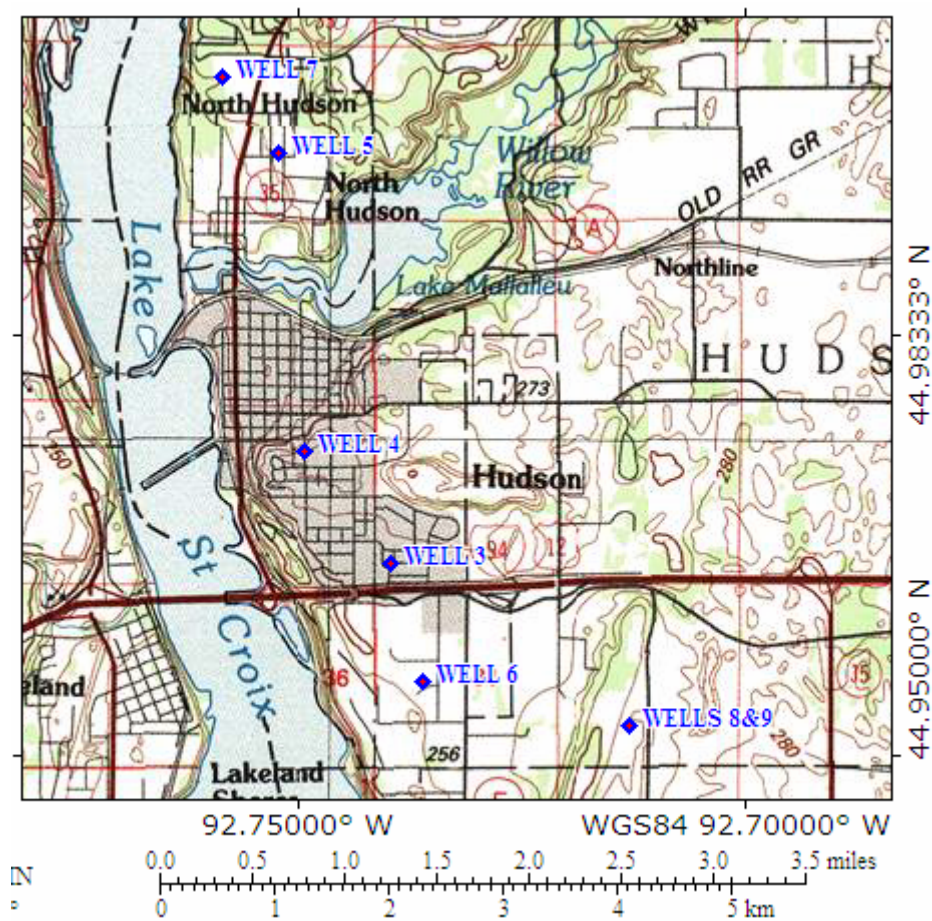


## City of Hudson Pumping Test and Wellhead Protection Plan Reports

### Approximate location of city wells



Wellhead Protection

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***Wellhead Protection Area  
Delineation Report***

---

**Hudson  
Wisconsin**

SEH No. A-HUDSO9403.00

October 1994

ENGINEERING & CONSULTING CORPORATION INC.

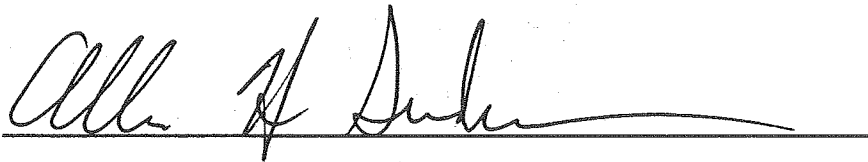


MULTIDISCIPLINED  
SINGLE SOURCE

Wellhead Protection Area  
Delineation Report  
Hudson  
Wisconsin

SEH No. A-HUDSO9403.00

October 1994

A handwritten signature in dark ink, appearing to read "Allen H. Sunderman", written over a horizontal line.

Allen H. Sunderman, C.P.G.  
Project Manager

A handwritten signature in dark ink, appearing to read "Artie Dworak", written over a horizontal line.

Artie Dworak, C.P.G.  
Project Hydrogeologist

**Note:** *This document has been printed on recycled paper.*

Short Elliott Hendrickson Inc.  
3535 Vadnais Center Drive  
St. Paul, Minnesota 55110  
(612) 490-2000

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# **Delineation Report**

## **Wellhead Protection Area**

**Hudson, Wisconsin**

---

### **1.0 Introduction**

The Federal Safe Drinking Water Act (SDWA) Amendments of 1986 established a national program to protect groundwater resources used for public water supplies. The SDWA has mandated states to develop Wellhead Protection (WHP) programs.

In Wisconsin, regulatory authority for groundwater related programs and activities exists in various statewide departments and agencies. The Wisconsin Department of Natural Resources (WDNR) has been designated as the lead State agency for developing a WHP program.

At the heart of a WHP program is the identification and delineation of Wellhead Protection Areas (WHPAs). A WHPA is defined as the surface and subsurface area surrounding a well or well field that supplies a public water system through which contaminants are likely to pass and eventually reach the water well or well field.

Clean drinking water is an important priority for the Hudson community. Short Elliott Hendrickson Inc. (SEH) has been retained to begin the process of protecting Hudson's drinking water supply. This report delineates the WHPAs within the Hudson community.

---

## **2.0 Purpose**

This report identifies and delineates the WHPAs for the municipal water well system for the City of Hudson, and the Village of North Hudson, Wisconsin. The WHPA boundaries are determined based on factors, such as well pumping rates, time of travel (TOT) for groundwater flowing to the well and aquifer characteristics, such as geology, transmissivity, porosity, thickness, gradient, flow direction and vulnerability.

The purpose in identifying the WHPAs is to assist the community in protecting the areas surrounding their wells from contaminants.

Since groundwater protection is a concern and priority for everyone, this report is written with the understanding that people with many different backgrounds will read it. This report is also intended to be utilized for the planning stages of wellhead protection within the WHPAs, and for siting of new municipal wells.

## **3.0 Site Information**

### **3.1 Location**

The City of Hudson, Wisconsin is located in west-central Wisconsin in western St. Croix County. Hudson lies on the eastern bank of the St. Croix River, approximately 18 miles east of St. Paul, Minnesota and 16 miles north of the confluence of the St. Croix and Mississippi Rivers (see Figure 1).

### **3.2 Description**

The land surface in the Hudson area is gently rolling, and rises steeply from an elevation of approximately 680 feet mean sea level (MSL), at the St. Croix River, to approximately 900 feet MSL near the intersection of County Road UU and Carmichael Road.

The study area consist of five active municipal wells and two proposed wells. The five active wells are numbered 3 through 7, and the two proposed wells are numbered 8 and 9. Well numbers 5 and 7 are located in the Village of North Hudson, with the remaining wells located in the City of Hudson. In addition, a deep pumping irrigation well belonging to the Hudson Country Club was included in the list of wells in order to determine if it impacts the Hudson Municipal Water Well system. Figure 2 shows the locations of the wells on the U.S. Geological Survey Map.



---

### **3.3 Soils**

The Soil Survey Report for St. Croix County was reviewed to determine the types and range of soils in the Hudson area. The surface soils of the Hudson area are moderately variable. They consist of loams, silt loams, sandy loams and loamy sands. Permeability rates range from 0.6 to 6.0 inches per hour. Slopes range from 0 to 35 percent. The Soil Survey Map and a soil properties table from the St. Croix County Soil Survey Report can be found in Appendix A.

### **3.4 Site Geology**

The soils and rocks which store and transmit groundwater in Western St. Croix County include, from youngest to oldest; glacial deposits, alluvium and soils of Quaternary age, and rocks of Ordovician, Cambrian and Precambrian age. Table 1 shows the stratigraphy of St. Croix County. Many of the rock units are present in only parts of the County due to glacial erosion or non-deposition.

#### **3.4.1 Quaternary Deposits**

Underlying the Hudson area are unconsolidated glacial deposits of Quaternary age. These glacial sediments were deposited by the Superior Ice Lobe during the Wisconsinian Glacial period, approximately 13,000 years ago. The glacial sediments are approximately 0 to 250 feet thick. Landforms which were produced by this glacial event, include end moraines and pitted outwash (see Figure 3).

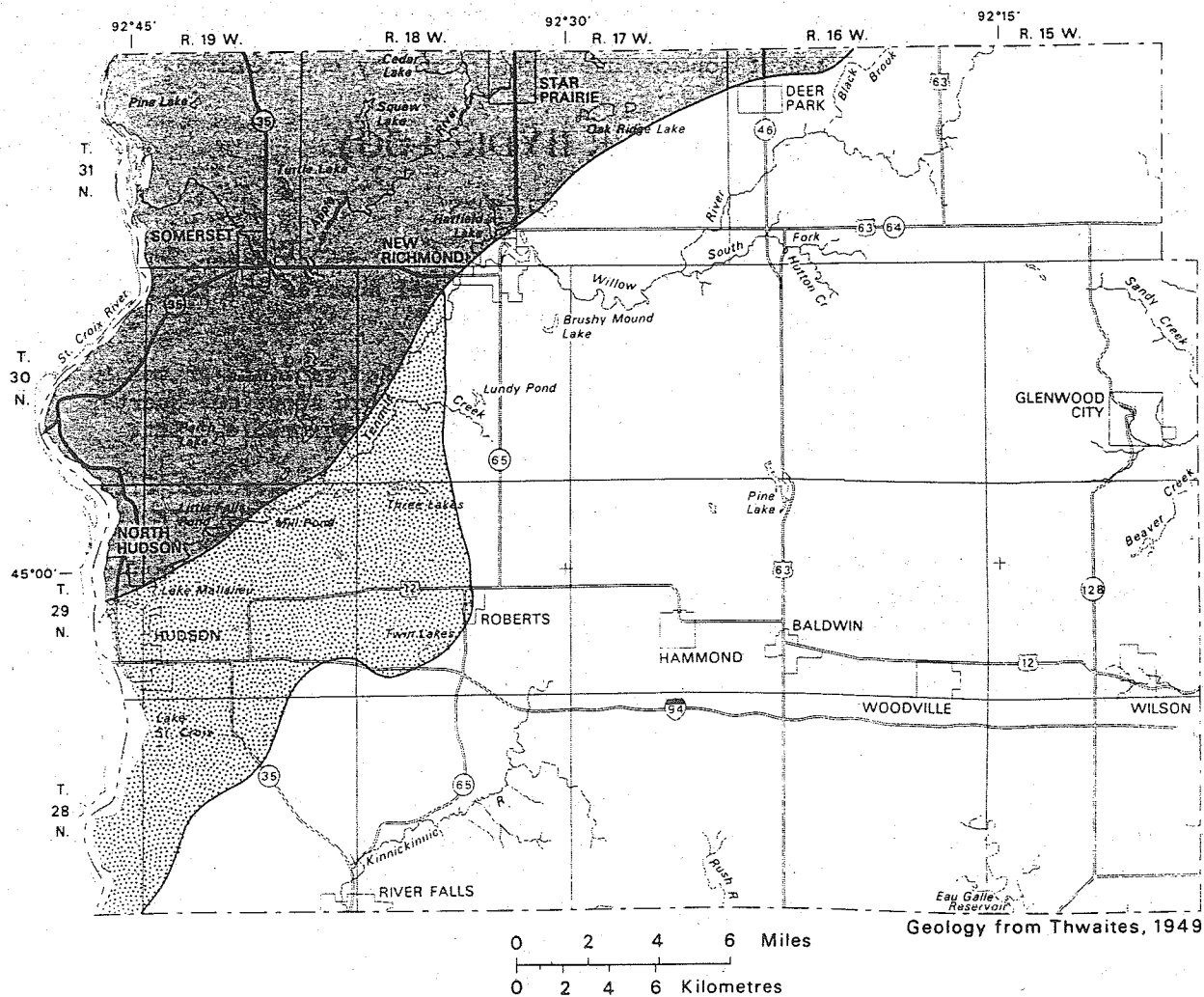
End moraines consist of unsorted glacial material ranging in size from clay to boulders. Typically, an end moraine is a broad ridge with a rolling to hummocky surface. They commonly contain kettles or pits and may also contain lakes or marshes.

