarks: REPLACED WITH 01DDD2 IN SAME HOLE

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Very fine sandy loam, black
2-6	SAND	Fine and medium, silty, yellowish gray, loose, lenticular, subangular to subrounded, iron-stained, oxidized
6-20	SAND	As above, gray, lenticular, unoxidized, mostly quartz with shale
20-42	SAND	Medium, well sorted and uniform, generally subrounded, gray, predominantly quartz, with rounded black siliceous shale and some carbonates, little lignite; taking some water
42-63	SILT	Clayey to sandy, light olive gray, soft, crumbly to moderately cohesive, non- to slightly plastic, calcareous; easy drilling
63-105	SILT	Occasional thin, very fine to fine gray sand, loose to slightly cohesive, non-plastic, calcareous
105-144	CLAY	Silt with sand grains, pebbles and occasional cobbles, rock predominantly shale and limestone, few granitics, olive to dark olive gray, moderately soft to slightly hard, stiff, tough, tight (Till)
144-190	CLAY	Very sandy with numerous lenses of sand and fine gravel, rock mostly carbonates, moderately soft, fairly cohesive, gritty highly calcareous (Fill), probably would make a decent well, lost some water
190-220	SILT	Shaly to sandy, dark brown to brownish black, soft to moderately soft, moderately cohesive to slightly brittle, oily, carbonaceous, tight, calcareous

145-055-01DDD2
NDSWC 14448

Date Completed:	11/30/1999	Purpose:	Observation Well
L.S. Elevation (ft):	1118.74	Well Type:	2 in. - PVC
Depth Drilled (ft):	50	Aquifer:	Undefined
Screen Int. (ft.):	36-41	Data Source:	

Completion Info: USED 38' OF 2" PVC, 5' #008 2" WELL SCREEN 1 CHECK VALVE, 4 BAGS OF # 10 SAND, 2 BAGS OF GROUT AND 8 BAGS OF HOLE PLUG.

Remarks: REPLACES 145-055-01DDD IN SAME HOLE

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Topsoil
2-20	CLAY	Sandy silt yellowish Oxodize.
20-42	SAND	Medium to very fine.
42-50	CLAY	Sandy silt, Gray

145-055-03DDD
NDSWC 3997

Date Completed: 06/22/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1140
 Depth Drilled (ft): 160
 Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Sandy loam, black
2-10	SAND	Fine to coarse with fine gravel, reddish brown, assorted, angular to subrounded, iron-stained, oxidized
10-20	SILT	Light olive gray, clayey to sandy (very fine), soft, slightly cohesive, crumbles easily calcareous
20-46	SAND	Very fine to medium, gray, sorted but lenticular, subangular to subrounded, predominantly quartz with shale and some carbonates, little lignite, loose; taking water
46-61	SILT	Clayey, light olive to olive gray, soft, slightly to moderately cohesive, slightly plastic, calcareous
61-143	CLAY	Silty to sandy with numerous coarse sand grains and pebbles (mostly shale and limestone), occasional gravelly streaks and frequent cobbles or boulders, olive gray, moderately soft, cohesive, stiff, tight (Till) rough drilling
143-160	SHALE	Silty dark grayish brown with light gray splotches and streaks, slightly hard, brittle, smooth, non-calcareous, tight

145-055-04BBB
NDSWC 8360

Date Completed: 06/26/1972 Purpose: Test Hole
 L.S. Elevation (ft): 1205
 Depth Drilled (ft): 80
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam, grayish-black
1-10	SAND	Slightly gravelly, medium to very coarse grained, angular to subrounded, moderately well sorted, well oxidized
10-13	CLAY	Silty, moderately sandy, moderate yellowish-brown, pebbly, slightly cohesive, oxidized (till)
13-25	CLAY	Silty, moderately sandy, slightly gravelly, pebbly, olive gray, moderately cohesive, moderately plastic, calcareous (Till)
25-27	GRAVEL	Sandy, fine to coarse, subangular to rounded, mostly shale and carbonates
27-29	CLAY	Silty, sandy, pebbly, olive gray, cohesive, crumbly (Till)
29-31	GRAVEL	Sandy, fine to coarse, angular to rounded, poorly sorted, mostly shale
31-49	SILT	Slightly clayey, medium gray with light olive gray laminae, slightly cohesive, calcareous
49-80	SHALE	Clayey, medium dark gray, slightly indurated, a few pyrite concretions, non-calcareous, (Carlisle Formation?)

145-055-07BBB
NDSWC 4001

Date Completed:	6/1970	Purpose:	Observation Well -
Plugged			
L.S. Elevation (ft):	1255.8	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	80	Aquifer:	Undefined
Screen Int. (ft.):	48-51	Data Source:	

Completion Info:

Remarks: Plugged with rig

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Pebbly silt loam, black
1-16	CLAY	Very silty and very sandy with occasional pebbles, yellowish gray, dusky yellow and reddish brown, soft, non- to moderately cohesive, leached and oxidized, iron-stained, jointed (?) (Till)
16-29	SAND	Fine to coarse, gravelly, assorted, angular to subrounded, dirty, mostly subrounded siliceous shale with heavily iron-stained carbonates and some granitics, partially oxidized
29-42	CLAY	Silty and sandy with pebbles and sandy gravel stringers, olive gray, soft to moderately soft, moderately cohesive, slightly plastic (Till)
42-49	GRAVEL	Fine, very sandy, assorted, dirty, shaley
49-53	TILL	Clayey, as above
53-74	SHALE	Very silty, very light gray, chalky, highly calcareous, soft, sticky
74-80	SHALE	Black, hard, smooth, very stiff, moderately calcareous, tight

145-055-08AAA
NDSWC 4000

Date Completed: 06/23/1970 Purpose: Test Hole
L.S. Elevation (ft): 1188
Depth Drilled (ft): 60
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty loam, black
1-4	CLAY	Silty, nearly white to yellowish gray, occasional pebble, heavily leached (Till)
4-12	CLAY	Silty and very sandy with pebbles, yellowish gray to dusky yellow, soft, slightly cohesive, jointed (?) oxidized (Till)
12-24	SAND	Coarse with fine gravel, moderately sorted but interbedded or lenticular, loose, subangular and subrounded, fairly clean, mostly carbonates and siliceous shale with a few pink granitics
24-33	SILT	Sandy (very fine), light olive gray, soft, chunky, crumbly calcareous
33-40	CLAY	Silty with sand grains, pebbles and cobbles, olive gray, moderately soft and cohesive to slightly hard and brittle, tightly compacted (Till)
40-60	SHALE	Silty, generally brownish black, thinly interbedded with sandy streaks and bentonitic clay, calcareous to non-calcareous; drills tight

145-055-10BCB1

Hans Gotfredson

Date Completed:	1947	Purpose:	Domestic Well
L.S. Elevation (ft):	1165	Well Type:	24 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Page
Screen Int. (ft.):	0-35	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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145-055-10BCB2
NDSWC 3999

Date Completed: 06/23/1970 Purpose: Test Hole
L.S. Elevation (ft): 1165
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Sandy silt loam, black
2-18	CLAY	Very silty and very sandy with frequent pebbles, yellowish gray and reddish brown, soft, crumbly to slightly cohesive, non- to slightly plastic, heavily iron-stained, oxidized (Till)
18-28	CLAY	Very silty with sand grains and pebbles, olive gray, slightly hard and brittle, chunky, (Till)
28-32	GRAVEL	Fine, sandy, assorted, angular to subrounded, mostly siliceous shale and very heavily iron-stained limestone, dirty
32-78	CLAY	Very silty to sandy with numerous coarse sand grains and pebbles, frequent cobbles and boulders and occasional blocks or layers of clay and/or silt, olive gray, moderately soft to slightly hard, cohesive, tightly compacted (Till) quite rocky right above bedrock
78-100	SHALE	Very silty, moderately soft to moderately hard, very dark brown to black, smooth, tight, non-calcareous, bentonitic

145-055-12BBB
NDSWC 3996

Date Completed: Plugged	6/1970	Purpose:	Observation Well -
L.S. Elevation (ft):	1125	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	200	Aquifer:	Page
Screen Int. (ft.):	38-41	Data Source:	

Completion Info:

Remarks: destroyed by road construction 2OCT78

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Fine sandy loam, black
2-12	SILT	Clayey fine sand with occasional pebbles, yellowish and reddish gray, soft, slightly to moderately cohesive, non- to slightly plastic, iron-stained oxidized (washed till?)
12-49	SAND	Fine to medium with silty streaks, gray, moderately well sorted but interbedded, subangular to subrounded, predominantly quartz with shale, loose
49-72	SILT	Clayey with very fine sand, light olive gray, soft, slightly cohesive, non- to very slightly plastic, highly calcareous
72-75	GRAVEL	Fine, sandy, assorted, angular to subrounded, mostly carbonates with shale and some granitics, appears to have been oxidized at one time
75-80	CLAY	Silty with sand grains and pebbles, olive gray, moderately soft, cohesive, stiff (Till)
80-90	GRAVEL	Fine and medium, some sand, lenticular, subangular and subrounded, predominantly carbonates, few shale and granitics; moderately rough drilling
90-123	CLAY	Silty with sand grains and pebbles, olive to dark olive gray, moderately soft to slightly hard, very stiff and tightly compacted (Till) rocky
123-184	CLAY	Silty and sandy with numerous limestone and shale pebbles, olive gray, moderately soft, cohesive, slightly plastic (Till)
184-200	SHALE	Silty, dark gray, moderately soft, slightly brittle to cohesive, smooth, tight, non-calcareous, limestone stringers?

145-055-13AAA
NDSWC 8359

Date Completed:	6/1972	Purpose:	Observation Well -
Plugged			
L.S. Elevation (ft):	1126.7	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	240	Aquifer:	Page
Screen Int. (ft.):	48-51	Data Source:	

Completion Info:

Remarks: Same hole replaced by 13AAA2

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clayey, pebbly loam grayish-black
1-8	CLAY	Silty, moderately sandy to sandy, pebbly, moderate yellowish-brown, slightly cohesive, crumbly oxidized (Till) gopher holes, taking water mixed 5 mud
8-51	SAND	Slightly clayey, very fine to coarse grained (mostly fine to medium), subangular to rounded, moderately well sorted, oxidized to about 30 feet, lignitic, taking some water
51-72	SILT	Clayey, medium gray with light olive gray laminae, slightly cohesive, highly calcareous
72-220	CLAY	Very silty, sandy, pebbly, numerous cobbles, boulders, olive gray, moderately cohesive, lightly plastic, crumbly (till)
220-240	SHALE	Grayish-brown, occasional small white specks, a few pyrite nodules, moderately indurated, highly calcareous (Greenhorn Formation)

145-055-13AAA2
NDSWC 14450

Date Completed:	11/30/1999	Purpose:	Observation Well
L.S. Elevation (ft):	1126.7	Well Type:	2 in. - PVC
Depth Drilled (ft):	58	Aquifer:	Page
Screen Int. (ft.):	46-51	Data Source:	

Completion Info:

Remarks: 48' 2" PVC PIPE, 5' #008 2" WELL SCREEN, SET 44' OF 1 1/4" TREWMIE LINE, USED 3 BAGS OF #10 SAND 2 BAGS OF GROUT AND 6 BAGS OF HOLE PLUG

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Topsoil
1-8	SAND	Oxidized yellowish sand with silt clay.
8-51	SAND	Gray fine to medium.
51-58	SAND	Gray sand with silty clay.