An outwash plain is stratified gravel, sand, silt and clay. Pits or kettles commonly develop in the plain from the melting of buried blocks of ice.



Table 1.--Stratigraphy of St. Croix County

System	Rock unit	Predominant lithology
QUATERNARY	Holocene deposits	Unconsolidated stratified deposits ranging in size from clay to boulders and marsh deposits.
	Pleistocene deposits	Unconsolidated stratified deposits ranging in size from clay to boulders and marsh deposits.
ORDOVICIAN	Galena Dolomite, Decorah Formation, and Platteville Formation, undifferentiated	Dolomite and some slightly shaly dolomite, light gray.
	St. Peter Sandstone	Sandstone, dolomitic in places, white to yellow-brown, fine- to medium-grained; shale.
	Prairie du Chien Group	Dolomite, gray; some sandstone and sandy dolomite.
	Trempealeau Formation	Sandstone, fine- to medium-grained; dolomite; some siltstone, light gray.
	Franconia Sandstone	Sandstone, dolomitic, very fine- to medium-grained; siltstone, dolomitic.
CAMBRIAN	Galesville Sandstone	Sandstone, light-gray, fine- to coarse-grained.
	Eau Claire Sandstone	Sandstone, dolomitic, light-gray, fine- to medium-grained; shale and siltstone.
	Mount Simon Sandstone	Sandstone, light-gray, fine- to coarse-grained; some interbedded siltstone.
	Precambrian rocks, undifferentiated	Crystalline and sedimentary rocks.
PRE-CAMBRIAN		



#### EXPLANATION

- |  |                |  |                |
|--|----------------|--|----------------|
|  | End moraine    |  | Pitted outwash |
|  | Ground moraine |  |                |

(Taken From Borman, 1976)



## QUATERNARY GEOLOGY MAP OF ST. CROIX COUNTY, WISCONSIN

DATE:  
8/1/94  
DWG. NAME  
/

FIGURE  
3

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#### **3.4.2 Ordovician Deposits**

Rocks of Ordovician age in St. Croix County include, in ascending order, the Prairie du Chien Group, the St. Peter Sandstone and the Platteville Formation, Decorah Formation and Galena Dolomite. The Ordovician bedrock is the first bedrock encountered in approximately 80 percent of the County.

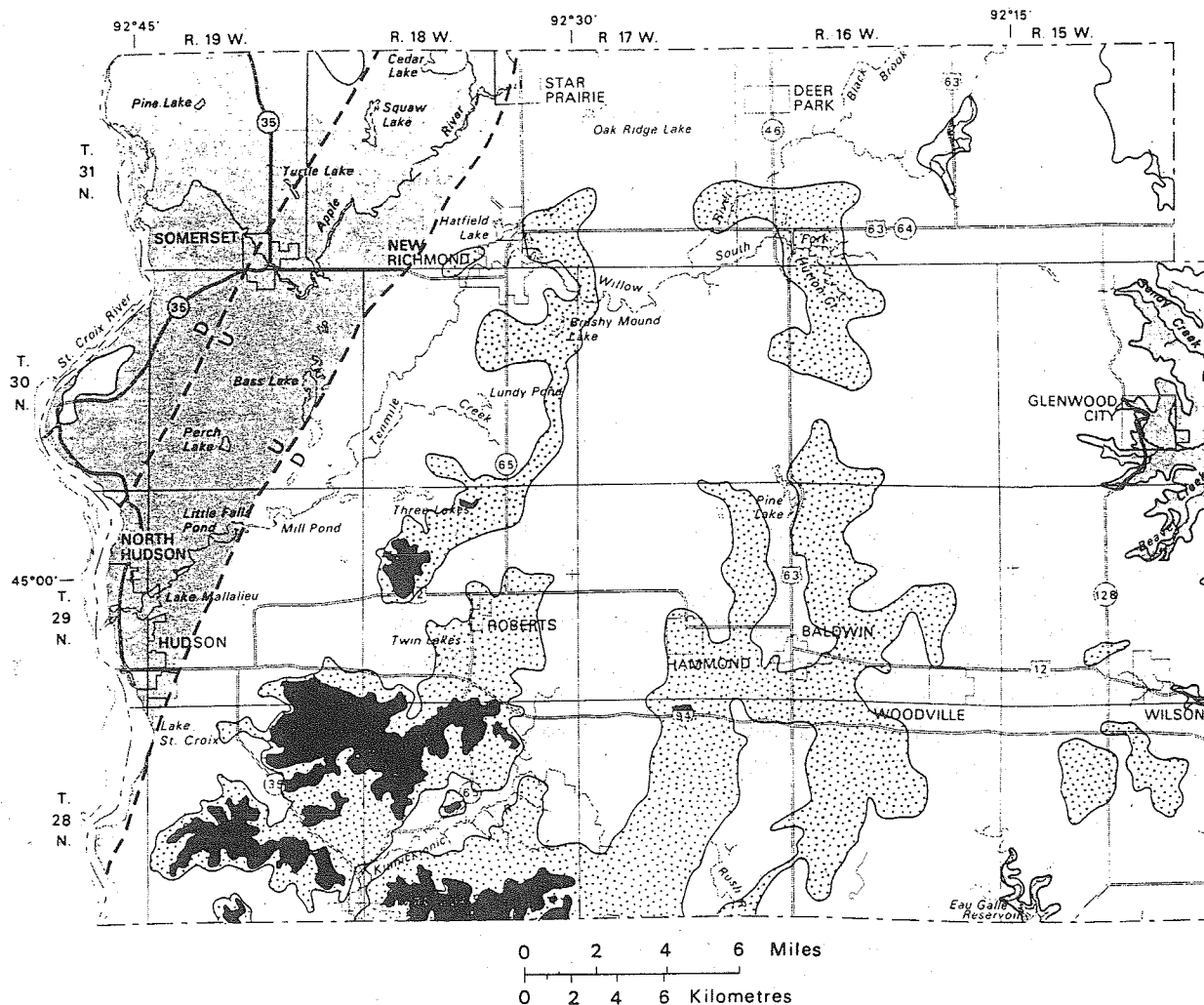
Figure 4 shows the bedrock geology map for St. Croix County. As can be seen from this map, the Prairie du Chien Dolomite is the uppermost bedrock in approximately 50 percent of the County. The Prairie du Chien is found south and east of Hudson and is exposed on the southeastern, downthrown side of a geologic structure known as a horst (see Figure 4). A horst is a block of the earth's crust that has been uplifted along faults relative to the rocks on either side. The St. Peter Sandstone and Galena, Decorah and Platteville Formations are the uppermost bedrock in approximately 30 percent of the County (see Figure 4).

#### **3.4.3 Cambrian Deposits**

Rocks of Cambrian age in St. Croix County include, in ascending order, the Mt. Simon Formation, the Eau Claire Formation, the Galesville and Ironston Formations, the Franconia Formation and the Trempealeau Group. As can be seen in Figure 4, these rocks are the uppermost bedrock in approximately 20 percent of the County.

#### **3.4.4 Precambrian Deposits**

Precambrian age rocks of igneous, metamorphic and sedimentary origin underlie all of St. Croix County. They do not outcrop on the land surface, nor are they found as the first bedrock under glacial drift. Precambrian aged shale and rhyolite were penetrated by Hudson Municipal Water Wells. The presence of Precambrian metamorphic rocks is inferred from their presence elsewhere in the State.



(Taken From Borman, 1976)



# BEDROCK GEOLOGY MAP OF ST. CROIX COUNTY, WISCONSIN

DATE:  
8/1/94  
DWG. NAME  
/

FIGURE  
4

---

### **3.4.5 Geologic Structure**

Well logs were obtained from the Wisconsin Geological Survey and the Minnesota Geological Survey. These logs were reviewed to determine the attitude and structure of the underlying bedrock and bedrock aquifers in the Hudson area, as well as the thickness of the glacial drift. Logs which were reviewed include municipal well logs for Hudson, Wisconsin and Lakeland, Minnesota; domestic water supply well logs and other miscellaneous well logs. The majority of the domestic wells are completed in the glacial drift or just into the first bedrock. Copies of the municipal well logs, which were reviewed for Hudson and Lakeland, can be found in Appendix B.