145-055-15DAD
NDSWC 4296

Date Completed: 10/31/1970 Purpose: Test Hole
L.S. Elevation (ft): 1137
Depth Drilled (ft): 220

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty loam, black
1-4	SILT	Sandy, yellowish gray, soft, slightly cohesive, laminated, leached
4-16	CLAY	Silty and sandy with occasional coarse sand grains and thin sand and gravel stringers, dusky yellow, soft, loose to moderately cohesive, oxidized (Till)
16-20	SILT	Light olive gray, soft, chunky, crumbly, laminated, light weight
20-24	SAND	Medium to coarse, tannish gray, loose, sorted, subrounded, clean
24-36	SAND	Fine and medium, gray, moderately well sorted, subrounded, quartzose with some shale and occasional lignite, loose, fairly clean, clayey silt, streak from 29'-31'
36-60	CLAY	Very silty to very sandy with pebbles, cobbles and boulders, olive gray, soft to moderately soft, moderately cohesive (Till); very rocky, rough drilling
60-92	CLAY	Silty, olive gray, soft, cohesive, moderately plastic, slightly sticky; fairly large pliable cuttings
92-126	SAND	Medium to very coarse but probably very silty; drills funny sample return poor (not much sand, silt probably carrying over in drilling mud), drills very lenticular
126-138	SAND	Fine, gray, getting progressively more silty and more clayey with depth, drills smooth and easy, practically no sample return
138-162	CLAY	Silty with sand grains, pebbles, cobbles, and occasional boulders, olive gray, moderately soft, cohesive, stiff, tough (Till)

162-170	GRAVEL	Fine and medium, sandy, dirty; generally subrounded, mostly carbonate and shale with granitics; didn't drill too bad
170-184	TILL	As above, rocky, silty, clay, olive gray, tough
184-220	SHALE	Silty, very light gray with interbedded dark brown, carbonaceous shale, moderately hard, smooth, very tight, calcareous

145-055-23CCC
NDSWC 3998

Date Completed:	06/22/1970	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1135	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	160	Aquifer:	Page
Screen Int. (ft.):	28-31	Data Source:	

Completion Info:

Remarks: plowed up, couldn't find 1DEC82. Reported destroyed on 10/13/94.

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Sandy loam, black
2-5	CLAY	Silty and sandy, very light to yellowish gray, soft, very slightly cohesive, nonplastic
5-32	SAND	Medium to coarse with fine gravel, subangular and subrounded, varicolored (nearly white mostly limestone; nearly black mostly shale), interbedded or lenticular, clean, no clay; taking water, occasional cobblestone
32-58	CLAY	Silty and sandy with numerous pebbles and gravel stringers, occasional cobbles, olive gray, moderately soft, cohesive (Till)
58-115	CLAY	Silty and sandy with pebbles and fine gravel stringers, occasional cobbles and boulders, olive gray, moderately soft, cohesive, stiff (Till) pebbles and cobbles mainly siliceous shale and limestone
115-160	SHALE	Very silty, soft to moderately soft, very cohesive and plastic, sticky, smooth, waxy, very dark brown, non-calcareous; contains layers of light blue, non-calcareous, slightly hard bentonitic clay

145-055-27DDD
NDSWC 4297

Date Completed:	11/1970	Purpose:	Observation Well
L.S. Elevation (ft):	1141	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	240	Aquifer:	Page
Screen Int. (ft.):	57-63	Data Source:	

Completion Info:

Remarks: replace or take off sample list, slow pumper Tried to sample 6-18-92 muddy spray within first 5 min and then no recharge. Could hear air at bottom of well not being undo any water from the end of the hose.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Gravelly silt loam, black
1-10	GRAVEL	Fine, sandy, assorted, subangular and subrounded, predominantly iron-stained carbonates, black, tabular shale and granitics, loose, oxidized, dry
10-55	CLAY	Very silty and sandy with occasional coarse sand grains, pebbles and cobbles, contains much clayey very fine sand and lenses of medium to coarse sand and fine shaley gravel, light olive to olive gray, loose to moderately cohesive (Till) small abraded samples
55-63	GRAVEL	Fine, sandy, poorly sorted, generally subrounded, clean, mostly granitics and carbonates with some shale, no large loss of drilling fluid
63-86	SAND	Fine to medium, silty to slightly clayey in spots, generally light olive gray in color, loose to slightly cohesive but crumbly, laminated and interbedded
86-89	CLAY	Dark olive gray, moderately soft, cohesive, stiff, smooth
89-98	SILT	Clayey to sandy, light olive gray soft, chunky, crumbly, laminated
98-105	GRAVEL	Fine, sandy, poorly sorted, generally subrounded, predominantly carbonates and shale with some granitics, loose
105-219	CLAY	Silty too sandy with pebbles and occasional cobbles, olive gray, moderately soft to slightly hard, cohesive, stiff, tough (Till) drills good
219-240	SHALE	Silty, medium dark gray to brownish black, smooth, slightly to moderately hard, very tight, waxy, calcareous (Carlyle?)

145-055-30CCB

Dale Hokum

Date Completed:	0/0	Purpose:	Stock Well
L.S. Elevation (ft):	1251	Well Type:	36 in. - Unknown
Depth Drilled (ft):	30	Aquifer:	Page
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-053-02AAD
NDSWC 7

Date Completed: 01/01/1947 Purpose: Test Hole
L.S. Elevation (ft): 982
Depth Drilled (ft): 335
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Black, sandy
2-20	CLAY	Yellow, pebbly
20-35	CLAY	Blue-gray
35-110	TILL	Light-gray, gravelly and bouldery clay
110-155	TILL	Medium-gray, bouldery clay
155-210	TILL	Dark-gray, bouldery clay
210-227	CLAY	Dark-brown
227-290	CLAY or SHALE	Dark-gray
290-320	SILT OR SILTSTONE	Clay or shale
320-335	SILTSTONE	Light-gray, fine, sandy

146-053-02ABC
NDSWC 8

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 995
Depth Drilled (ft): 427

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black
2-11	TILL	Gray, pebbly clay
11-40	SILT	Yellow, shell fragments
40-56	CLAY	Gray, compact, fissile
56-70	TILL	Gray, sandy with shale pebbles
70-71	SHALE	Gravel
71-90	TILL	Gray clay with shale and limestone pebbles
90-110	TILL	Dark-gray, sandy, pebbly clay
110-150	TILL	Bouldery clay
150-180	TILL	Gray clay with shale and limestone pebbles
180-210	CLAY	Gray, sandy, gravelly
210-380	SHALE	Siltstone interbedded, gray
380-400	CLAY	White to pink
400-427	CLAY	Light-brown

146-053-02DCC
NDSWC 102

Date Completed: 05/13/1960 Purpose: Test Hole
L.S. Elevation (ft): 989
Depth Drilled (ft): 87

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black
2-7	CLAY	Olive-gray
7-10	CLAY	Brownish-gray
10-20	CLAY	Light-brownish-gray, plastic
20-25	CLAY	Smooth, brownish-gray
25-82	CLAY	Clay, silty, olive-gray
82-87	CLAY	Gray, with fine and coarse gravel (till)

146-053-02DDC
NDSWC 101

Date Completed: 05/12/1960 Purpose: Test Hole
L.S. Elevation (ft): 981
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black
2-22	CLAY	Smooth, yellow to brown, oxidized
22-37	CLAY	Smooth, gray

146-053-05AAA1

James Strand

Date Completed:	1926	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	42 in. -
Depth Drilled (ft):	0	Aquifer:	Page
Screen Int. (ft.):	0-26	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-053-05AAA2

James Strand

Date Completed:	1954	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	2 in. -
Depth Drilled (ft):	540	Aquifer:	Dakota Group
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-053-05ABB
NDSWC 6

Date Completed: 01/01/1947 Purpose: Test Hole
L.S. Elevation (ft): 995
Depth Drilled (ft): 117
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-12	TILL	Yellow clay with shale and limestone pebbles
12-21	SAND	Mostly fine, gravelly
21-29	TILL	Yellow gravelly clay
29-89	SILT	Gray, gravelly
89-117	TILL	Bouldery clay

146-053-05DCC
NDSWC 31

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1039
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Black, gravelly
2-7	SAND	Light-tan, fine to medium
7-32	SAND	Tan to gray, very fine to fine
32-37	CLAY	Olive-gray

146-053-07AAA
NDSWC 32

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1059
Depth Drilled (ft): 47
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Black, sandy
2-22	SAND	Tan to gray, very fine to fine
22-42	SAND	Light-tan, very fine, clayey
42-47	CLAY	Light-gray, silty

146-053-07BAA
NDSWC 33

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1063
Depth Drilled (ft): 52
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black, sandy
2-7	SAND	Tan, fine; contains some calcareous cement
7-12	SAND	Light brown, fine
12-17	SAND	Grayish-tan, very fine to fine
17-27	SAND	Gray, very fine, clayey
27-47	SILT	Very fine sand, gray
47-52	CLAY	Light gray, silty, compact

146-053-07DDD
NDSWC 3

Date Completed: 01/01/1946 Purpose: Test Hole
L.S. Elevation (ft): 1080
Depth Drilled (ft): 169
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-10	GRAVEL	Fine to coarse, and sand
10-24	SAND	A little gravel
24-70	TILL	Sandy and gravelly clay
70-105	SAND	Fine, with a very little gravel
105-135	TILL	Sandy clay
135-169	TILL	Sandy, and bouldery clay

146-053-08AAA

NDSWC 30

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1026
Depth Drilled (ft): 37

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black, sandy
2-32	SAND	Light-tan, very fine, silty
32-37	CLAY	Light gray

146-053-08CDD
NDSWC 4

Date Completed: 01/01/1947 Purpose: Test Hole
L.S. Elevation (ft): 1062
Depth Drilled (ft): 161
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-5	TILL	Gravelly, gray clay
5-70	SAND	Fine
70-115	SAND	Very fine to fine, silty
115-141	TILL	Clay with shale pebbles and limestone boulders
141-148	SAND	Gravelly and boulders
148-161	TILL	Sandy and gravelly clay

146-053-08DDD
NDSWC 5

Date Completed: 01/01/1947 Purpose: Test Hole
L.S. Elevation (ft): 1046
Depth Drilled (ft): 156
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-4	SAND	Mostly fine, with a little gravel
4-13	TILL	Yellow gravelly clay
13-20	TILL	Gray gravelly clay
20-35	SAND	Very fine to fine
35-60	TILL	Gray clay with shale and limestone pebbles
60-80	SAND	Fine
80-108	TILL	Sandy and gravelly clay
108-156	TILL	Bouldery clay

146-053-16BBC
NDSWC 21

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1048
Depth Drilled (ft): 102
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-053-16CBB
NDSWC 22

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1048
Depth Drilled (ft): 102
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-12	CLAY	Mottled yellow and gray, silty
12-27	SHALE	Gravel, fine, clayey; lignite flakes

146-053-16CCC
NDSWC 23

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1051
Depth Drilled (ft): 102
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	CLAY	Yellow, sandy
2-7	SAND	Light-brown, fine
7-32	SAND	Light-gray, silty
32-37	SAND	Light-tan, very fine
37-72	SAND	Light-gray, very fine
72-102	SAND	Light-brown, very fine, silty

146-053-19AAA
NDSWC 8378

Date Completed:	06/30/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1083	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	140	Aquifer:	Page
Screen Int. (ft.):	77-80	Data Source:	

Completion Info:

Remarks: Well plugged by SWC drill rig, on 9/29/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam grayish-black
1-22	CLAY	Very silty, sandy, pebbly, slightly gravelly, moderate yellow-brown, slightly cohesive, crumbly, oxidized (till)
22-63	CLAY	Very silty, sandy, a few pebbles, olive gray, slightly cohesive, crumbly, calcareous (till)
63-90	SAND	Silty, slightly clayey, very fine to fine-grained, subangular to subrounded, moderately well sorted, lignitic
90-120	CLAY	Very silty, olive gray with light olive gray laminae, moderately cohesive, highly plastic, calcareous
120-140	CLAY	Silty, moderately sandy, pebbly, olive gray, moderately cohesive, moderately plastic, calcareous (till)

146-053-20AAA
NDSWC 8379

Date Completed: 06/30/1972 Purpose: Test Hole
L.S. Elevation (ft): 1062
Depth Drilled (ft): 120

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, slightly sandy, clay loam, grayish-black
1-8	SAND	Silty, Slightly clayey, very fine to medium-grained, subrounded, oxidized
8-15	SILT	Slightly clayey, moderate yellowish-brown, slightly cohesive, crumbles easily, oxidized
15-18	SAND	Fine to medium-grained, well sorted, subrounded, lignitic
18-38	SILT	Clayey, sandy, olive gray, slightly cohesive, crumbly, highly calcareous
38-58	SAND	Silty, slightly clayey, very fine to fine-grained, moderately well sorted, subrounded, lignitic, not taking water
58-102	SILT	Clayey, medium gray with light olive gray laminae, slightly to moderately cohesive, slightly plastic, highly calcareous
102-120	CLAY	Silty, sandy, pebbly, olive gray, cohesive, crumbly, calcareous (till)