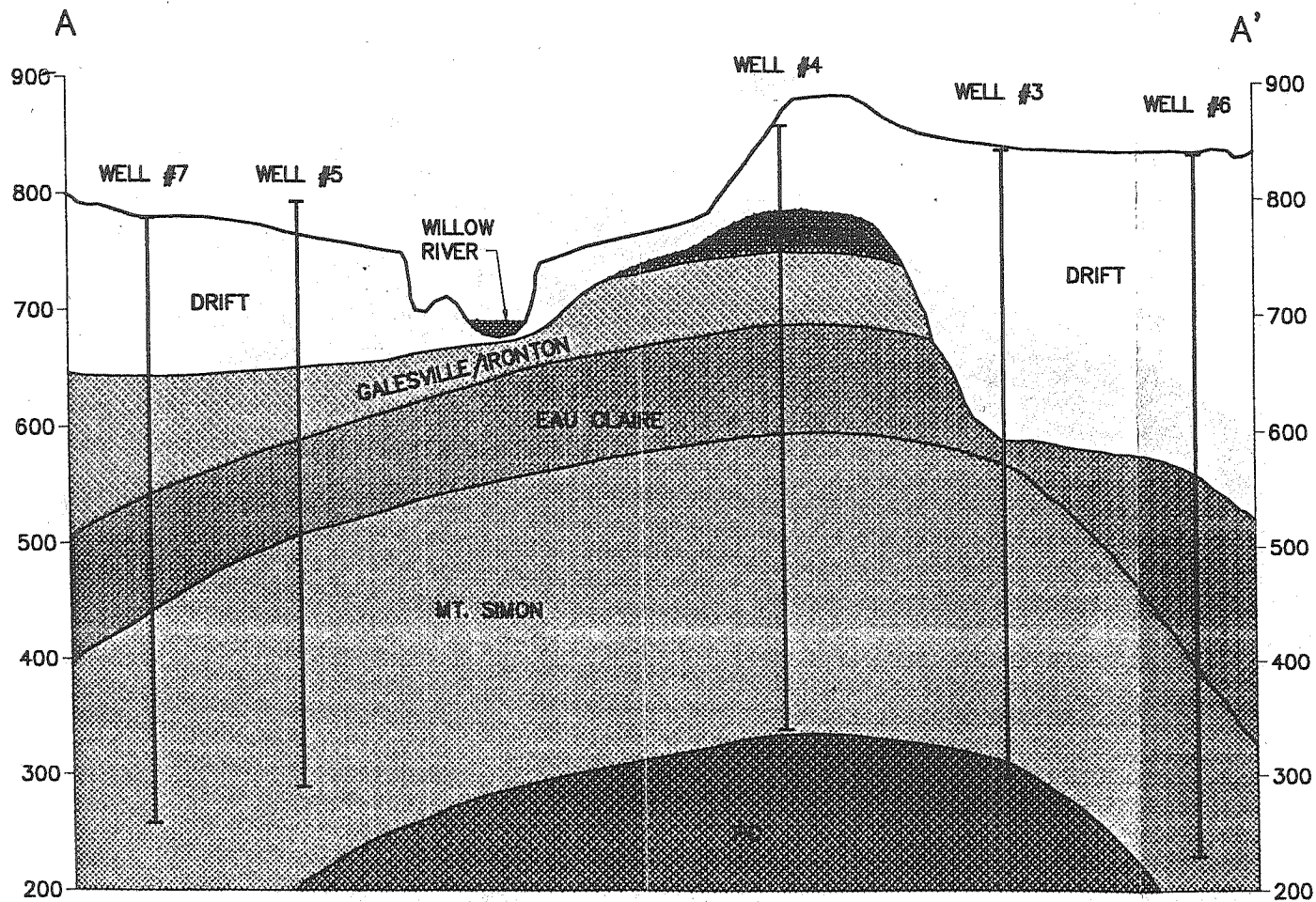
Figures 5 and 6 are geologic cross sections through the Hudson area. They are labeled A-A' and B-B', respectively. Figure 7 shows the locations of the wells and cross sections in the Hudson area. The cross sections reveal that the underlying strata is folded into an anticlinal structure. This anticlinal structure is bound by a horst, as described in Section 3.4.2 above. The same forces that created the faulting and subsequent uplift of the horst may have caused the rock strata to bend or flex downward on the upthrown side of the faults as the rocks were dragged past one another. It is unclear whether or not the anticlinal structure is congruent with the Hudson-Afton anticline (as mapped by Schwartz, 1936; Mossler and Bloomgren, 1990; and others) on the Minnesota side of the St. Croix River.

### **3.5 Site Hydrogeology**

All of the potable water used in and around the Town of Hudson is derived from two principal aquifers; the sand and gravel aquifer of Quaternary age and the sandstone aquifer of Cambrian age.

#### **3.5.1 Sand and Gravel Aquifer**

The sand and gravel aquifer consists of saturated unconsolidated sand and gravel in glacial drift and alluvium. These deposits occur either near the surface or buried under less permeable glacial deposits. The saturated sand and gravel aquifer is present in less than one-quarter of St. Croix County. It is most prevalent from Star Prairie, southwesterly toward Hudson, where it fills bedrock valleys. The yields in the sand and gravel aquifer are generally low and it is used primarily for domestic water supply.



SCALE: 1"=2000' HORIZONTAL  
1"=100' VERTICAL

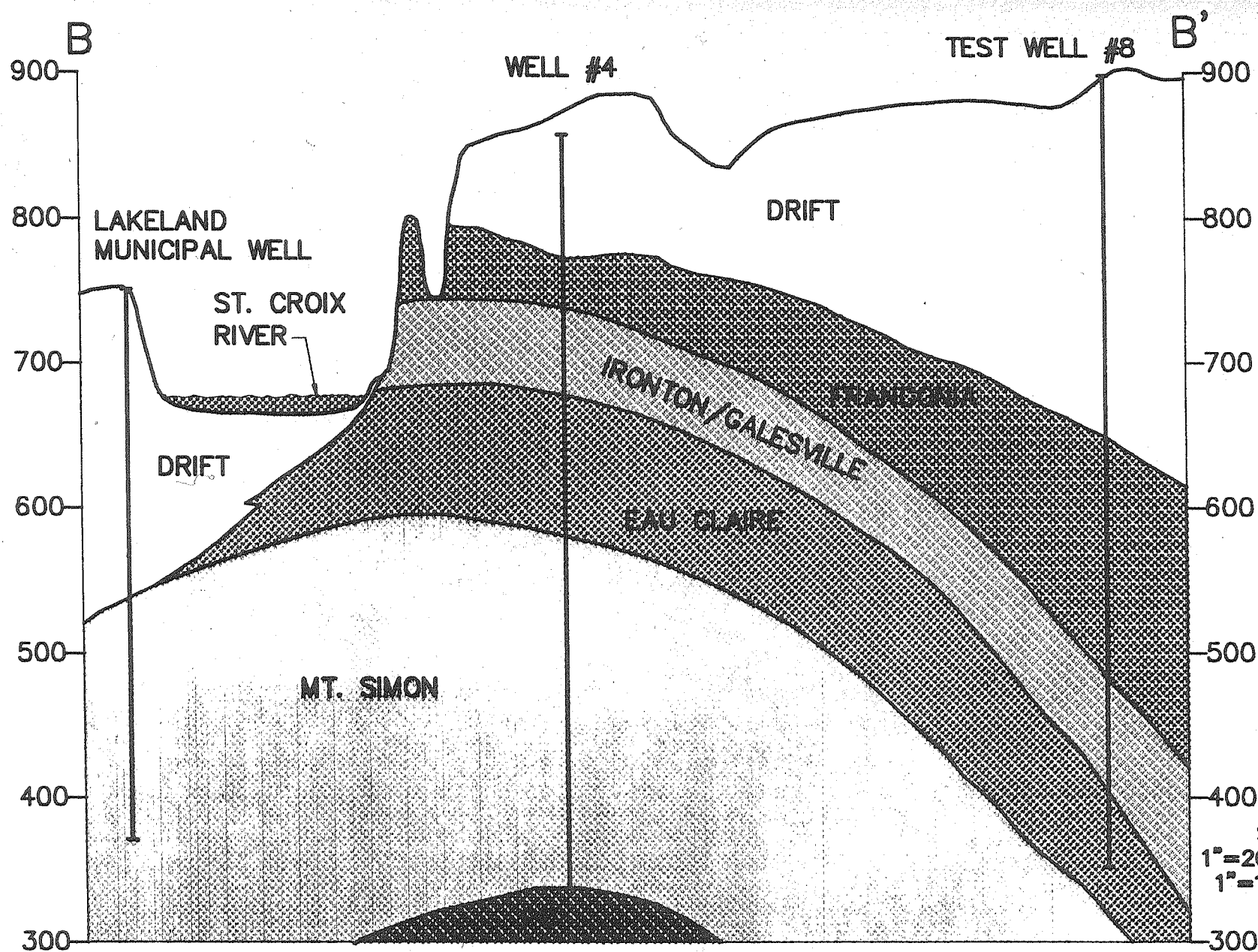


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CITY OF HUDSON, WISCONSIN

CROSS SECTION A-A'

FIGURE NO.  
5



SCALE:  
 1"=2000' HORIZ.  
 1"=100' VERT.

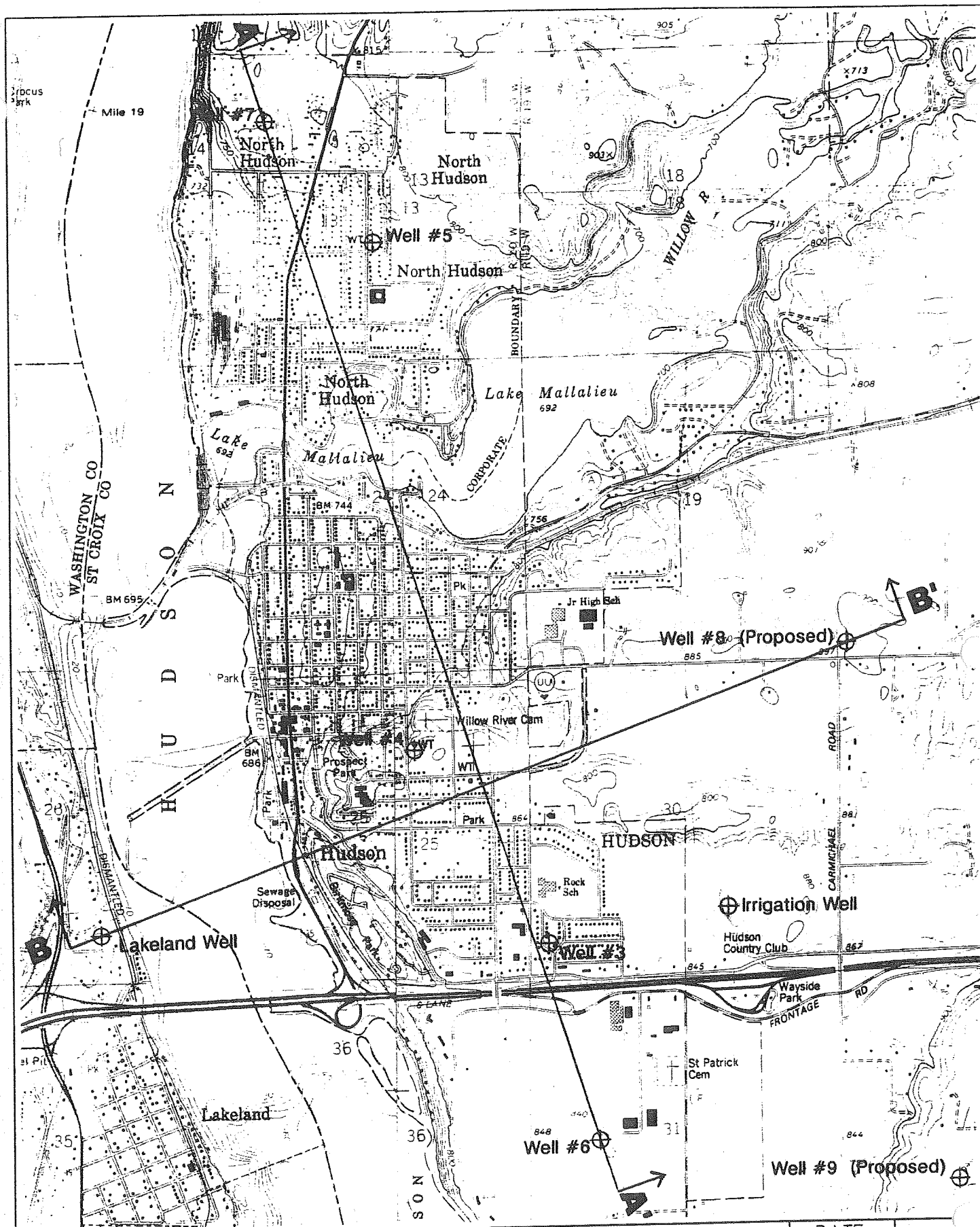


GEOLOGIC CROSS SECTION B-B'  
 HUDSON, WISCONSIN

DATE:  
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 HUDSOFX1

FIGURE  
 6





# WELL AND CROSS SECTION LOCATION MAP

DATE:  
8/1/94  
DWG. NAME  
/

FIGURE  
7



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### 3.5.2 Sandstone Aquifer

The sandstone aquifer includes all water bearing rocks younger than Precambrian age. The permeability of Precambrian rocks is relatively low, and for this reason, it is considered to be the lower limit of groundwater movement (Borman, 1976).

The sandstone aquifer is continuous over St. Croix County and includes rocks of Cambrian and Ordovician age. The Cambrian aged rocks include, in ascending order from oldest to youngest, the Mt. Simon sandstone, the Eau Claire Formation, the Galesville and Ironton Sandstones, the Franconia Formation, and the St. Lawrence Formation and the Jordan Sandstone. The Ordovician aged rocks include, in ascending order from oldest to youngest, the Prairie du Chien Group, the St. Peter Sandstone and the Galena-Platteville unit.

Within the horst discussed above, all the rock units younger than the Franconia Formation have been uplifted and eroded, as seen on the Geologic Cross Sections (Figures 5 and 6). As previously discussed, the Prairie du Chien is presently southeast of Hudson on the downthrown side of the horst.

The Eau Claire Formation, of Cambrian age, becomes progressively more shaley westward toward the center of the Twin City Basin, where it is considered a confining bed; however, at Hudson, it is considered hydrologically continuous with the formations above and below it. Therefore, the above rock formations act as one aquifer at Hudson.

### 3.5.3 Groundwater Elevations and Flow Direction

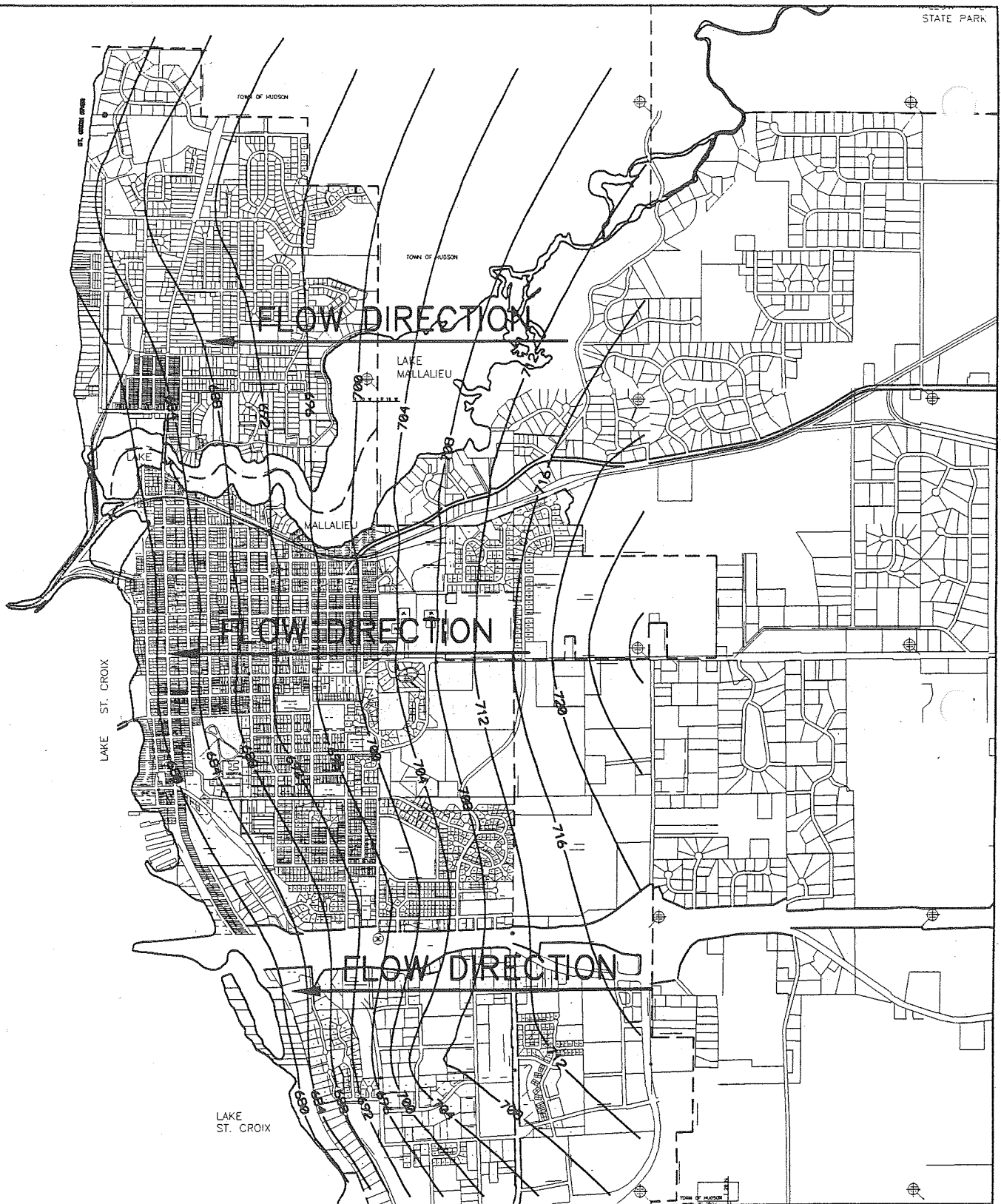
Water levels in the municipal water wells were measured on March 10 and 11, 1994. Wells 4, 5, 6 and the test well 8 were measured on March 10, 1994. Wells 3 and 7 were measured on March 11, 1994. The water levels were measured using a Solinst® electronic water level indicator. The wells were turned off approximately 24 hours prior to measuring the water level. The wellheads were surveyed on March 24 and April 1, 1994. Water level data and wellhead elevations can be found in Table 2.

---

**TABLE 2**  
**WATER LEVEL ELEVATIONS**

<b>Well #</b>	<b>Elevation of Top of Riser (FMSL)</b>	<b>Measurement on 3/10 &amp; 11/94 (Feet)</b>	<b>Correction (Feet)</b>	<b>Water Elevation (FMSL)</b>
3	846.00	151.55	-0.31	694.76
4	864.91	173.56	-0.46	691.81
5	795.27	104.35	-0.85	691.77
6	840.54	133.69	-0.61	707.46
7	780.15	89.53	-0.84	691.46
8 (Test)	903.29	173.67	--	729.62

FMSL - Feet Mean Sea Level



WATER LEVEL MEASUREMENTS TAKEN 3/10/94 AND 3/11/94



# HUDSON WATER TABLE CONTOUR MAP

DATE:  
8/1/94  
DWG. NAME  
GW

FIGURE  
8

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A water table contour map was constructed using the water level data obtained on March 10 and 11, 1994 (see Figure 8). This map indicates the overall groundwater flow direction is to the west, toward the St. Croix River. The groundwater gradient is approximately 0.0045 ft/ft.

#### **3.5.4 Aquifer Recharge**

The two aquifers being utilized at Hudson have a recharge zone that extends from the St. Croix River east to approximately one mile east of Baldwin, Wisconsin.

Clay and till layers are scattered throughout the recharge zone but are not continuous, and therefore, do not prevent recharge.

### **4.0 Aquifer Characteristics**

Certain physical characteristics of the sandstone aquifer were analyzed in order to determine its hydrogeologic properties and to estimate the vulnerability of the aquifer to contamination.

#### **4.1 Saturated Thickness**

The saturated thickness of the sandstone aquifer varies across the site. It ranges from approximately 360 feet at well 4 to about 580 feet at test well 8. This is due to the location of the well relative to the anticline, and depth to the crystalline bedrock.

#### **4.2 Porosity**

The porosity of the sandstone aquifer is a measure of the amount of void space within the rock. Specifically, it is the ratio of the volume of void space divided by the total volume of the aquifer. It is typically reported as a decimal fraction or a percentage, and is therefore dimensionless. The range of porosities for sandstone rock, as reported by Freeze and Cherry (1979), is 5 to 30 percent. In the State of Wisconsin's Wellhead Protection Program Plan, a porosity of 30 percent is specified for sandstone rock (WDNR, 1992). This porosity was used in the calculation of the wellhead protection areas.

#### **4.3 Transmissivity**

The transmissivity is a measure of the amount of water that can be transmitted horizontally by the full saturated thickness of an aquifer under a given hydraulic gradient. It is a product of the hydraulic conductivity and the saturated thickness of the aquifer.

---

The transmissivity for the sandstone aquifer was calculated by using computer model, AQTESOLV. AQTESOLV allows the user to estimate aquifer parameters by matching time versus drawdown data to theoretical type curves.

Time versus drawdown data from test well 8 was used in the AQTESOLV program to determine the transmissivity of the sandstone aquifer. Data from two separate pump tests were used (March 24 and March 25, 1993). Two different curve generating methods were used in the AQTESOLV program: the Theis method and the Cooper-Jacob method.

Four transmissivities were calculated from the two methods and the two sets of drawdown data. The Theis method resulted in transmissivities of 4.271 and 9.688 ft<sup>2</sup>/minute. The Cooper-Jacob method resulted in transmissivities of 7.113 and 16.41 ft<sup>2</sup>/minute. A low, average and a high transmissivity value was calculated. The results were 6,100, 13,500 and 23,600 ft<sup>2</sup>/day. These values were then compared to published transmissivities for the Mt. Simon and Franconia-Ironton-Galesville aquifers. Kanivetsky and Walton (1979) reported a transmissivity modal value, that is an approximate value which is most probably typical of the aquifer, of 4,000 ft<sup>2</sup>/day for the Mt. Simon and Franconia-Ironton-Galesville aquifers. The transmissivity value of 6,100 ft<sup>2</sup>/day, which was obtained from the pumping tests, compares favorably with this published value of 4,000 ft<sup>2</sup>/day; therefore, the transmissivity value of 6,100 ft<sup>2</sup>/day was utilized in the delineation of the wellhead protection areas. The pump test data for test well 8, as well as the Theis and Cooper-Jacob curves, can be found in Appendix C.

The high transmissivity values calculated with the AQTESOLV program may be due to the method of measuring drawdown. Typically, a well test in a unconfined aquifer should utilize observation wells for measuring drawdown at a certain distance from the well. This data was not available; therefore, we utilized drawdown data directly from the well.

#### **4.4 Hydraulic Conductivity**

Hydraulic conductivity describes the rate water can move through an aquifer. It is calculated as follows:

$$K = T/b$$

K = Hydraulic Conductivity

T = Transmissivity

b = Saturated Thickness of the Aquifer

Inserting the transmissivity of 6,100 ft<sup>2</sup>/day and the saturated

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thickness of 580 feet as discussed in Sections 4.1 and 4.3 above, into the above equation gives a hydraulic conductivity of 10.52 ft/day.