146-053-20DDD
NDSWC 8380

Date Completed: 06/30/1972 Purpose: Test Hole
L.S. Elevation (ft): 1065
Depth Drilled (ft): 120
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-6	SAND	Slightly gravelly, clayey, fine to coarse-grained, subangular to subrounded, moderately well sorted, oxidized
6-39	SILT	Slightly clayey, slightly sandy, medium gray with some light olive gray laminae, slightly cohesive, crumbly, highly calcareous
39-55	SAND	Clayey, very silty, very fine to fine-grained, subrounded, lignitic, very dirty
55-95	CLAY	Very silty, an occasional pebble, olive gray with light olive gray mottling, moderately cohesive, highly plastic, highly calcareous
95-120	CLAY	Silty, moderately sandy to sandy, pebbly, olive gray, cohesive, slightly plastic, calcareous (till)

146-053-21BCC
NDSWC 24

Date Completed: 1948 Purpose: Test Hole
L.S. Elevation (ft): 1055
Depth Drilled (ft): 102
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Black, sandy
2-7	SAND	Light-tan, fine, silty
7-17	SAND	Light-gray, fine to very fine
17-82	SAND	Light-gray, very fine, silty and clayey
82-102	CLAY	Light-gray, silty and sandy

146-059-28BBB
NDSWC 25

Date Completed: 01/01/1948 Purpose: Test Hole
L.S. Elevation (ft): 1064
Depth Drilled (ft): 102
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black, sandy
2-12	SAND	Light-tan, fine to very fine
12-22	SAND	Light-gray, clayey
22-52	SAND	Light-gray, fine
52-62	SAND	Light-gray, very fine, clayey
62-92	SAND	Light-gray, fine
92-102	TILL	Sandy and gravelly clay

146-053-28CCC
NDSWC 208

Date Completed: 01/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 1080
Depth Drilled (ft): 32
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-12	SAND	Very fine to fine, dark brown, clayey
12-20	SAND	Very fine to fine, olive brown, silty
20-32	CLAY	Sandy, light gray

146-053-28CDD3
NDSWC 2

Date Completed: 01/01/1947 Purpose: Test Hole
L.S. Elevation (ft): 1050
Depth Drilled (ft): 216
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-3	TOPSOIL	Black, sandy
3-20	SAND	Fine, with a very little gravel
20-40	SAND	Fine
40-55	SAND	Very fine to fine, silty
55-70	SAND	Fine, silty and clayey
70-105	TILL	Sandy clay with shale pebbles
105-175	TILL	Sandy and bouldery clay
175-185	GRAVEL	Clayey
185-216	TILL	Sandy and bouldery clay

146-053-28DDC3
NDSWC 143

Date Completed: 01/01/1960 Purpose: Test Hole
L.S. Elevation (ft): 1032
Depth Drilled (ft): 17
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Black
1-15	CLAY	Sandy, light-brown to buff, oxidized
15-17	CLAY	Smooth, gray

146-053-29BBB
NDSWC 8377

Date Completed: Destroyed	1972	Purpose:	Observation Well -
L.S. Elevation (ft):	1082	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	37-40	Data Source:	

Completion Info:

Remarks: 9/23/99 KKKUNZ COULDN'T LOCATE WELL. IT'S BELEIVED THIS WELL HAS BEEN DESTROYED BY FARMING.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam grayish-black
1-40	SAND	Slightly clayey, silty, very fine to medium grain (mostly very fine to fine), subrounded, shaley, lignitic, taking some water, occasional thin silty clay layers, well sorted
40-50	SILT	Sandy, clayey, medium gray, slightly cohesive, samples washing out in mud
50-65	SAND	Silty very fine to fine-grained, subrounded, well sorted, a few thin clay layers, lignitic, shaley
65-102	CLAY	Very silty, olive gray, moderately cohesive, highly plastic, highly calcareous
102-120	CLAY	Silty, moderately sandy, pebbly, olive gray, cohesive, moderately plastic, calcareous (till)

146-053-29CBC
NDSWC 8497

Date Completed:	09/20/1972	Purpose:	Observation Well - Destroyed
L.S. Elevation (ft):	1088	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	37-40	Data Source:	

Completion Info:

Remarks: Well has been destroyed. Reported 10/4/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-9	SILT	Slightly clayey, sandy, moderately yellowish-brown, slightly cohesive, crumbly, oxidized
9-14	SILT	Slightly clayey, medium gray, laminated, crumbly, highly calcareous
14-25	SAND	Slightly silty, very fine to medium, mostly very fine to fine, subangular to rounded, moderately well sorted, lignitic, shaley - taking some water
25-62	SAND	A few thin sandy silt interbeds, very fine to medium, mostly fine to medium, subangular to rounded, moderately well sorted, lignitic taking some water
62-100	SILT	Moderately clayey to clayey, a few thin sand layers from 65'-80', olive gray, slightly cohesive, slightly plastic, becomes more clayey with depth, highly calcareous

146-053-29DAA
NDSWC 8500

Date Completed:	9/1972	Purpose:	Observation Well - Destroyed
L.S. Elevation (ft):	1082	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	57-60	Data Source:	

Completion Info:

Remarks: Well reported to have been destroyed 9/4/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-0.5	TOPSOIL	Very silty, sandy loam, brownish black
0.5-4	SILT	Sandy, slightly clayey, dusky yellow, crumbly, well oxidized
4-8	SAND	Silty, very fine to medium, moderately well sorted, subangular, oxidized
8-20	SILT	Slightly sandy, slightly clayey, medium gray, slightly cohesive, crumbly, highly calcareous
20-78	SAND	A few thin sandy silt interbeds, very fine to medium, mostly fine, subangular to rounded, well sorted, some lignite and shale, taking some water
78-96	SILT	Slightly clayey, medium gray with light brownish-gray mottling and laminae, crumbles easily, highly calcareous
96-100	CLAY	Moderately silty, medium dark gray with brownish-gray mottling, slightly sandy, pebbly, moderately cohesive, slightly plastic, calcareous (till)

146-053-32ABB
NDSWC 8496

Date Completed:	09/19/1972	Purpose:	Observation Well - Destroyed
L.S. Elevation (ft):	1096	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	57-60	Data Source:	

Completion Info:

Remarks: Well was destroyed. Reported 10/4/1994.

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-24	SAND	Silty, very fine to medium (mostly fine) well sorted, subangular to rounded, oxidized to about 15' below land surface, taking water
24-29	SILT	Interbedded with sand, slightly clayey medium gray, crumbly, samples washing out
29-73	SAND	Very fine to medium (mostly fine) subangular to rounded, moderately well sorted, taking some water, not caving in clean-looking sand a few thin clayey silt interbeds below 40'
73-90	CLAY	Very silty to silty, olive gray, cohesive, highly plastic, highly calcareous
90-100	CLAY	Silty, moderately sandy, pebbly, medium dark gray, cohesive, moderately plastic, calcareous (till)

146-058-32BBB
NDSWC 209

Date Completed: 1960 Purpose: Test Hole
L.S. Elevation (ft): 1096
Depth Drilled (ft): 42
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-10	SAND	Very fine to fine
10-20	SAND	Very fine to fine, light-brown, silty
20-42	SAND	Very fine to fine, light-gray, silty

146-053-32CBB
NDSWC 8498

Date Completed:	09/20/1972	Purposc:	Observation Well -
Destroyed			
L.S. Elevation (ft):	1089	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	32-35	Data Source:	

Completion Info:

Remarks: Well was destroyed. Reported 10/4/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, sandy, clay loam, brownish-black
1-4	SILT	Sandy, slightly clayey, dusky yellow, slightly cohesive, crumbly, oxidized
4-25	SAND	Slightly silty, very fine to medium, mostly fine to medium, subrounded, well sorted, lignitic, some shale, taking some water
25-31	SILT	Slightly clayey, sandy, medium gray, laminated, crumbly, highly calcareous
31-39	SAND	Slightly silty, very fine to medium, mostly fine to medium, subangular to rounded, moderately well sorted, taking some water, lignitic
39-95	SILT	Slightly to moderately clayey, medium gray, some thin light olive gray laminae, becomes more clayey with depth, slightly to moderately cohesive, slightly plastic, highly calcareous
95-100	CLAY	Moderately silty, pebbly, medium dark gray, moderately cohesive, moderately plastic, calcareous (till)

146-058-32DDD
NDSWC 8384

Date Completed: 7/1972 Purpose: Observation Well -
Plugged
L.S. Elevation (ft): 1095 Well Type: 1.25 in. - ABS
Depth Drilled (ft): 120 Aquifer: Page
Screen Int. (ft.): 57-60 Data Source:

Completion Info:

Remarks: Well plugged by SWC drill rig, on 10/5/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-12	TOPSOIL	Very sandy, silty, brown
12-42	SAND	Slightly silty, occasional clay layers, slightly clayey, very fine to medium-grained, subangular to subrounded, well sorted, oxidized to about 15', taking some water
42-46	SILT	Moderately clayey, medium gray, slightly cohesive, calcareous, poor samples
46-80	SAND	Silty, occasional thin clay layers, very fine to medium-grained (mostly fine), subangular to rounded, well-sorted, shaley, lignitic, taking some water
80-120	CLAY	Silty, olive gray to medium gray, moderately cohesive, plastic, highly calcareous

146-053-33BAA
NDSWC 8495

Date Completed:	9/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1056	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	37-40	Data Source:	

Completion Info:

Remarks: Well plugged by SWC drill rig, on 10/5/1994

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Sandy, silty clay loam, brownish-black
1-14	SAND	Silty, very fine to medium, moderately well sorted, oxidized, taking water
14-19	SILT	Slightly sandy clayey, medium gray, light gray laminae, crumbles easily
19-32	SAND	Very fine to medium, mostly fine, subangular to rounded, moderately well sorted, taking some water
32-36	SILT	Moderately clayey, medium gray, laminated, crumbly, highly calcareous
36-43	SAND	Very fine to fine, subrounded, well sorted, shaley
43-76	SILT	Moderately clayey to clayey, medium gray to olive gray, slightly cohesive, crumbly, highly calcareous
76-100	CLAY	Silty, moderately sandy, pebbly, a few cobbles, medium dark gray, cohesive, moderately plastic, calcareous (till)

146-053-33BBB
NDSWC 1

Date Completed: 1947 Purpose: Test Hole
L.S. Elevation (ft): 1080
Depth Drilled (ft): 172
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Black, sandy
2-20	SAND	Brown, fine to medium, gravelly
20-25	SAND	Gray, medium, clayey
25-70	SAND	Very fine to fine, silty
70-85	SAND	Fine, some lignite pebbles, silty
85-95	SAND	Very fine, silty
95-107	TILL	Very sandy clay
107-151	TILL	Gray sandy clay with shale pebbles
151-172	TILL	Clay, sand and boulders

146-053-83BBB1
NDSWC 8385

Date Completed:	07/10/1972	Purpose:	Observation Well
L.S. Elevation (ft):	1083	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	120	Aquifer:	Page
Screen Int. (ft.):	42-45	Data Source:	

Completion Info:

Remarks: EAST WELL 10/20/04 - Backwashed and got the well to pump much better

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Sandy, silty, brown
1-18	SAND	Silty, very fine to medium-grained, subrounded, well sorted, oxidized to about 15', taking water
18-32	SILT	Clayey, medium gray, cohesive, slightly plastic, highly calcareous
32-36	SAND	Very fine to medium grained, well sorted, rounded clean, lignitic
36-38	CLAY	Very silty, slightly sandy, medium gray, moderately cohesive, highly plastic calcareous
38-47	SAND	Silty, very fine to fine-grained, subrounded, well sorted, shaley, lignitic
47-97	CLAY	Very silty to silty, dark gray to medium gray, very plastic, cohesive, highly calcareous
97-120	CLAY	Silty, moderately sandy, pebbly, olive gray, cohesive, moderately plastic, calcareous (till)

146-053-33BCC
NDSWC 8499

Date Completed:	9/1972	Purpose:	Observation Well -
Destroyed			
L.S. Elevation (ft):	1085	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Page
Screen Int. (ft.):	32-35	Data Source:	

Completion Info:

Remarks: Well has been destroyed. Reported 10/4/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-12	TOPSOIL	Sandy, Silty clay loam, brownish black
12-17	SAND	Silty, very fine to medium, subrounded, moderately well sorted, oxidized, taking some water
17-19	SILT	Slightly clayey, medium gray, crumbly, highly calcareous
19-25	SAND	Very fine to medium, subangular to rounded, moderately well sorted, lignitic
25-32	SILT	Moderately clayey, sandy, medium gray to olive gray, crumbly highly calcareous
32-38	SAND	Slightly clayey, silty, very fine to medium, mostly fine to medium, subangular to rounded, moderately well sorted, taking some water
38-80	SILT	Slightly to moderately clayey, medium gray with light olive gray laminae and light brownish-gray mottling (limestone boulder from 47'-48'), crumbly, highly calcareous
80-100	CLAY	Silty, pebbly, moderately sandy, medium dark gray, moderately cohesive, moderately plastic, calcareous (till)

146-053-35BAA
NDSWC 146

Date Completed: 05/27/1960 Purpose: Test Hole
L.S. Elevation (ft): 1006
Depth Drilled (ft): 37

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Black
1-24	CLAY	Dark-brown with fine and medium gravel (till)
24-32	SAND	Very fine to fine, dark-brown, clayey
32-37	SAND	Fine to coarse, gray, clayey

146-053-35BAD
NDSWC 145

Date Completed: 1960 Purpose: Test Hole
L.S. Elevation (ft): 1006
Depth Drilled (ft): 37
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-20	SAND	Very fine to fine, light-brown, clayey
20-30	SAND	Very fine to fine, dark-brown, very clayey
30-37	SAND	Very fine to fine, gray (all quicksand)

146-053-35BBB
NDSWC 144

Date Completed: 05/27/1960 Purpose: Test Hole
L.S. Elevation (ft): 1009
Depth Drilled (ft): 87
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Black
1-25	CLAY	Yellow to light-gray, mottled
25-65	CLAY	Very sandy, dark-brown to gray
65-80	CLAY	Sandy, gray
80-87	CLAY	Gray with fine to medium gravel (till)

146-054-05AAA
NDSWC 8369

Date Completed: 06/29/1972 Purpose: Test Hole
L.S. Elevation (ft): 1088
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, pebbly, clay loam, grayish-black
1-12	SILT	Moderately clayey, moderate yellowish-brown to dusky yellow, slightly cohesive, slightly plastic, oxidized
12-45	SILT	Moderately clayey to clayey, a few limestone pebbles, olive gray, moderately cohesive, slightly plastic, calcareous
45-55	CLAY	Silty, moderately sandy, pebbly, olive gray, moderately cohesive, plastic, calcareous (Till)
55-72	SILT	Clayey, medium gray with light olive gray laminae, slightly cohesive, slightly plastic, calcareous
72-77	GRAVEL	Slightly sandy, clayey, fine to coarse, angular to subrounded, poorly sorted, mostly limestone and dolostone, some shale
77-100	CLAY	Sandy, silty, pebbly, slightly gravelly, olive gray, cohesive, moderately plastic, calcareous (Till)

146-054-05BCC
NDSWC 8370

Date Completed:	6/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1097	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Not Yet Entered
Screen Int. (ft.):	32-35	Data Source:	

Completion Info:

Remarks: Well reported destroyed 05/26/1993 & 10/12/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, moderately sandy, clay loam grayish-black
1-8	SAND	Fine to coarse grained, well sorted, subangular to subrounded, mostly quartz and feldspar oxidized
8-14	SILT	Moderately clayey, moderate yellowish-brown, slightly cohesive, moderately plastic, oxidized
14-22	SILT	Moderately clayey to clayey, olive gray with some light gray mottling, a few pebbles, moderately cohesive, moderately plastic, highly calcareous
22-37	SAND	A few thin clay layers, very fine to fine grained, subrounded, well sorted, shaley, lignitic, not taking water
37-44	SILT	Moderately clayey, sandy, olive gray, slightly cohesive, slightly plastic
44-100	CLAY	Silty, moderately sandy to sandy, pebbly, slightly gravelly, a few cobbles and boulders, olive gray, moderately cohesive, slightly plastic, calcareous (Till)

146-054-06BBB
NDSWC 8371

Date Completed: 06/29/1972 Purpose: Test Hole
L.S. Elevation (ft): 1100
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Very silty, clay loam, grayish-black
1-10	SAND	Silty, moderately clayey, very fine to medium grained, subangular to rounded, shaley, oxidized
10-14	SILT	Clayey, slightly sandy, moderate yellowish-brown, slightly cohesive, crumbly, oxidized
14-72	SILT	Moderately clayey, slightly sandy, a few limestone pebbles, medium gray with some light gray mottling
72-100	CLAY	Silty, moderately sandy, pebbly, a few cobbles, olive gray, cohesive, slightly plastic, calcareous (Till)

146-054-09AAD
Edward Sparrow

Date Completed:	1/1950	Purpose:	Domestic Well
L.S. Elevation (ft):	1050	Well Type:	30 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-22	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-054-13ABB
NDSWC 8408

Date Completed: 07/14/1972 Purpose: Test Hole
L.S. Elevation (ft): 1072
Depth Drilled (ft): 120
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, slightly sandy, clay loam, black
1-50	CLAY	Very silty, a few thin gravel layers, moderate yellowish-brown with olive gray mottling and some brownish-black, carbonaceous laminae, cohesive, highly plastic, oxidized
50-91	SILT	Slightly clayey, medium gray, slightly cohesive, slightly plastic, crumbles easily, highly calcareous
91-120	CLAY	Silty, very slightly sandy to sandy, pebbly, a few cobbles, medium gray, cohesive, slightly plastic, crumbly, moderately calcareous (Till)

146-054-13DCD
NDSWC 8407

Date Completed: 07/14/1972 Purpose: Test Hole
L.S. Elevation (ft): 1075
Depth Drilled (ft): 120
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, slightly sandy, clay loam, black
1-34	CLAY	Very silty, slightly sandy, pebbly, moderate yellowish-brown, moderately cohesive, slightly plastic, oxidized (Till)
34-56	CLAY	Very silty, gravelly, slightly sandy, pebbly, olive gray, slightly cohesive, slightly plastic, calcareous till gravel from 37'-38'
56-58	SAND	Moderately clayey, silty, very fine to medium grained (mostly fine), subangular to subrounded, moderately well sorted, lignitic, dirty-looking
58-80	CLAY	Very silty, sandy, olive gray, slightly cohesive, plastic, calcareous
80-120	CLAY	Very silty, pebbly, medium dark gray to medium gray, moderately cohesive, plastic, highly calcareous (Till)

146-054-14DDD
NDSWC 8406

Date Completed: 07/14/1972 Purpose: Test Hole
 L.S. Elevation (ft): 1080
 Depth Drilled (ft): 160
 Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, moderately sandy, pebbly clay loam, black
1-25	CLAY	Very silty to silty, slightly sandy, a few pebbles, moderate yellowish-brown, moderately cohesive, moderately plastic, oxidized (Till)
25-80	CLAY	Silty, moderately sandy, pebbly, a few cobbles, olive gray, cohesive, moderately plastic, calcareous (Till)
80-82	COBBLES	with gravel, unsorted
82-101	CLAY	Silty, moderately sandy, pebbly, gravelly, olive gray, cohesive, moderately plastic, calcareous (Till)
101-107	GRAVEL	Clayey, cobbles, poorly sorted, mostly carbonates and granitics, some shale (very dirty)
107-135	CLAY	Silty, moderately sandy to sandy, pebbly, gravelly, a few cobbles, olive gray, moderately cohesive, slightly plastic, calcareous (Till)
135-137	GRAVEL	Fine to coarse, angular to subrounded, poorly sorted, mostly carbonates
137-142	CLAY	Sandy, moderately silty, light olive gray, moderately cohesive, gravelly, some cobbles and boulders, calcareous (older Till?)
142-160	CLAY	Silty, moderately sandy, medium dark gray, cohesive, brittle, crumbles easily, (Till)

146-054-15AAA

NDSWC 4015

Date Completed: 06/26/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1095
 Depth Drilled (ft): 220

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-2	TOPSOIL	Sandy loam, black
2-9	SAND	Fine and medium, yellowish gray, loose, sorted, subrounded, quartzose
9-15	SAND	Fine and medium, gray, well-sorted, subrounded, quartzose and shaley
15-39	CLAY	Silty to sandy with pebbles, olive gray, moderately soft, moderately cohesive, slightly plastic, compacted, stiff (Till)
39-67	SILT	Clayey to sandy, light olive to olive gray, soft, crumbly to friable, quartzose but highly calcareous, laminated, interbedded
67-80	CLAY	Silty and sandy with limestone and shale pebbles, olive gray, moderately soft, cohesive, lightly compacted, chunky (Till)
80-113	SILT	Clayey fine sand, gray, soft, crumbly to slightly cohesive, non-plastic, quartzose, occasionally organic-rich material, calcareous; smooth drilling
113-142	CLAY	Silty to sandy with pebbles and gravel stringers, olive gray, moderately soft to slightly hard, cohesive, stiff, rough (Till) gravel mostly angular to subrounded carbonates
142-152	GRAVEL	Predominantly fine, varies from coarse sand to medium gravel, mostly subrounded black siliceous shale; medium rough drilling, no large loss of water
152-180	CLAY	Silty to sandy with pebbles (Till, as above, not much gravel but numerous cobbles or boulders)
180-201	TILL	As above with many lenses of black, angular shale gravel
201-220	SHALE	Silty, medium dark gray to brownish black, smooth, waxy, moderately soft to moderately hard, very tight, speckled, highly calcareous, oily; black clay 201'-202', fractured sandy shale 202'-207', blue bentonite clay 207'-208'

146-054-19DDD
NDSWC 4293

Date Completed: 10/29/1970 Purpose: Test Hole
L.S. Elevation (ft): 1105
Depth Drilled (ft): 180
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Very fine silty sand loam, black
1-9	CLAY	Very silty and sandy with occasional pebbles, dusky yellow with yellowish gray and moderate olive brown, laminations, soft, slightly to moderately cohesive, oxidized, (Till)
9-78	SILT	Clayey with lenses of very fine to medium sand, light olive to olive gray, soft, laminated, crumbly to slightly cohesive, non-plastic, light weight
78-84	CLAY	Silty, olive gray; soft, cohesive plastic, sticky
84-94	SILT	Clayey to sandy, light olive to olive gray, laminated, soft, slightly cohesive, chunky, easy drilling
94-116	CLAY	Very silty and very sandy with numerous pebbles and occasional pebbles, olive gray, moderately soft, moderately cohesive (till)
116-120	SAND	Coarse and very coarse, subangular to subrounded, moderately sorted, predominantly quartz and granitic derivatives
120-122	ROCK	Diorite
122-161	CLAY	Silty to sandy with numerous shale and limestone pebbles, occasional cobbles, olive to dark olive gray, moderately soft, cohesive, tough (Till)
161-180	SHALE	Very dark gray to brownish black, smooth, massive, very tight, non-calcareous

146-054-22DAA

Alwood Brent

Date Completed:	0/0	Purpose:	Stock Well
L.S. Elevation (ft):	N/A	Well Type:	3 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Dakota Group
Screen Int. (ft.):	0-575	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-054-25AAD
NDSWC 8405

Date Completed: 07/14/1972 Purpose: Test Hole
L.S. Elevation (ft): 1082
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clayey loam, grayish-black
1-9	CLAY	Silty, pebbly, moderate yellowish-brown, cohesive, plastic, oxidized (Till)
9-15	CLAY	Silty, moderately sandy, pebbly, olive gray, cohesive, moderately plastic, calcareous (Till)
15-18	SAND	Silty, slightly clayey, very fine to medium grained, subrounded, moderately well sorted, lignitic, shaley dirty
18-25	CLAY	Very silty, pebbly, olive gray, slightly to moderately cohesive, crumbly, calcareous (Till)
25-37	SILT	Moderately clayey, medium gray, slightly cohesive, slightly plastic, calcareous
37-40	SAND	Clayey, fine-grained, subrounded, moderately well sorted, lignitic
40-48	SILT	Moderately clayey, olive gray, slightly cohesive, slightly plastic, calcareous
48-52	SAND	Moderately clayey, very fine to fine grained, subrounded, moderately well sorted, lignitic
52-63	SILT	Clayey, olive gray, slightly cohesive, slightly plastic, calcareous
63-69	SAND	Very fine to fine grained, subangular, moderately well sorted, lignitic, shaley
69-88	SILT	Clayey, olive gray, slightly cohesive, slightly plastic calcareous
88-100	CLAY	Moderately sandy, pebbly, olive gray, cohesive, moderately plastic, calcareous (Till)

146-054-26BAA

Edwin Pladson

Date Completed:	1/1957	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	3 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-141	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-054-26DD

Oscar Eide

Date Completed:	1/1937	Purpose:	Stock Well
L.S. Elevation (ft):	N/A	Well Type:	30 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-92	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-054-27DDD
NDSWC 8362

Date Completed: 06/27/1972 Purpose: Test Hole
L.S. Elevation (ft): 1095
Depth Drilled (ft): 220

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clayey, loam grayish-black
1-15	CLAY	Silty, moderately sandy, pebbly, moderate yellowish-brown, cohesive, moderately plastic, oxidized (till)
15-106	CLAY	Silty, slightly sandy, pebbly, olive gray, moderately cohesive, slightly plastic, calcareous (Till)
106-166	CLAY	Very silty, olive gray with light olive gray mottling, moderately cohesive, plastic, highly calcareous
166-180	CLAY	Silty, moderately sandy, pebbly, a few cobbles, olive gray, moderately cohesive, moderately plastic, calcareous (Till)
180-210	CLAY	Silty, moderately sandy to sandy, pebbly, numerous cobbles and boulders, olive gray, moderately cohesive, moderately plastic, calcareous (Till) rough drilling
210-220	SHALE	Brownish-black, occasional small white specks, highly calcareous, moderately indurated (Cretaceous Greenhorn Formation?)