#### **4.5 Groundwater Flow Velocity**

The flow velocity of groundwater in the sandstone aquifer can be calculated from the Darcy Equation:

$$V = -K/n (dh/dl)$$

V	=	Flow Velocity
K	=	Hydraulic Conductivity
n	=	Porosity (0.30)
dh/dl	=	Groundwater Gradient (- 0.0045 ft/ft)

Using a hydraulic conductivity of 10.52 ft/day, and the above porosity and groundwater gradient, we obtain the following flow velocity for the groundwater:

$$V = 0.1578 \text{ ft/day or } 57.60 \text{ ft/year}$$

#### **4.6 Aquifer Vulnerability**

The vulnerability of an aquifer is evaluated by the ability of geologic materials to restrict downward migration of contaminants to the saturated zone. A variety of factors can be used to evaluate aquifer vulnerability. These factors include:

- Depth to groundwater;
- Soil types and attenuation;
- Confining layers;
- Aquifer material;
- Recharge potential;
- Vadose zone; and
- Unsaturated zone materials.

---

The sandstone aquifer at Hudson is recharged by direct infiltration of rainwater and surface water, through the glacial drift. Although some clayey layers may exist locally within the glacial drift, there is no uniform confining layer between the drift and the aquifer. Therefore, the sandstone aquifer is hydrologically connected to the glacial drift above it. The various formations within the sandstone are not divided by confining layers. This factor alone makes the aquifer at Hudson somewhat vulnerable.

Attenuation is a series of complex processes. During attenuation, the soil immobilizes metals and removes bacteria contained in animal or human wastes, or reduces contaminants by other physical or biological means. Soils in the Hudson area that have the least potential for attenuating contaminants are primarily sands like Plainfield, Gotham and Burkhardt (see the Soil Survey Map in Appendix A). As can be seen in Figure 9, the attenuation potential for the surface soils in the Hudson area ranges from least to best; however, the surface soils predominantly maintain the least attenuation potential.

Depth to groundwater is less than 100 feet in certain areas of Hudson. The soils in some areas have high permeability rates to 6.0 inches per hour. These factors also increase the aquifer vulnerability.

The aquifer vulnerability in the Hudson area should be considered high based on the above factors.

## **5.0 Known Contaminant Sources**

A limited investigation was conducted to determine if any known sources of contamination were present in the area, which may intersect the wellhead protection areas.

### **5.1 Junker Landfill, Nor-Lake, Inc. and Duro Bag, Inc.**

The Junker Landfill, Nor-Lake, Inc. and Duro Bag, Inc. are facilities known to have released contamination to the groundwater.

The Wisconsin Department of Natural Resources (WDNR), was contacted regarding these releases. Nor-Lake is located in the northwest (NW) corner of Section 22 and Duro Bag is located in the southeast (SE) corner of Section 17, both in Township 29 North, Range 19 West. The former Junker Landfill is located approximately three miles east of Nor-Lake, Inc. See Figures 10A and 10B.

The Junker Landfill is located on the eastern edge of an approximately six-mile long contaminant plume which discharges westward toward the Willow River. The WDNR indicated that the contamination is limited to an area north of Highway 12. The red plume shown on Figures 10A and 10B shows an area which groundwater has been or still is contaminated according to various reports submitted to the WDNR.

In July of 1991, the WDNR issued a memorandum to Wisconsin Licensed Well Drillers advising of a special well casing requirement for water wells placed within the area of the contaminant plume. The area includes Sections 13 through 18 and the north half of Sections 21 through 24 (see Figure 10A and 10B). A copy of the memorandum can be found in Appendix D.

## **5.2 LUST Sites**

An inventory of Leaking Underground Storage Tanks (LUST's) was reviewed for Hudson, Township, the Village of North Hudson and the City of Hudson. A total of twenty-two sites were identified from the WDNR LUST Site Inventory List. These sites are identified in Figures 10A, 10B, 10C and 10D.

## **6.0 Potential Contaminant Sources**

A limited investigation was conducted to review potential contaminant sources present in the area, which may impact the wellhead protection areas.

### **6.1 Hudson Landfill**

An area of potential groundwater contamination was identified in North Hudson, where the former City of Hudson Landfill is located in the northeast (NE) corner of Section 13, Township 29 North, Range 19 West. This landfill is directly upgradient of municipal well 7 (see Figure 10A).

In a report dated August, 30 1993, Northern Environmental, Inc. submitted results of groundwater quality monitoring activities conducted at the landfill. This report indicated that no significant amounts of groundwater contamination were found; however,



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monitoring well 1, which is located downgradient of the landfill and toward municipal well 7, was not sampled due to an insufficient amount of sample in the well.

## **6.2 UST/AST Inventories**

A review of Underground Storage Tanks (UST's) and Aboveground Storage Tanks (AST's) was conducted for the Hudson area. Twenty-three current USTs and seven former UST locations, as well as five AST locations, were identified and are shown on Figures 10A, 10B, 10C and 10D.

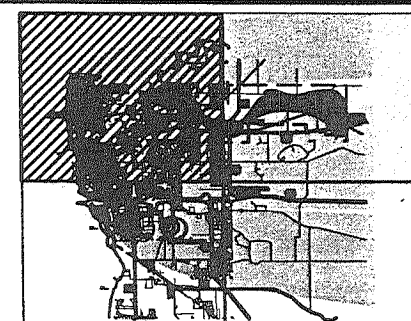
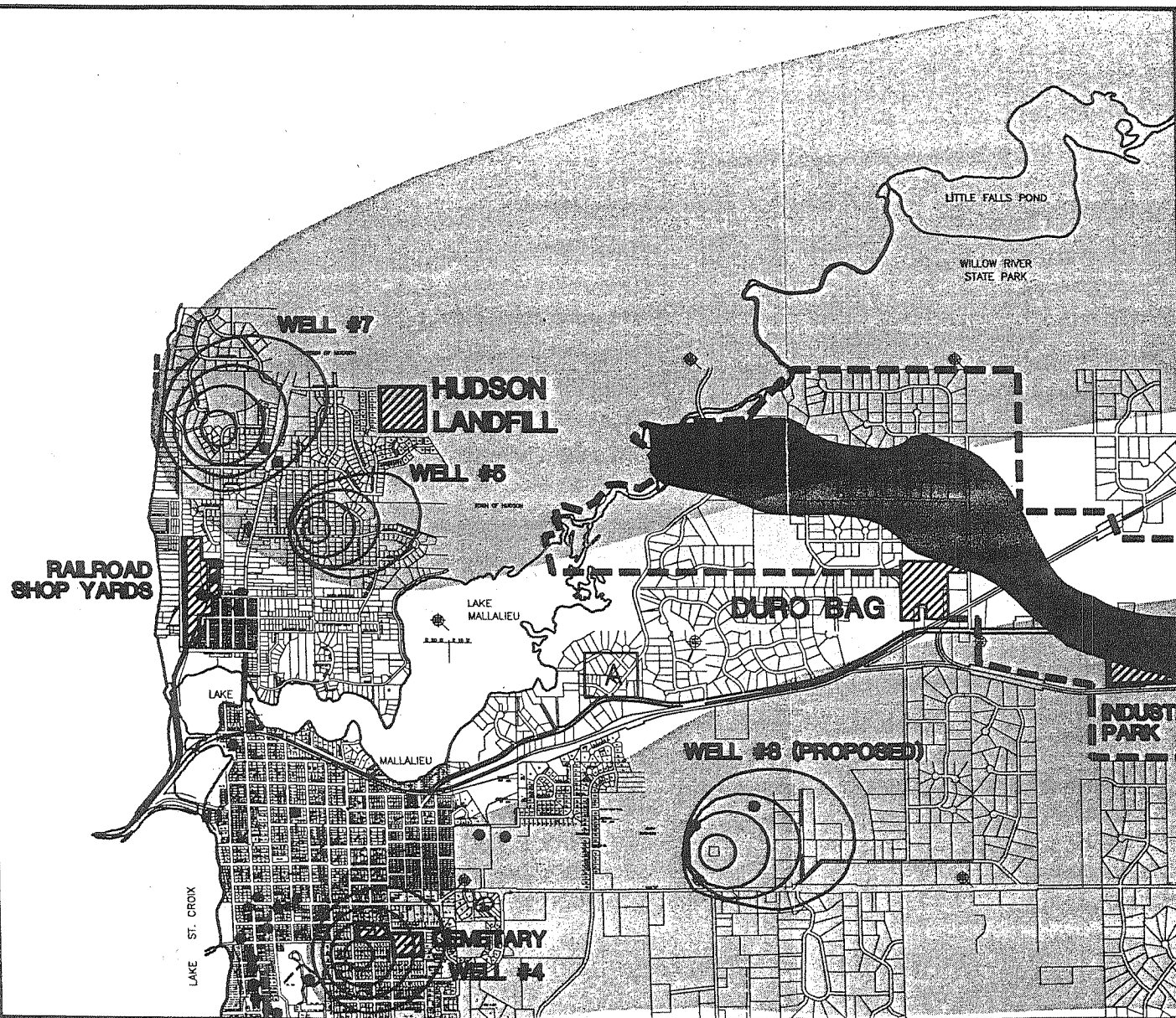
## **6.3 Other Potential Contaminant Sources**

There are numerous other potential contaminant sources in the Hudson area. Some of these are identified on Figures 10A, 10B, 10C and 10D, they include: the railroad shop yards, two cemeteries, and two industrial parks.

The WDNR listed potential contaminant sources in *A Guide for Conducting Potential Contaminant Source Inventories for Wellhead Protection*, March, 1993. The list is as follows:

- Abandoned Wells
- Aboveground Storage Tanks
- Agricultural Fertilizer Use
- Agricultural Pesticide Use
- Airports
- Animal Feedlots, Barnyard Waste Storage Pits
- Auto Repair, Body Shops, Salvage, Car Washes
- Cemeteries
- Chemical Production or Storage
- Electroplaters, Metal Refinishing
- Fertilizer/Pesticide Storage, Mixing Production or Loading
- Golf Courses
- Grain Storage
- Hazardous Waste Sites
- Holding Ponds/Lagoons
- Infiltration Ponds
- Injection or Drainage Wells
- Irrigation Systems
- Landfills (active or abandoned)
- Laundromats and Dry Cleaners
- Machine Shops
- Manure Spreading
- Municipal Sewers
- Mining Operations (Gravel Pits, Quarries)
- Oil or Gas Pipelines
- Photo Processors

- 
- Plastics Manufacturing
  - Printers
  - Private Wells
  - Production or Other Wells
  - Road Salt Storage
  - Septic Systems
  - Service or Gas Stations
  - Sewage Treatment Plants
  - Underground Storage Tanks
  - Urban Fertilizer and Pesticide Use
  - Waste Tailing Piles
  - Wood Preserving Facilities
  - Other