146-054-31AAA
NDSWC 8361

Date Completed:	06/26/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1130	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	180	Aquifer:	Undefined
Screen Int. (ft.):	27-30	Data Source:	

Completion Info:

Remarks: listed in Griggs/Steele basic data as 146-055-31AAA; Well reported destroyed 05/26/1993 & 10/12/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-3	ROADFILL	Silty, clay
3-34	SAND	Slightly clayey, very fine to coarse grained, (mostly fine to medium), subangular to rounded, well sorted, shaley, taking a little water
34-85	SILT	Moderately clayey, medium gray with light olive gray laminae, slightly cohesive, slightly plastic, highly calcareous
85-170	CLAY	Silty, moderately sandy, pebbly, occasional cobbles, olive gray, moderately cohesive, moderately plastic, calcareous (Till)
170-180	SHALE	Slightly clayey, medium dark gray, a few pyrite grains, very slightly calcareous to non-calcareous, moderately indurated (Cret. Carlile Formation?)

146-054-31ABA
F.E. Thykeson

Date Completed:	1/1957	Purpose:	Domestic Well
L.S. Elevation (ft):	1120	Well Type:	42 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-18	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-054-32DDD
NDSWC 8366

Date Completed: 06/28/1972 Purpose: Test Hole
L.S. Elevation (ft): 1103
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-1	TOPSOIL	Silty, slightly sandy, clayey, loam grayish-black
1-12	CLAY	Very silty, sandy, pebbly, moderate yellowish-brown, slightly cohesive, crumbly, oxidized (Till)
12-45	SAND	Very clayey, very silty, becomes very clayey and silty lower 20', very fine to medium grained, subangular to rounded, shaley, lignitic, taking some water dirty looking samples
45-75	SILT	Moderately clayey, medium gray with light olive gray laminae, slightly cohesive, slightly plastic, calcareous
75-100	CLAY	Very silty, sandy, pebbly, olive gray, moderately cohesive, plastic, calcareous (Till)

146-054-34DDD
NDSWC 8363

Date Completed:	6/1972	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1096.4	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	160	Aquifer:	Not Yet Entered
Screen Int. (ft.):	67-70	Data Source:	

Completion Info:

Remarks: Well plugged by SWC drill rig on, 9/28/1994.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Silty, clay loam, grayish-black
1-9	CLAY	Very silty, sandy, pebbly, dusky yellow, slightly cohesive, slightly plastic, oxidized (Till)
9-68	CLAY	Silty, moderately sandy, slightly gravelly, more gravelly lower 20', pebbly, olive gray, slightly cohesive, crumbly, calcareous (Till)
68-82	SAND	Slighty, clayey, silty, very fine to medium grained, subangular to rounded, moderately well sorted, shaley dirty-looking samples
82-122	CLAY	Very silty, sandy, olive gray, cohesive, crumbly, highly calcareous
122-138	SILT	Clayey, olive gray, moderately cohesive, slightly plastic, highly calcareous
138-160	CLAY	Silty, moderately sandy, pebbly, a few cobbles, slightly gravelly, olive gray, cohesive, moderately plastic, calcareous (Till)

146-054-35AAA
NDSWC 4300

Date Completed: 11/10/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1080
 Depth Drilled (ft): 260
 Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Fine sandy loam, black
1-3	SILT	Clayey to sandy, nearly white, soft, slightly cohesive, very limey
3-10	SAND	Fine to coarse, gravelly, assorted, subangular and subrounded, iron-stained, mostly carbonates and granitics, oxidized, dry; 3 bags of mud
10-21	SILT	Clayey and sandy, interbedded, laminated, lenticular, occasional coarse sand grains, dusky yellow to light olive gray, soft, crumbly
21-31	CLAY	Silty, olive gray, soft, cohesive, plastic, slightly sticky, smooth, tight
31-61	SILT	Sandy (very fine), light olive to olive gray, soft, chunky, crumbly, calcareous
61-93	SILT	Clayey, light olive to olive gray, soft, cohesive, moderately plastic, smooth, light weight
93-129	SILT	Sandy (very fine to fine), light olive gray, soft, moderately cohesive, non-plastic, chunky, crumbly, laminated
129-137	CLAY	Very silty to sandy with pebbles, olive gray, moderately soft, cohesive, stiff, pliable (Till)
137-141	SAND	Medium, dark gray, loose, sorted, subrounded, quartzose with shale, carbonates and a little lignite
141-147	SILT	Sandy (very fine to fine) light olive gray, soft, crumbly
147-158	SAND	Very fine to medium, moderately sorted, generally subrounded, dark gray, quartzose and shaley
158-171	CLAY	Silty to sandy with pebbles, olive gray, moderately soft, cohesive, stiff, fairly light, occasional rock (Till)

171-173	ROCK	Limestone
173-184	SAND	Medium to coarse with gravel and cobbles, assorted, subrounded, mostly carbonates and granitics
184-197	CLAY	Silty with sand grains and pebbles, dark olive gray, slightly hard, very cohesive and tightly compacted, stiff and tough (till)
197-205	SAND	Medium, dark gray, loose, sorted, subrounded, quartzose, lignitic, clean
205-221	SAND	Very fine to medium, silty, dark gray, poorly sorted, dirty
221-237	CLAY	Silty with sand grains and pebbles, occasional rock, olive to dark olive gray, moderately soft to slightly hard, cohesive, stiff, tightly compacted (Till)
237-245	SHALE	Silty, nearly black, moderately hard, very smooth, slippery and oily, very tight (Carlyle)
245-249	SANDSTONE	Very fine grained, very light gray, indurated, quartzose but moderately calcareous
249-260	SHALE	Silty to sandy, very dark brown, slightly hard, brittle, very oily

146-055-04CCC
NDSWC 4288

Date Completed: 10/28/1970 Purpose: Test Hole
L.S. Elevation (ft): 1210
Depth Drilled (ft): 100
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Pebbly silt loam, black
1-4	SILT	Clayey to sandy, yellowish gray, soft, dry, very slightly cohesive, leached
4-14	CLAY	Silty with sand grains and occasional pebbles, dusky yellow, soft, cohesive, slightly plastic, oxidized, laminated (Till)
14-74	CLAY	Very silty to very sandy with occasional pebbles and cobbles, also blocks or lenses of silt, clayey sand, shaley sand and gravel, lenticular, poorly stratified (Till)
74-100	SHALE	Silty, dark brownish gray to black, moderately hard, brittle, smooth, oily, ispeckled, very tight

146-055-11AAD
USAF

Date Completed:	1/1965	Purpose:	Domestic Well
L.S. Elevation (ft):	1120	Well Type:	0 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-055-19CBC
KEN SWARTZ

Date Completed:	0/0	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	0 in. -
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-0	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-055-20DCC
NDSWC 4291

Date Completed: 10/29/1970 Purpose: Test Hole
L.S. Elevation (ft): 1225
Depth Drilled (ft): 80

Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Pebbly silt loam, black
1-3	SILT	Clayey to sandy with coarse sand grains and pebbles, yellowish gray, dry, crumbly, leached (Till)
3-6	CLAY	Silty to sandy with pebbles, dusky yellow, soft, cohesive, slightly plastic, oxidized (Till)
6-11	SAND	Medium and coarse with some gravel, moderately sorted, subangular and subrounded, shaley, heavily iron-stained
11-20	CLAY	Silty to sandy with pebbles, moderately olive brown, moderately soft, cohesive, chunky, tightly compacted, oxidized, (Till)
20-56	CLAY	Very silty and sandy with pebbles and numerous thin sand and gravel lenses, olive gray, soft to moderately soft, moderately cohesive to slightly crumbly rocky
56-68	SILTSTONE	Very fine shaley sandstone, variegated medium and dark browns, soft, moderately cohesive, sticky, oily, smelly, very light weight (floury) (Carlyle)
68-80	SHALE	Silty, medium dark gray, moderately hard, very stiff and brittle, smooth, speckled, non-calcareous

146-055-23BBA
NDSWC 4292

Date Completed:	10/29/1970	Purpose:	Observation Well - Plugged
L.S. Elevation (ft):	1140	Well Type:	1.25 in. - ABS
Depth Drilled (ft):	100	Aquifer:	Undefined
Screen Int. (ft.):	22-25	Data Source:	

Completion Info:

Remarks: Well was destroyed, reported on 10/12/94.

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Very fine silty sand loam, black
1-4	SILT	Clayey to sandy, yellowish gray, very soft, dry, loose to very slightly cohesive, leached, washed till
4-9	CLAY	Very silty to sandy with occasional coarse sand grains, dusky yellow, soft, slightly to moderately cohesive, oxidized (Till)
9-14	SAND	Medium to coarse, dusky yellow, loose sorted, subrounded, shaley, oxidized
14-20	TILL	As above, dusky yellow to moderately olive brown, very silty, oxidized, moderately soft
20-26	SAND	Medium and coarse with gravel-sized detrital lignite, gray, well sorted and uniform, subrounded, mostly quartz
26-33	SAND	Fine, gray, well sorted, subrounded
33-47	SILT	Sandy (very fine), light olive gray, moderately soft, chunky, crumbly, calcareous
47-52	SAND	Fine, gray, well sorted, subrounded
52-77	SILT	Clayey to sandy (very fine) moderately soft, olive gray, chunky, cohesive but crumbles under pressure, laminated, compacted; easy drilling
77-100	SHALE	Silty, medium dark gray, moderately hard, massive, smooth, very tight, non-calcareous

146-055-27AAA
NDSWC 4014

Date Completed: 06/26/1970 Purpose: Test Hole
L.S. Elevation (ft): 1140
Depth Drilled (ft): 80
Data Source:

Completion Info:

Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-3	ROADFILL	
3-12	CLAY	Silty to sandy with pebbles and sand lenses, yellowish gray to reddish brown, soft to moderately soft, moderately cohesive, slightly plastic, oxidized, iron stained (Till)
12-18	CLAY	Silty to sandy with numerous limestone and shale pebbles, olive gray, moderately soft, moderately cohesive, chunky, crumbles under pressure, compacted (Till)
18-28	SAND	Medium, varies from fine to coarse but fairly uniform and sorted, generally subrounded, light olive gray, mostly quartz
28-61	CLAY	Silty to sandy with pebbles and occasional cobbles and gravelly streaks, olive gray, moderately soft to shale hard, chunky, compacted (Till)
61-80	SHALE	Silty, nearly black, smooth, slippery, slightly hard, brittle, tight, non-calcareous

146-055-31BCD

B. JULIUSON

Date Completed:	1/1920	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	36 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-60	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-055-31CCB2

I. RICTER

Date Completed:	1/1945	Purpose:	Domestic Well
L.S. Elevation (ft):	N/A	Well Type:	24 in. - Unknown
Depth Drilled (ft):	0	Aquifer:	Not Yet Entered
Screen Int. (ft.):	0-45	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
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146-055-34AAA
NDSWC 4294

Date Completed: 10/30/1970 Purpose: Test Hole
 L.S. Elevation (ft): 1150
 Depth Drilled (ft): 100
 Data Source:
 Completion Info:
 Remarks:

Lithologic Log

Depth (ft)	Unit	Description
0-1	TOPSOIL	Fine sandy silt loam, black
1-6	SAND	Medium to very coarse with fine gravel, poorly sorted, generally subrounded, mostly granitics and carbonates, heavily iron-stained, loose, dry
6-11	SILT	Clayey to sandy with lenses of sand and gravel, dusky yellow to reddish brown, soft, crumbly to slightly cohesive (washed or stratified till?)
11-21	SILT	Clayey, olive gray, moderately soft, slightly brittle, smooth, tightly compacted
21-23	SAND	Medium, dark gray, sorted and uniform, subrounded, quartzose with a little lignite, loose
23-32	SAND	Coarse and very coarse with some gravel, medium sorted, generally subrounded, predominantly quartz and granitic derivatives with carbonates and some shale, loose; taking a little water, grayish tan color
32-43	SILT	Clayey, light olive gray, moderately soft, moderately cohesive, slightly brittle, smooth, compacted, laminated
43-49	SAND	Medium to coarse, well-sorted and uniform, clean, subrounded, mostly quartz and carbonates
49-54	CLAY	Silty, olive gray, smooth, tight, moderately soft, cohesive, slightly plastic
54-58	SAND	Fine to medium, gray, loose, sorted, subrounded, quartzose with a little lignite
58-63	SAND	Very coarse with gravel and possible cobbles, assorted, subrounded, mostly granitics and carbonates, some shale, loose
63-72	CLAY	Silty and sandy with pebbles and cobbles, olive gray, moderately soft, stiff, tough (Till)
72-100	SHALE	Silty, medium dark gray, smooth, moderately hard, brittle, massive, very tight, gypsum bed from 90' to 92'

146-055-34DDD
SWC

Date Completed:	10/1970	Purpose:	Observation Well
L.S. Elevation (ft):	1150	Well Type:	1.25 in. - PVC
Depth Drilled (ft):	120	Aquifer:	Not Yet Entered
Screen Int. (ft.):	48-51	Data Source:	

Completion Info:

Remarks:

Lithologic Log

<u>Depth (ft)</u>	<u>Unit</u>	<u>Description</u>
0-2	TOPSOIL	Sandy loam, black
2-8	SAND	Medium and coarse, well-sorted and uniform, subrounded, yellowish gray and reddish brown, loose, washed (beach sand)
8-16	SILT	Slightly clayey to sandy with occasional pebbles, dusky yellow, soft, slightly cohesive, laminated, oxidized (stratified till)
16-25	SILT	Slightly clayey, light olive gray, soft, compacted but crumbly, laminated
25-41	SAND	Medium to coarse, gray, well-sorted and uniform, subrounded, clean, mostly quartz with some carbonates and shale, little bit of lignite; taking some water
41-59	SAND	Fine and medium, possibly slightly silty, gray, quartzose, uniform
59-99	CLAY	Very silty and sandy with pebbles and lenses or blocks of chunky clayey silt and sandy silt, occasional rocks, olive gray, moderately soft to slightly hard, tough (Till)
99-106	SHALE	Silty, medium dark gray, smooth, massive, moderately hard, non-calcareous (Carlyle)
106-116	SILTSTONE	Clayey, very dark brown, soft to moderately soft, highly carbonaceous, micaceous
116-120	SHALE	Nearly black, massive, hard, smooth, very tight

APPENDIX II

Historical Water Levels from Wells Within the Study Area

145-053-04CCC
Page Aquifer

MP Elev (msl,ft)=1,102.00
SI (ft.)=67-70

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	7.90	1094.10	11/29/76	9.29	1092.71
12/13/73	7.61	1094.39	03/01/77	9.57	1092.43
01/08/74	7.91	1094.09	05/19/77	8.55	1093.45
02/12/74	8.24	1093.76	05/31/77	8.50	1093.50
03/27/74	8.50	1093.50	06/03/77	8.53	1093.47
04/16/74	8.32	1093.68	06/21/77	8.60	1093.40
06/04/74	5.55	1096.45	07/11/77	8.84	1093.16
09/04/74	6.93	1095.07	08/29/77	9.49	1092.51
12/05/74	7.04	1094.96	09/22/77	9.80	1092.20
			11/29/77	8.35	1093.65
03/18/75	7.77	1094.23	03/01/78	8.75	1093.25
06/04/75	5.19	1096.81	03/15/78	9.17	1092.83
09/10/75	6.98	1095.02	06/09/78	6.70	1095.30
12/02/75	7.66	1094.34	06/14/78	7.15	1094.85
			09/08/78	8.27	1093.73
02/27/76	8.05	1093.95	10/03/78	8.67	1093.33
06/01/76	7.46	1094.54	11/22/78	5.90	1096.10
09/13/76	9.07	1092.93			

145-053-05BBB
Page Aquifer

MP Elev (msl,ft)=1,096.00
SI (ft.)=42-45

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	7.70	1088.30			

145-053-05CBC
Page Aquifer

MP Elev (msl,ft)=1,100.00
SI (ft.)=52-55

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	7.10	1092.90			

145-053-08CBC
Page Aquifer

MP Elev (msl,ft)=1,102.00
SI (ft.)=37-40

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	9.60	1092.40			

145-053-16BBB
Page Aquifer

MP Elev (msl,ft)=1,097.00
SI (ft.)=32-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	9.40	1087.60	06/21/77	10.66	1086.34
01/08/74	9.65	1087.35	07/11/77	11.10	1085.90
02/12/74	10.43	1086.57	08/29/77	12.36	1084.64
03/27/74	10.10	1086.90	09/22/77	12.83	1084.17
04/16/74	8.88	1088.12	11/29/77	10.66	1086.34
06/04/74	6.32	1090.68	03/01/78	10.80	1086.20
09/04/74	8.95	1088.05	03/15/78	11.00	1086.00
12/05/74	8.85	1088.15	06/09/78	7.95	1089.05
03/18/75	9.48	1087.52	06/14/78	8.57	1088.43
06/04/75	6.44	1090.56	09/08/78	10.41	1086.59
09/10/75	9.39	1087.61	10/03/78	11.02	1085.98
12/02/75	9.87	1087.13	11/22/78	10.66	1086.34
02/27/76	10.35	1086.65	12/12/78	11.13	1085.87
06/01/76	9.18	1087.82	04/12/79	10.48	1086.52
09/13/76	11.65	1085.35	09/19/79	8.58	1088.42
11/29/76	11.99	1085.01	12/04/79	9.15	1087.85
03/01/77	11.95	1085.05	04/15/80	8.99	1088.01
05/19/77	10.76	1086.24	05/14/80	8.74	1088.26
05/31/77	10.56	1086.44	06/10/80	9.28	1087.72
06/03/77	10.68	1086.32	08/31/99	6.90	1090.10

145-053-16BBB2
Page Aquifer

MP Elev (msl,ft)=1,096.28
SI (ft.)=30-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/08/99	7.10	1089.18	09/05/02	5.94	1090.34
07/27/00	6.22	1090.06	07/29/03	5.32	1090.96
09/25/01	7.55	1088.73			

145-054-04AAA
Page Aquifer

MP Elev (msl,ft)=1,099.05
SI (ft.)=87-90

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	10.89	1088.46	12/18/80	11.62	1087.43
06/21/77	11.38	1087.97	04/15/81	11.87	1087.18
07/11/77	11.58	1087.47	07/14/81	11.69	1087.36
09/22/77	12.70	1086.35	10/08/81	12.73	1086.32
03/15/78	11.50	1087.55	12/03/81	11.82	1087.23
06/14/78	8.68	1090.37	12/01/82	9.77	1089.28
10/03/78	11.00	1088.05	12/07/83	10.46	1088.59
12/12/78	10.92	1088.13			
04/12/79	10.74	1088.31			

09/19/79	8.89	1090.16	12/05/84	10.88	1088.17
12/04/79	9.05	1090.00			
			12/03/87	7.91	1091.14
04/15/80	9.04	1090.01			
04/16/80	9.04	1090.01	04/13/92	11.36	1087.69
07/09/80	11.00	1088.05			
10/29/80	11.58	1087.47	07/29/03	6.32	1092.73

145-054-09BBB
Page Aquifer

MP Elev (msl,ft)=1,107.20
SI (ft.)=38-41

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/27/70	4.69	1102.51	09/22/77	12.90	1094.30
07/10/70	6.10	1101.10	11/30/77	11.98	1095.22
08/05/70	8.41	1098.79			
09/03/70	10.12	1097.08	03/15/78	12.48	1094.72
10/01/70	10.76	1096.44	06/14/78	7.49	1099.71
11/04/70	11.03	1096.17	10/03/78	12.73	1094.47
12/03/70	10.46	1096.74	11/22/78	12.95	1094.25
			12/12/78	13.40	1093.80
02/17/71	11.04	1096.16			
03/31/71	11.54	1095.66	04/12/79	13.56	1093.64
04/14/71	11.17	1096.03	09/19/79	11.54	1095.66
05/05/71	10.54	1096.66	12/04/79	14.71	1092.49
06/04/71	8.94	1098.26			
07/22/71	9.93	1097.27	04/15/80	12.79	1094.41
10/06/71	12.35	1094.85	07/09/80	12.92	1094.28
			10/29/80	13.63	1093.57
04/20/72	11.96	1095.24	12/18/80	13.43	1093.77
06/09/72	10.07	1097.13			
10/26/72	11.82	1095.38	04/15/81	13.30	1093.40
12/01/72	11.97	1095.23	07/14/81	12.89	1094.31
			10/08/81	13.48	1093.72
12/07/73	12.17	1095.03	12/03/81	12.81	1094.39
12/05/74	10.53	1096.67	12/01/82	7.40	1099.80
12/02/75	11.93	1095.27	12/07/83	10.16	1097.04
11/29/76	14.02	1093.18	12/05/84	12.32	1094.88
06/03/77	13.10	1094.10	12/03/87	7.85	1099.35
06/21/77	12.96	1094.24			
07/11/77	12.71	1094.49	04/13/92	13.53	1093.67

145-054-09CCC
Page Aquifer

MP Elev (msl,ft)=1,115.30
SI (ft.)=47-50

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	13.35	1101.45			
06/21/77	13.99	1100.81	04/15/81	13.76	1101.04

07/11/77	14.28	1100.52	07/14/81	13.30	1101.50
09/22/77	14.63	1100.17	10/08/81	13.81	1100.99
			12/03/81	13.50	1101.30
03/15/78	14.28	1100.52			
06/14/78	13.31	1101.49	12/01/82	12.30	1102.50
10/03/78	14.20	1100.60			
12/12/78	14.20	1100.60	12/07/83	12.49	1102.31
04/12/79	13.85	1100.95	12/05/84	12.98	1101.82
09/19/79	13.72	1101.08			
12/04/79	13.59	1101.21	12/03/87	12.39	1102.41
04/15/80	13.07	1101.73	04/13/92	13.31	1101.49
07/09/80	13.80	1101.00			
10/29/80	13.57	1101.23	09/23/99	13.06	1102.24
12/18/80	13.73	1101.07			

145-054-09CCC2
Page Aquifer

MP Elev (msl,ft)=1,112.42
SI (ft.)=45-50

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/08/99	12.75	1099.67			
			09/05/02	12.54	1099.88
07/27/00	11.62	1100.80			
			07/29/03	11.40	1101.02
09/25/01	12.27	1100.15			

145-054-10DDD
Page Aquifer

MP Elev (msl,ft)=1,120.20
SI (ft.)=17-20

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
05/19/77	9.70	1110.50	12/18/80	9.70	1110.50
06/03/77	9.44	1110.76			
06/21/77	9.62	1110.58	04/15/81	10.42	1109.78
07/11/77	10.15	1110.05	07/14/81	9.97	1110.23
09/22/77	10.92	1109.28	10/08/81	9.70	1110.50
			12/03/81	10.96	1109.24
03/15/78	10.39	1109.81			
06/14/78	7.50	1112.70	12/01/82	6.92	1113.28
10/03/78	8.43	1111.77			
12/12/78	9.16	1111.04	12/07/83	8.51	1111.69
04/12/79	9.47	1110.73	12/05/84	8.73	1111.47
09/19/79	8.59	1111.61			
12/04/79	8.25	1111.95	12/03/87	7.10	1113.10
04/15/80	9.32	1110.88	04/13/92	10.76	1109.44
07/09/80	9.50	1110.70			
10/29/80	9.54	1110.66	11/13/96	8.49	1111.71