**PLAN**

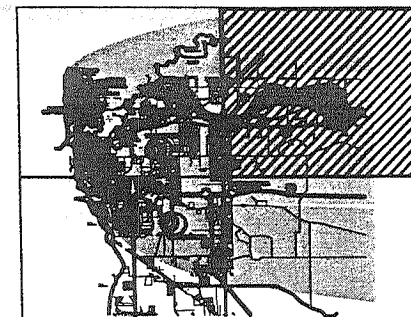
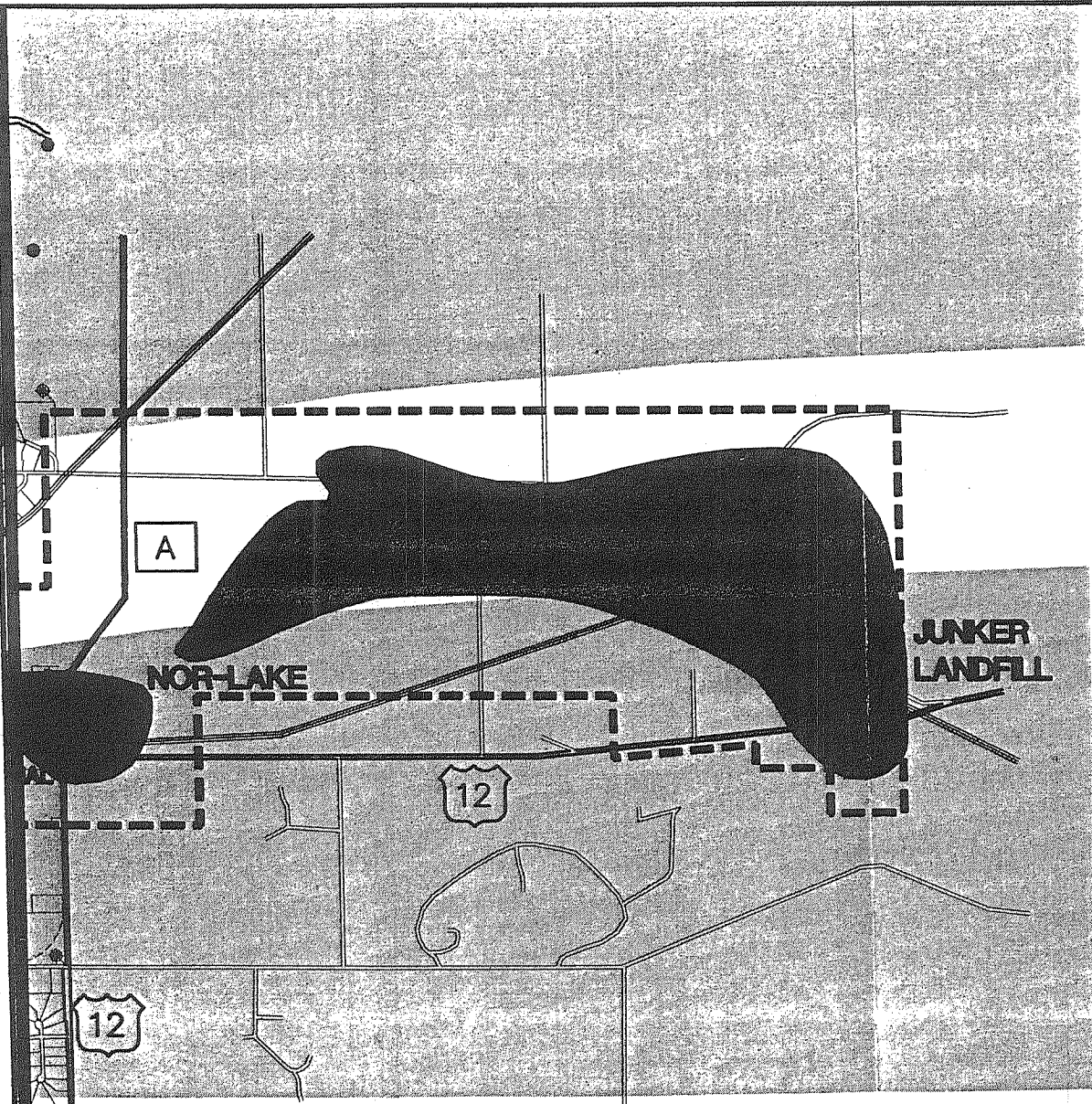
**LEGEND**

- ZONE OF CONTRIBUTION
- KNOWN GROUNDWATER CONTAMINATION
- DNR LUST SITES
- DNR WELL ADVISORY AREA
- FORMER UNDERGROUND STORAGE TANK LOCATION
- UNDERGROUND STORAGE TANKS (UST's)
- ABOVE GROUND STORAGE TANKS (AST's)










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**ZONES OF CONTRIBUTION/CONTAMINATION  
CITY OF HUDSON, WISCONSIN**



PLAN

LEGEND

-  ZONE OF CONTRIBUTION
-  KNOWN GROUNDWATER CONTAMINATION
-  DNR LUST SITES
-  DNR WELL ADVISORY AREA
-  FORMER UNDERGROUND STORAGE TANK LOCATION
-  UNDERGROUND STORAGE TANKS (UST's)
-  ABOVE GROUND STORAGE TANKS (AST's)

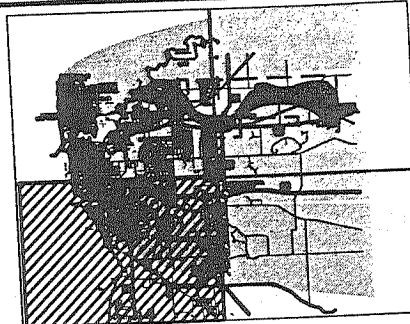
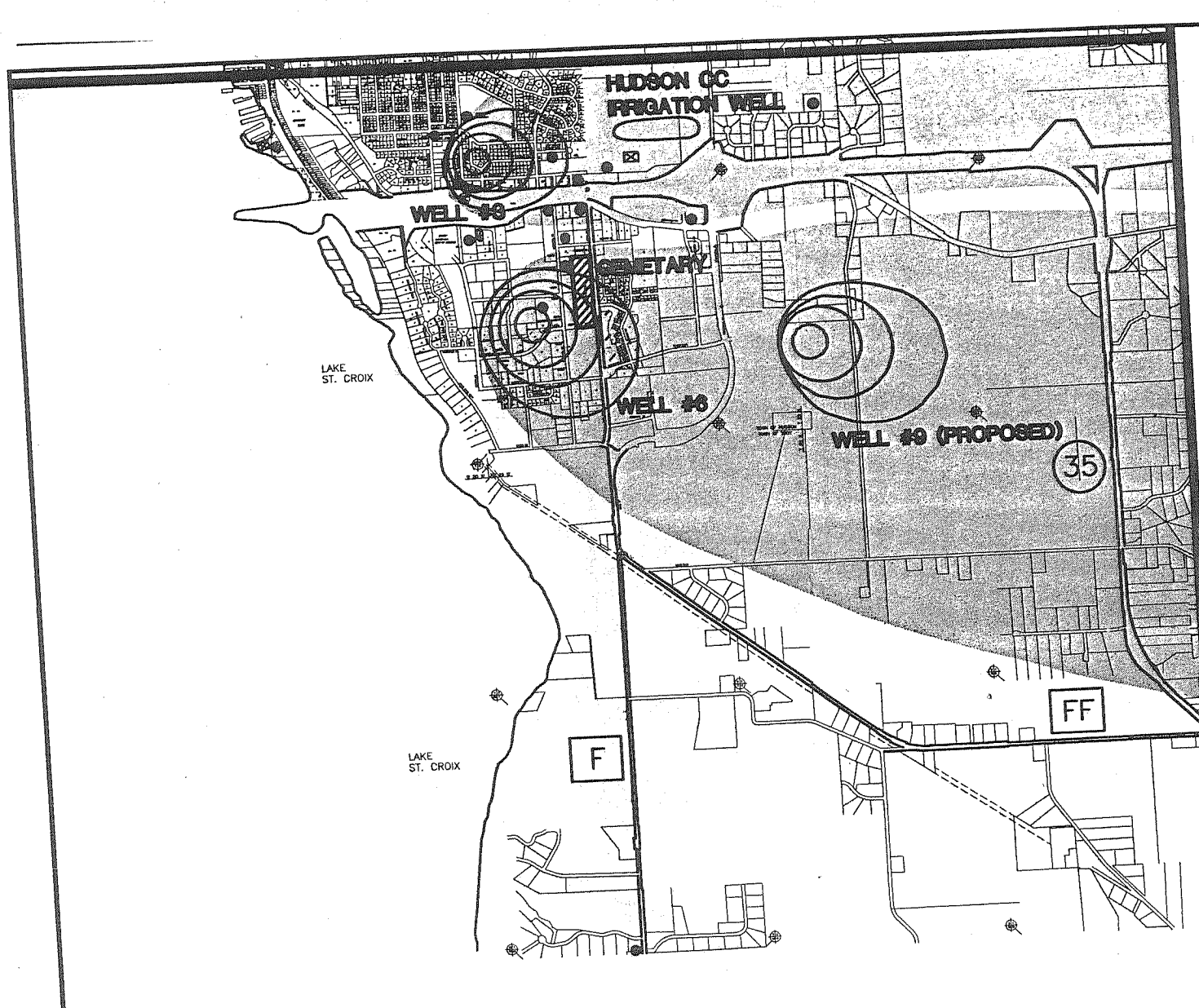


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ZONES OF CONTRIBUTION/CONTAMINATION  
CITY OF HUDSON, WISCONSIN

FIGURE NO.  
**10B**





PLAN

**LEGEND**

- ZONE OF CONTRIBUTION
- KNOWN GROUNDWATER CONTAMINATION
- DNR LUST SITES
- DNR WELL ADVISORY AREA
- FORMER UNDERGROUND STORAGE TANK LOCATION
- UNDERGROUND STORAGE TANKS (UST's)
- ABOVE GROUND STORAGE TANKS (AST's)

ZONES OF CONTRIBUTION/CONTAMINATION  
CITY OF HUDSON, WISCONSIN

FIGURE NC  
10C



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## 7.0 Wellhead Delineation

The U.S. Environmental Protection Agency (EPA) WHPA model was utilized for this study. The EPA WHPA program is a modular, semi-analytical groundwater flow model consisting of four independent computational modules that may be used to delineate wellhead capture zones. A capture zone is the portion of the aquifer which contributes water to a well.

The module used for the delineation of the Hudson Wellhead Protection Areas is called RESSQC. RESSQC delineates time-related capture zones around pumping wells or multiple pumping wells in homogeneous aquifers, with steady and uniform groundwater flow conditions. Well interference effects are accounted for.

Capture zones delineated using RESSQC are valid for fully penetrating pumping wells screened in aquifers that are essentially homogeneous. Groundwater flow is assumed to be two-dimensional, and therefore, the aquifer may be confined or unconfined if the drawdown-to-initial saturated thickness ratio is small (less than approximately 0.1). Steady groundwater flow is assumed.

Eight separate wells were input into the RESSQC WHPA module. These wells include the five existing pumping wells, the proposed wells 8 and 9 and the Hudson Country Club irrigation well.

Tables 3 and 4 contain the program input data for the RESSQC module. Table 3 contains general program information and Table 4 contains pump information. The maximum pump data for each of the pumping wells and the proposed wells was utilized in the WHPA program along with the transmissivity, as determined in Section 4.3 above. The pump data used for the Hudson Country Club irrigation well was estimated high by assuming five months of operation at eight hours per day; approximately 14 percent of the maximum pump capacity taken over a yearly average. The maximum pump capacity of 650 gpm, or 125,000 ft<sup>3</sup>/day, was therefore multiplied by 0.14 to yield 17,500 ft<sup>3</sup>/day. This value was utilized in the program.