145-054-10DDD2
Page Aquifer

MP Elev (msl,ft)=1,119.05
SI (ft.)=15-20

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/08/99	7.52	1111.53			
07/27/00	6.45	1112.60	09/05/02	7.96	1111.09
09/25/01	8.47	1110.58	07/29/03	6.06	1112.99

145-054-13DDD2
Page Aquifer

MP Elev (msl,ft)=1,117.67
SI (ft.)=62-68

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/21/77	14.25	1103.42	10/29/80	14.42	1103.25
07/11/77	14.30	1103.37	12/18/80	14.47	1103.20
09/22/77	14.98	1102.69			
			07/14/81	14.73	1102.94
03/15/78	14.76	1102.91	10/08/81	15.06	1102.61
06/14/78	13.53	1104.14	12/03/81	14.84	1102.83
10/03/78	14.34	1103.33			
12/12/78	14.60	1103.07	12/01/82	13.37	1104.30
04/12/79	14.95	1102.72	12/07/83	12.12	1105.55
09/19/79	12.93	1104.74			
12/04/79	13.44	1104.23	12/05/84	13.13	1104.54
04/15/80	13.87	1103.80	04/13/92	14.22	1103.45
07/09/80	14.08	1103.59			

145-054-22AAA
Page Aquifer

MP Elev (msl,ft)=1,151.10
SI (ft.)=78-81

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
05/19/77	25.83	1125.59	04/15/81	26.04	1125.38
06/03/77	25.45	1125.97	07/14/81	26.22	1125.20
06/21/77	25.77	1125.65	10/08/81	26.31	1125.11
07/11/77	25.69	1125.73	12/03/81	26.49	1124.93
09/22/77	26.15	1125.27			
			12/01/82	25.38	1126.04
03/15/78	26.23	1125.19			
06/14/78	25.12	1126.30	12/07/83	24.91	1126.51
10/03/78	25.27	1126.15			
12/12/78	25.57	1125.85	12/05/84	25.16	1126.26
04/12/79	25.85	1125.57	12/03/87	23.65	1127.77
09/19/79	24.25	1127.17			
12/04/79	24.36	1127.06	04/13/92	27.35	1124.07
04/15/80	25.22	1126.20	11/13/96	22.49	1128.93
07/09/80	25.24	1126.18			
10/29/80	25.56	1125.86	09/01/99	20.37	1131.05
12/18/80	25.76	1125.66			
			07/29/03	19.91	1131.51

145-054-27CDC
Newcastle Formation Aquifer

MP Elev (msl,ft)=1,145.50
SI (ft.)=640-660

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/05/70	79.52	1065.98	09/10/75	78.14	1067.36
09/03/70	79.43	1066.07	10/06/75	78.26	1067.24
10/01/70	79.42	1066.08	11/24/75	78.38	1067.12
11/04/70	79.58	1065.92	12/02/75	78.20	1067.30
12/03/70	79.32	1066.18			
			02/11/76	78.05	1067.45
04/22/71	79.30	1066.20	03/16/76	78.00	1067.50
05/05/71	79.22	1066.28	05/07/76	78.21	1067.29
06/04/71	79.31	1066.19	06/03/76	78.14	1067.36
07/22/71	79.39	1066.11	07/06/76	78.64	1066.86
07/25/71	79.40	1066.10	08/02/76	78.40	1067.10
07/30/71	79.41	1066.09	09/07/76	78.27	1067.23
08/05/71	79.50	1066.00	10/04/76	77.60	1067.90
08/10/71	79.43	1066.07	11/02/76	78.60	1066.90
08/15/71	79.50	1066.00	11/29/76	78.45	1067.05
08/20/71	79.39	1066.11			
08/25/71	79.21	1066.29	01/03/77	78.30	1067.20
08/30/71	79.18	1066.32	01/31/77	77.61	1067.89
09/01/71	79.00	1066.50	03/01/77	78.31	1067.19
09/05/71	78.95	1066.55	04/11/77	78.20	1067.30
10/06/71	79.15	1066.35	05/02/77	78.29	1067.21
10/10/71	79.16	1066.34	05/31/77	78.06	1067.44
10/15/71	79.30	1066.20	06/30/77	78.10	1067.40
10/20/71	79.24	1066.26	08/02/77	78.37	1067.13
10/25/71	79.06	1066.44	08/30/77	78.32	1067.18
10/30/71	79.17	1066.33	10/04/77	78.29	1067.21
11/05/71	78.88	1066.62	10/31/77	77.55	1067.95
11/10/71	79.10	1066.40	11/30/77	77.87	1067.63
11/15/71	79.01	1066.49			
11/20/71	78.77	1066.73	01/04/78	78.06	1067.44
11/22/71	79.20	1066.30	02/27/78	77.99	1067.51
12/01/71	79.35	1066.15	03/31/78	77.74	1067.76
			05/01/78	78.19	1067.31
03/08/72	78.95	1066.55	06/09/78	78.10	1067.40
04/20/72	78.73	1066.77	07/06/78	78.23	1067.27
06/09/72	78.77	1066.73	08/01/78	78.27	1067.23
10/27/72	77.46	1068.04	09/08/78	78.27	1067.23
11/30/72	78.46	1067.04	09/21/78	78.48	1067.02
			10/03/78	75.57	1069.93
08/07/73	79.18	1066.32	10/30/78	68.40	1077.10
08/27/73	78.42	1067.08	11/22/78	66.17	1079.33
10/04/73	78.27	1067.23			
12/07/73	78.13	1067.37	01/03/79	65.91	1079.59
			02/09/79	66.85	1078.65
01/08/74	78.12	1067.38	03/07/79	67.85	1077.65
03/27/74	78.07	1067.43	04/03/79	68.66	1076.84
05/08/74	77.95	1067.55	06/21/79	63.41	1082.09
06/04/74	77.79	1067.71	07/30/79	64.33	1081.17
07/09/74	78.04	1067.46	08/28/79	62.72	1082.78
08/05/74	78.24	1067.26	09/25/79	60.50	1085.00
09/04/74	78.24	1067.26	10/16/79	59.76	1085.74
11/04/74	78.16	1067.34	11/15/79	58.75	1086.75
			11/27/79	53.51	1091.99
01/31/75	78.29	1067.21			

03/06/75	78.04	1067.46	03/03/80	56.53	1088.97
04/13/75	77.94	1067.56	04/14/80	56.68	1088.82
05/05/75	77.82	1067.68	04/29/80	56.28	1089.22
06/04/75	77.94	1067.56	06/03/80	56.30	1089.20
07/22/75	78.05	1067.45	06/24/80	56.47	1089.03
08/08/75	77.97	1067.53	07/29/80	57.12	1088.38

145-054-27CDC
Newcastle Formation Aquifer

MP Elev (msl,ft)=1,145.50
SI (ft.)=640-660

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/25/80	58.65	1086.85	08/06/97	77.18	1068.32
10/28/80	59.98	1085.52	10/16/97	77.38	1068.12
12/02/80	60.28	1085.22	12/18/97	77.05	1068.45
01/06/81	60.62	1084.88	04/28/98	76.95	1068.55
02/03/81	61.28	1084.22	06/17/98	76.64	1068.86
03/10/81	63.15	1082.35	09/16/98	77.28	1068.22
04/23/81	64.76	1080.74	10/22/98	79.37	1066.13
06/12/81	65.26	1080.24	11/24/98	78.57	1066.93
07/06/81	76.90	1068.60			
08/13/81	70.95	1074.55	05/12/99	76.07	1069.43
09/16/81	70.87	1074.63	07/11/99	76.30	1069.20
10/20/81	73.02	1072.48	07/20/99	76.14	1069.36
12/01/81	73.22	1072.28	08/10/99	76.67	1068.83
			10/05/99	76.77	1068.73
03/15/82	74.43	1071.07	11/17/99	76.75	1068.75
11/29/82	70.22	1075.28	12/02/99	79.31	1066.19
07/26/83	66.38	1079.12	01/14/00	71.40	1074.10
11/30/83	64.57	1080.93	03/22/00	66.59	1078.91
			07/19/00	60.24	1085.26
11/28/84	64.22	1081.28	08/21/00	59.19	1086.31
			10/19/00	59.76	1085.74
12/05/85	63.89	1081.61			
			01/18/01	62.02	1083.48
12/10/86	66.60	1078.90	03/01/01	62.53	1082.97
			04/26/01	64.12	1081.38
11/30/87	77.90	1067.60	07/03/01	62.31	1083.19
			08/16/01	61.78	1083.72
11/28/88	78.02	1067.48	10/09/01	62.65	1082.85
			12/10/01	64.06	1081.44
05/16/89	76.40	1069.10			
11/24/89	67.99	1077.51	01/24/02	65.02	1080.48
			03/04/02	67.20	1078.30
11/07/90	78.10	1067.40	05/07/02	67.42	1078.08
			07/01/02	67.34	1078.16
11/13/91	77.76	1067.74	08/06/02	66.11	1079.39
			10/10/02	66.12	1079.38
04/13/92	76.37	1069.13	11/07/02	66.35	1079.15
11/17/92	77.79	1067.71	12/30/02	65.89	1079.61
11/16/93	77.53	1067.97	01/30/03	67.45	1078.05
			03/12/03	68.12	1077.38
11/21/94	77.46	1068.04	05/06/03	68.75	1076.75
			06/25/03	66.13	1079.37
10/18/95	77.46	1068.04	07/29/03	64.56	1080.94

			08/11/03	64.53	1080.97
05/31/96	70.02	1075.48	10/08/03	64.98	1080.52
08/20/96	69.80	1075.70	11/05/03	66.28	1079.22
10/04/96	77.49	1068.01	12/22/03	65.87	1079.63
05/08/97	77.00	1068.50	03/08/04	67.47	1078.03
06/18/97	77.11	1068.39			

145-054-31AAA2
Page Aquifer

MP Elev (msl,ft)=1,117.60
SI (ft.)=38-44

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
07/11/77	6.28	1111.32	07/09/81	5.54	1112.06
09/22/77	6.50	1111.10	07/14/81	4.03	1113.57
03/15/78	5.72	1111.88	08/11/81	4.90	1112.70
06/14/78	5.40	1112.20	10/08/81	4.65	1112.95
10/03/78	6.04	1111.56	12/03/81	4.33	1113.27
12/12/78	5.93	1111.67	12/01/82	4.00	1113.60
04/12/79	4.28	1113.32	12/07/83	5.92	1111.68
09/19/79	5.41	1112.19	12/05/84	6.55	1111.05
12/04/79	4.86	1112.74	12/03/87	5.22	1112.38
04/15/80	4.38	1113.22	05/16/89	4.95	1112.65
07/09/80	5.98	1111.62	04/13/92	4.54	1113.06
10/29/80	4.51	1113.09			
12/18/80	5.15	1112.45			
04/15/81	4.58	1113.02			

145-055-01DDD
Undefined Aquifer

MP Elev (msl,ft)=1,120.40
SI (ft.)=38-41

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	8.96	1111.44	04/15/81	9.45	1110.95
06/21/77	9.40	1111.00	07/14/81	9.53	1110.87
07/11/77	9.71	1110.69	10/08/81	9.72	1110.68
09/22/77	10.11	1110.29	12/03/81	9.40	1111.00
03/14/78	9.72	1110.68	12/01/82	9.85	1110.55
06/14/78	8.67	1111.73	12/06/83	8.02	1112.38
10/03/78	9.90	1110.50	12/04/84	8.78	1111.62
12/12/78	9.87	1110.53	12/03/87	7.25	1113.15
04/12/79	9.05	1111.35	04/13/92	8.24	1112.16
09/19/79	9.41	1110.99	11/13/96	7.65	1112.75
12/04/79	9.11	1111.29			
04/15/80	8.56	1111.84			
07/09/80	9.58	1110.82			
10/29/80	9.27	1111.13			
12/18/80	9.58	1110.82			

145-055-01DDD2
Undefined Aquifer

MP Elev (msl,ft)=1,120.70
SI (ft.)=36-41

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/08/99	7.65	1113.05	09/05/02	8.03	1112.67
07/27/00	7.10	1113.60	07/29/03	6.73	1113.97
09/25/01	7.27	1113.43			

145-055-07BBB
Undefined Aquifer

MP Elev (msl,ft)=1,257.70
SI (ft.)=48-51

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	14.18	1243.52	07/14/81	14.80	1242.90
06/08/77	14.18	1243.52	10/08/81	14.97	1242.73
06/21/77	14.31	1243.39	12/03/81	14.35	1243.35
07/11/77	13.72	1243.98			
09/22/77	14.57	1243.13	12/01/82	10.76	1246.94
			12/06/83	9.15	1248.55
06/14/78	10.91	1246.79	12/04/84	11.87	1245.83
10/03/78	12.31	1245.39			
12/12/78	13.26	1244.44	12/03/87	9.51	1248.19
			06/14/89	7.27	1250.43
04/12/79	14.00	1243.70			
09/19/79	11.14	1246.56	04/13/92	13.42	1244.28
12/04/79	11.98	1245.72			
			11/13/96	6.71	1250.99
04/15/80	12.66	1245.04			
07/09/80	13.20	1244.50	09/01/99	6.85	1250.85
10/29/80	13.68	1244.02			
12/18/80	14.14	1243.56			

145-055-12BBB
Page Aquifer

MP Elev (msl,ft)=1,127.00
SI (ft.)=38-41

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	13.67	1111.33			
06/21/77	13.63	1111.37	03/15/78	14.20	1110.80
07/11/77	13.66	1111.34	06/14/78	10.77	1114.23
09/22/77	14.55	1110.45			

145-055-13AAA
Page Aquifer

MP Elev (msl,ft)=1,128.70
SI (ft.)=48-51

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/03/77	14.62	1114.08	12/18/80	14.15	1114.55
06/21/77	14.56	1114.14			
07/11/77	14.65	1114.05	04/15/81	14.82	1113.88
09/22/77	15.26	1113.44	07/14/81	14.19	1114.51
			10/08/81	14.83	1113.87
03/15/78	15.00	1113.70	12/03/81	14.64	1114.06
06/14/78	13.26	1115.44			
10/03/78	14.45	1114.25	12/01/82	11.97	1116.73
12/12/78	14.77	1113.93			
			12/06/83	13.04	1115.66
09/19/79	13.53	1115.17			
12/04/79	13.90	1114.80	12/04/84	13.53	1115.17
04/15/80	14.23	1114.47	12/03/87	11.79	1116.91
07/09/80	14.05	1114.65			
10/20/80	14.11	1114.59	04/13/92	14.24	1114.46
10/29/80	14.11	1114.59			

145-055-13AAA2
Page Aquifer

MP Elev (msl,ft)=1,128.92
SI (ft.)=46-51

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/08/99	12.81	1116.11			
			09/05/02	12.63	1116.29
07/27/00	11.47	1117.45			
			07/29/03	9.66	1119.26
09/25/01	12.36	1116.56			

145-055-23CCC
Page Aquifer

MP Elev (msl,ft)=1,137.00
SI (ft.)=28-31

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
06/02/77	13.09	1121.91	12/04/79	10.92	1124.08
06/21/77	12.73	1122.27			
07/11/77	12.88	1122.12	04/15/80	11.83	1123.17
09/22/77	14.10	1120.90	07/09/80	11.09	1123.91
			10/29/80	11.84	1123.16
03/15/78	13.24	1121.76	12/18/80	12.00	1123.00
06/14/78	8.86	1126.14			
10/03/78	12.38	1122.62	04/15/81	12.30	1122.70
12/12/78	13.10	1121.90	07/14/81	12.32	1122.68
			10/08/81	12.14	1122.86
04/12/79	14.30	1120.70	12/03/81	12.96	1122.04
09/19/79	10.21	1124.79			

145-055-27DDD
Page Aquifer

MP Elev (msl,ft)=1,143.00
SI (ft.)=57-63

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/03/70	9.14	1133.86	11/22/78	9.52	1133.48
01/20/71	9.56	1133.44	12/12/78	10.00	1133.00
03/31/71	9.48	1133.52	04/12/79	10.42	1132.58
04/14/71	9.50	1133.50	09/19/79	9.62	1133.38
05/05/71	9.32	1133.68	12/04/79	9.88	1133.12
06/04/71	8.75	1134.25	04/15/80	10.05	1132.95
06/16/71	7.37	1135.63	07/09/80	9.99	1133.01
07/17/71	9.85	1133.15	10/29/80	10.10	1132.90
10/06/71	7.37	1135.63	12/18/80	10.17	1132.83
04/20/72	8.63	1134.37	04/15/81	10.38	1132.62
06/09/72	8.63	1134.37	07/09/81	10.50	1132.50
10/26/72	8.62	1134.38	07/14/81	10.48	1132.52
12/01/72	8.77	1134.23	10/08/81	10.44	1132.56
12/07/73	8.33	1134.67	12/03/81	10.60	1132.40
12/05/74	8.90	1134.10	12/01/82	10.27	1132.73
12/02/75	5.12	1137.88	12/07/83	9.39	1133.61
11/29/76	10.12	1132.88	12/05/84	9.28	1133.72
05/19/77	10.57	1132.43	12/03/87	8.68	1134.32
06/02/77	10.28	1132.72	05/16/89	10.40	1132.60
06/21/77	10.34	1132.66	04/13/92	11.10	1131.90
07/11/77	10.38	1132.62	09/23/99	7.74	1135.26
09/22/77	10.50	1132.50	07/29/03	7.89	1135.11
11/30/77	10.20	1132.80			
03/15/78	10.60	1132.40			
06/14/78	9.60	1133.40			
10/03/78	9.83	1133.17			

146-053-19AAA
Page Aquifer

MP Elev (msl,ft)=1,085.00
SI (ft.)=77-80

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	13.70	1071.30	02/27/76	15.43	1069.57
12/13/73	13.87	1071.13	06/01/76	13.93	1071.07
01/08/74	14.34	1070.66	09/13/76	16.17	1068.83
02/12/74	15.11	1069.89	11/29/76	16.67	1068.33
03/27/74	15.67	1069.33	03/01/77	17.48	1067.52
04/16/74	15.34	1069.66	05/31/77	14.96	1070.04
06/04/74	11.30	1073.70	08/29/77	16.32	1068.68
09/04/74	12.99	1072.01	11/29/77	15.06	1069.94
12/05/74	12.69	1072.31			

03/18/75	14.94	1070.06	03/01/78	16.25	1068.75
06/04/75	11.10	1073.90	06/09/78	13.25	1071.75
09/10/75	13.49	1071.51	09/08/78	14.75	1070.25
12/02/75	14.15	1070.85	11/22/78	15.23	1069.77

146-053-29BBB
Page Aquifer

MP Elev (msl,ft)=1,084.00
SI (ft.)=37-40

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	5.20	1078.80	09/22/77	5.67	1078.33
			11/29/77	4.52	1079.48
12/13/73	4.76	1079.24			
01/08/74	5.20	1078.80	03/01/78	6.07	1077.93
02/12/74	7.72	1076.28	03/15/78	5.72	1078.28
03/27/74	5.28	1078.72	06/09/78	3.76	1080.24
04/16/74	3.60	1080.40	06/14/78	3.92	1080.08
06/04/74	1.26	1082.74	09/08/78	4.94	1079.06
09/04/74	3.80	1080.20	10/03/78	4.90	1079.10
12/05/74	3.87	1080.13	11/22/78	5.38	1078.62
			12/12/78	5.30	1078.70
03/18/75	4.64	1079.36	09/19/79	4.06	1079.94
06/04/75	1.87	1082.13	12/04/79	4.03	1079.97
09/10/75	5.32	1078.68			
12/02/75	5.43	1078.57	04/15/80	4.14	1079.86
			05/14/80	3.75	1080.25
02/27/76	5.52	1078.48	06/10/80	4.10	1079.90
06/01/76	4.71	1079.29	07/09/80	4.82	1079.18
09/13/76	6.98	1077.02	10/29/80	5.42	1078.58
11/29/76	6.79	1077.21	12/18/80	5.48	1078.52
03/01/77	7.29	1076.71	04/14/81	5.82	1078.18
05/19/77	4.82	1079.18	07/14/81	4.89	1079.11
05/31/77	4.90	1079.10	10/08/81	4.71	1079.29
06/07/77	4.68	1079.32	12/03/81	4.10	1079.90
06/21/77	4.76	1079.24			
07/11/77	5.09	1078.91	12/01/82	12.43	1071.57
08/29/77	6.16	1077.84			

146-053-29CBC
Page Aquifer

MP Elev (msl,ft)=1,088.00
SI (ft.)=37-40

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	7.70	-7.70			

146-053-29DAA
Page Aquifer

MP Elev (msl,ft)=1,082.00
SI (ft.)=57-60

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	4.90	-4.90			

146-053-32ABB
Page Aquifer

MP Elev (msl,ft)=1,086.00
SI (ft.)=57-60

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	7.05	-7.05			

146-053-32CBB
Page Aquifer

MP Elev (msl,ft)=1,089.00
SI (ft.)=32-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	6.20	-6.20			

146-053-32DDD
Page Aquifer

MP Elev (msl,ft)=1,095.00
SI (ft.)=57-60

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	15.90	-15.90			

146-053-33BAA
Page Aquifer

MP Elev (msl,ft)=1,056.00
SI (ft.)=37-40

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	4.15	-4.15			

146-053-33BBB1
Page Aquifer

MP Elev (msl,ft)=1,084.97
SI (ft.)=42-45

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	8.65	1075.55	06/14/78	14.99	1069.21
			10/03/78	15.98	1068.22
12/13/73	14.04	1070.16	12/12/78	16.48	1067.72
01/08/74	14.37	1069.83	04/12/79	17.09	1067.11
02/12/74	15.35	1068.85	09/19/79	15.09	1069.11
03/27/74	14.74	1069.46	12/04/79	15.54	1068.66
04/16/74	14.12	1070.08			
06/04/74	12.13	1072.07	04/15/80	15.77	1068.43
09/04/74	13.38	1070.82	05/14/80	15.69	1068.51
12/05/74	10.98	1073.22	06/10/80	16.14	1068.06
			07/09/80	16.58	1067.62
03/18/75	14.03	1070.17	10/29/80	17.17	1067.03
06/04/75	11.50	1072.70	12/18/80	17.30	1066.90
09/10/75	13.38	1070.82			
12/02/75	13.86	1070.34	04/14/81	17.69	1066.51
			07/14/81	17.46	1066.74
02/27/76	14.79	1069.41	10/08/81	18.39	1065.81
06/01/76	14.23	1069.97	12/03/81	17.10	1067.10
09/13/76	15.81	1068.39			
11/29/76	15.91	1068.29	12/01/82	13.73	1070.47
03/01/77	16.48	1067.72	12/07/83	15.71	1068.49
05/19/77	15.90	1068.30			
05/31/77	15.87	1068.33	12/04/84	16.65	1067.55
06/03/77	15.95	1068.25			
06/21/77	16.10	1068.10	12/03/87	15.65	1068.55
07/11/77	16.32	1067.88			
08/29/77	16.57	1067.63	08/01/01	17.08	1067.95
09/22/77	16.93	1067.27			
11/29/77	15.98	1068.22	08/15/02	16.90	1068.13
03/15/78	16.80	1067.40	07/29/03	16.80	1068.23

146-053-33BCC
Page Aquifer

MP Elev (msl,ft)=1,085.00
SI (ft.)=32-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
12/18/72	8.05	-8.05			

146-054-34DDD
Not Yet Entered Aquifer

MP Elev (msl,ft)=1,098.40
SI (ft.)=67.70

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
05/19/77	6.69	1091.71	04/15/80	7.78	1090.62
06/03/77	6.15	1092.25	07/09/80	5.97	1092.43
06/21/77	6.03	1092.37	10/29/80	7.99	1090.41
07/11/77	6.10	1092.30	12/18/80	7.90	1090.50
09/22/77	8.52	1089.88			
			04/15/81	9.14	1089.26
03/15/78	8.68	1089.72	07/14/81	7.02	1091.38
06/14/78	4.87	1093.53	10/08/81	7.74	1090.66
10/03/78	7.00	1091.40	12/03/81	4.83	1093.57
12/12/78	7.70	1090.70			
			12/01/82	3.39	1095.01
04/12/79	8.29	1090.11			
09/19/79	6.58	1091.82	12/07/83	5.06	1093.34
12/04/79	6.70	1091.70			
			04/13/92	6.71	1091.69