**TABLE 3**  
**PROGRAM INPUT DATA**

Program Variable	Program Value
Number of Wells:	8
Minimum X-Coordinate:	0 feet
Maximum X- Coordinate:	20,000 feet
Minimum Y-Coordinate:	0 feet
Maximum X-Coordinate:	25,000 feet
Transmissivity of the Aquifer:	6,100 ft <sup>2</sup> /day
Hydraulic Gradient:	0.0045 (dimensionless)
Angle of Ambient Flow:	180 degrees
Aquifer Porosity:	0.30 (dimensionless)
Aquifer Saturated Thickness:	580 feet
Maximum Spacial Step Length:	10
Number of Pathlines:	20
Capture Zone Type:	Time-related
Time Values:	1, 5, 10 and 20 years

**TABLE 4  
WELL AND PUMP  
WHPA PROGRAM INPUT DATA**

Well	X-Coordinate	Y-Coordinate	Well Radius	Maximum Pump Rate	1993 Pump Rate
3	8,205	8,780	0.5'	104,000 ft <sup>3</sup> /day	72,000 ft <sup>3</sup> /day
4	5,853	11,987	0.5'	124,000 ft <sup>3</sup> /day	38,000 ft <sup>3</sup> /day
5	5,152	20,626	0.5'	104,000 ft <sup>3</sup> /day	10,000 ft <sup>3</sup> /day
6	9,157	5,202	0.5'	193,000 ft <sup>3</sup> /day	17,000 ft <sup>3</sup> /day
7	3,206	22,620	0.5'	193,000 ft <sup>3</sup> /day	20,000 ft <sup>3</sup> /day
8 (Test)	13,322	13,998	0.5'	193,000 ft <sup>3</sup> /day	193,000 ft <sup>3</sup> /day*
9 (Proposed)	14,705	4,694	0.5'	193,000 ft <sup>3</sup> /day	193,000 ft <sup>3</sup> /day*
Golf Course Well	11,217	9,177	0.5'	125,000 ft <sup>3</sup> /day	17,500 ft <sup>3</sup> /day

These are assumed pumping rates based on a 1,000 GPM pump.



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Input of the above data generated seven different wellhead protection areas; one for each of the five municipal wells and the two proposed wells. The data also generated the capture zone for the Hudson Country Club irrigation well. Figures 11 and 12 show the wellhead protection areas and the Hudson Country Club capture zone generated by the RESSQC module within the sandstone aquifer. The concentric rings around each well represent different capture zones for the one, five, ten, and twenty year time of travel (TOT). The TOT rings represent the distance that it would take a particle of water to travel to the pumping well in that given time for that particular transmissivity and pumping rate.

The wellhead protection areas shown on Figures 11 and 12 were calculated using conservative values for transmissivity and pumping rates. High pumping rates were used resulting in larger wellhead protection areas.

The criteria selected in delineating the WHPAs were based on existing data and the hydrogeologic investigation performed for this project. Both technical and nontechnical considerations were applied. The technical considerations were based on physical processes affecting groundwater flow. The nontechnical considerations include the community's desired degree of protection, and its economic concerns.

The semi-analytical model and hydrogeologic investigation of this area allowed for more accurate delineation than if less sophisticated methods would have been utilized.

The WHPAs delineated on Figures 11 and 12 are delineated within the Sandstone aquifer using parameters and values calculated within the bedrock. This two-dimensional WHPA model does not take into consideration the much higher transmissivities and flow velocities of the upper unconsolidated portions of the aquifer. We know the contaminant plumes from the Junker Landfill and Nor-Lake facility travelled at a much faster rate than shown in Figures 11 and 12.

A Zone of Contribution (ZOC) was calculated to represent the potential of contamination through the drift. The ZOC is the area of the aquifer which contributes or will contribute groundwater to the well. The ZOC was calculated using the EPA WHPA model with the same input parameters discussed above. The Time of Travel (TOT) was assumed to be infinite. Due to the higher flow rates in the upper portion of the aquifer, the ZOC must be taken into consideration when reviewing potential contaminant sources. The ZOC is shown on Figures 10A, 10B, 10C and 10D.

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## **8.0 Conclusions**

The geology and hydrogeology of the Hudson area indicates that the underlying aquifer is vulnerable to contamination. Although the groundwater travels relatively slow through the sandstones, it can and has migrated at a much faster rate through the unconsolidated portion of the upper aquifer. These facts lead us to the conclusion that the entire "Hudson" community, including the City of Hudson, Village of North Hudson and Hudson Township, as well as other townships within St. Croix County, must work together to protect this region's groundwater.

## **9.0 Recommendations**

Following are recommendations for the use and implementation of this report:

### **9.1 Identify Contaminant Sources within WHPAs**

Existing land uses that may have a high potential to contaminate groundwater should be identified within the wellhead protection areas, and Zone of Contribution if possible. If the wellhead protection area is already occupied by a known source of contamination, it should be removed and/or monitored carefully. Potential sources of contamination within each wellhead protection area should be identified, listed and inventoried. Land uses which could potentially contaminate groundwater are listed in Section 6.3.

Appendix E contains additional information relating to contaminant sources.

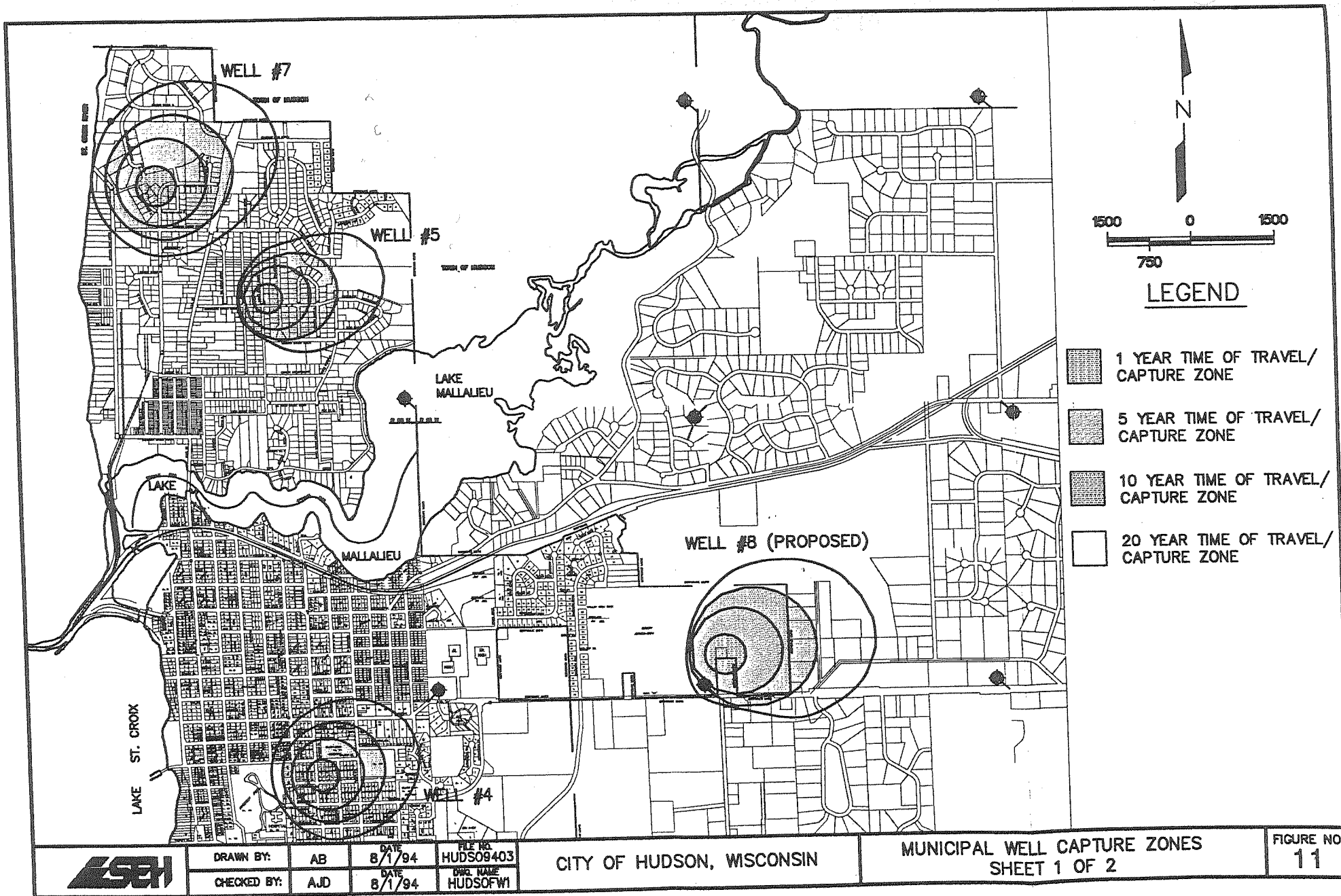
### **9.2 Develop Management Approaches**

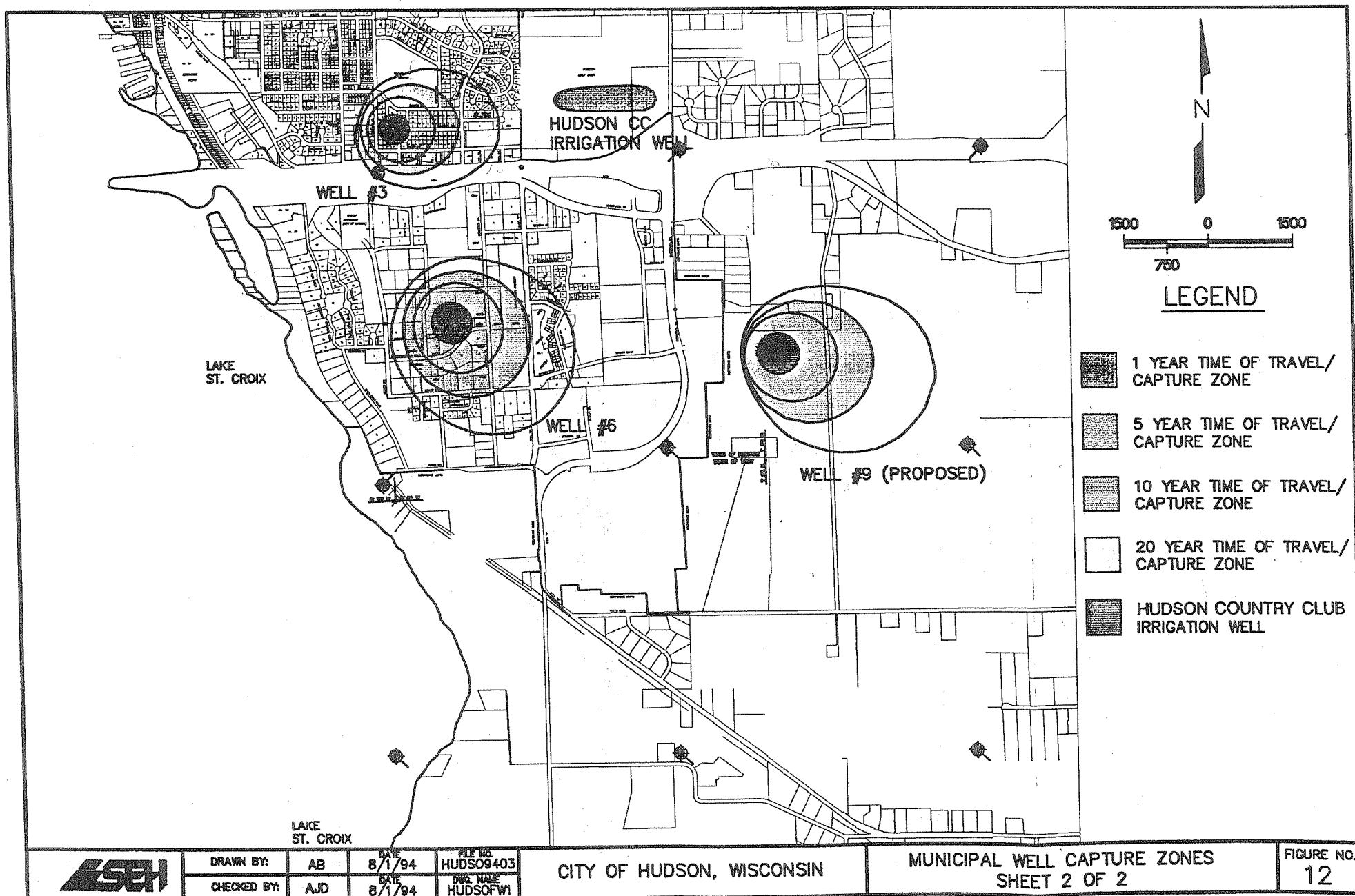
The City of Hudson should develop a Wellhead Protection Plan to protect its municipal water supply wells. Groundwater protection should be prevention oriented to be effective. This is because full restoration of groundwater quality can be very difficult and costly once contamination occurs.

#### **9.2.1 State Management**

The City of Hudson should continue to comply with State regulations. These regulations protect groundwater in two ways:

1. Directly through specific distance restrictions between potential contamination sources and water supplies; and





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## 11.0 References

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- Young, H.L., and S.M. Hindall, 1973, *Water Resources of Wisconsin St. Croix River Basin*, U.S. Geological Survey.

CITY WELL NO. 3, HUDSON, WIS.

NE $\frac{1}{4}$ , SW $\frac{1}{4}$  sec. 30, T. 29 N., R. 19 W. Elevation 845' ETM

H. T. Hagestad, Engineer

Keys Well Drilling Co., Contractors, 1953

Samples examined by F. T. Thwaites, Nos. 160526-160634

0-5	5		Gravel, brown-gray		
5-25	20		Sand, fine to gravel, sandy, silty, gy, brown		
25-35	10		Sand, fine to medium, light pink-gray		
35-130	95		Sand, medium to small pebbles, light gray		24" pipe 16" pipe cemented
				76	
				16" pipe	
130-185	55		Gravel, fine, sandy; sand, medium to very coarse, light gray		139 water
185-205	20		Sand, medium to very coarse, light gray		
205-215	10		Sand, medium to very coarse, rusty-gray		
215-225	10		Silt, sandy, pink, slightly dolomitic (till?)		
225-245	20		Silt, dark pink to dark gray, slightly dol.		
245-250	5		Gravel, very sandy, glacial		
250-265	15		Siltstone, gray, gy; sandstone, very fine, g		257.75
265-270	5		Sandstone, very fine to fine, silty, gray		
270-285	15		Sandstone, medium to coarse, silty, gray		
285-295	10		Sandstone, fine to medium, silty, gray		
295-320	25		Sandstone, fine to very fine, silty, gray		
320-325	5		Sandstone, fine to coarse, gray		15" hole
325-345	20		Sandstone, very fine to medium, silty, gray		
345-350	5		Sandstone, fine to coarse, silty, gray		
350-375	25		Sandstone, very fine to coarse, silty, gray		
375-380	5		Siltstone, gray		
380-385	5		Sandstone, fine to medium, silty, gray		
385-425	40		Sandstone, very fine to medium, silty, gray to light gray		
425-480	55		Sandstone, very fine to coarse, light gray		
480-490	10		Siltstone, sandy, light brown-gray		
490-500	10		Sandstone, fine to very coarse, light gray		
500-510	10		Sandstone, fine to medium, light gray		
510-520	10		Sandstone, very coarse, light gray		
520-530	10		Sandstone, very fine to coarse, silty, lt. gy		
530-543	13		Shale, red, green gray, part dolomitic		

ions: Drift; Eau Claire; Mt. Simon; pre-Cambrian (Keweenaw or Red Clastic series)  
 d at 752 g.p.m. specific capacity = 12.3 g.p.m./ft.; at 512 g.p.m. specific capacity =  
 g.p.m./ft.



#4

George H. Keys, Driller, June<sup>15</sup>, 1961

7Lt 880' ETM

880 ETM				+3'	
D R I F T	0- 25	25		Snd,yl bn,C,Sang,P srtg,mch VC,M,fn, & Vfn; mxd	20"hole 20"pipe 3/8"blk heat,cem grout
	25- 30	5		Snd,yl bn,C,Sang,mch VC,M,fn &Vfn;tr Vfn gvl	
	30- 40	10		Snd,yl bn,C,Sang,mch VC,M,fn & Vfn;tr Vfn gvl	
	40- 70	30		Snd,yl bn,C,Sang,P srtg,mch VC-M,tr fn;ltl Vfn gvl	56'
F R A N	70- 75	5		Snd,yl bn,C,Sang,P srtg,mch VC-M,tr fn;ltl gvl	16"hole
	75- 80	5		Gvl,Vfn,Sang,P srtg,mch fn,mxd;mch snd,VC & C	16"pipe,
	80- 85	5		Gvl,fn,Sang,P srtg,mch Vfn,ltl M,mxd;tr VC snd	3/8"blk s
	85- 90	5		Ss,Vlt ol gry,Vfn,Sang,F cem dol,mch fn;sty	
	90- 95	5		Ss,lt ol,Vfn,F cem dol,mch fn;sty;mch glauc	
	95-100	5		Ss,lt ol,Vfn,G cem dol,mch fn;sty;mch glauc	
	100-120	20		Ss,lt ol,Vfn,Sang,P srtg,P cem dol,mch fn;sty; mch glauc;ltl mica	
I R O N T O	120-125	5		Ss,lt ol,fn,P cem dol,mch Vfn,ltl M,C,&VC;sty	
	125-130	5		Ss,lt ol gry,fn,P cem dol,mch Vfn,ltl M,C,&VE	
	130-135	5		Ss,vl gry,M,P cem dol,mch Vfn,fn,C,&VC;sty	
	135-140	5		Ss,lt ol gry,M,P cem dol,mch Vfn,fn,C,&VC;sty	
	140-145	5		Ss,yl gry,C,P cem dol,mch VC,M,& fn, tr Vfn;ltl	st
	145-150	5		Ss,yl gry,C,P cem dol,mch VC,M,& fn, tr Vfn	
	150-155	5		Ss,yl gry,C,P cem dol,mch VC,M,& fn, tr Vfn;sty	
	155-160	5		Ss,yl gry,C,P cem dol,mch VC,M,& fn, tr Vfn;sty	
	160-165	5		Ss,yl gry,C,P cem dol,mch VC,M,ltl fn&Vfn	
	165-170	5		Ss,Vlt vl bn,fn,P cem dol,mch M&Vfn,ltl C, tr VC	
	170-175	5		Ss,lt vl bn,fn,F cem dol,mch M&Vfn,ltl C, tr VC	
	175-180	5		Ss,lt vl bn,fn,P cem dol,mch M&Vfn,ltl C, tr VC	
	180-185	5		Ss,yl gry,fn,P cem dol,mch Vfn, tr M,mch st	
	185-190	5		Ss,yl gry,fn,P cem dol,mch Vfn;mch st;ltl cl	
E A U C L A I R E	190-195	5		Ss,lt ol gry,fn,P cem dol,mch Vfn;mch st;ltl cl	
	195-205	10		Ss,lt ol gry,fn,Sang,P srtg,P cem dol,mch Vfn; mch st;ltl cl,dol, & sh;many foss	
	205-215	10		Ss,lt ol gry,fn,Sang,P srtg dol,mch Vfn;mch st;ltl cl,dol & sh	
	215-220	5		Ss,ol gry,Vfn,P cem dol,mch fn;mch st&cl	
	220-225	5		Dol,yl gry,fn,sndy,many foss;mch st,sh & snd	
	225-230	5		Ss,ol gry,fn,F cem dol,mch Vfn,ltl M, tr C	
	230-235	5		Ss,ol gry,Vfn,F cem dol,mch fn,ltl M, tr C;mch	st
	235-240	5		Ss,ol gry,Vfn,F cem dol,mch fn,ltl M, tr C	
	240-245	5		Ss,ol gry,Vfn,F cem dol,mch fn;mch st&sh	
	245-260	15		Ss,ol gry,Vfn,ang,P srtg,VP cem dol,mch fn; mch st & sh;mch mica;tr glauc	
M T S I M O N	260-275	15		Ss,ol gry,Vfn,Srnd,P srtg,VP cem dol,mch fn, ltl M & C;mch st & cl;mch mica;tr foss & pyr	
	275-280	5		Ss,ol gry,Vfn,VP cem dol,mch fn,ltl M&C;mch st&cl	
	280-295	15		Ss,ol gry,Vfn,Srnd,P srtg,VP cem dol,mch fn, ltl M & C, tr VC;tr Vfn gvl;mch st&cl;tr pyr & foss	
	295-300	5		Ss,ol gry,C,VP cem dol,mch VC,M,fn,& Vfn;mch st	
	300-310	10		Ss,ol gry,Vfn,Srnd,P srtg,VP cem dol,mch VC, M,fn,& Vfn;"sooty";mch Vfn gvl;mch st;ltl sh	
	310-320	10		Ss,ol gry,C,Srnd,P srtg,VP cem dol,mch VC,M,fn, & Vfn;"sooty";mch Vfn gvl;ltl st	
	320-325	5		Ss,ol gry,C,VP cem dol,mch VC,M,& fn;"sooty"	
	325-330	5		Ss,ol gry,C,VP cem dol,mch VC,M,& fn;"sooty"	
	330-335	5		Ss,ol gry,VC,VP cem dol,mch C,M,& fn;"sooty"	
	335-345	10		Ss,ol gry,VC,VP cem dol,mch C,M,& fn;"sooty" mch Vfn gvl;ltl st & sh	
	345-350	5		Ss,lt ol gry,C,VP cem dol,mch VC,M,&fn;"sooty"	
	350-365	15		Ss,ol gry,C,Srnd,P srtg,VP cem dol,mch VC,M,& fn;"sooty";tr Vfn gvl;mch st	
	365-370	5		Ss,ol gry,C,VP cem dol,mch M-fn, tr VC-Vfn;tr st	

370-380	10		Ss, ol gry, C, Srnd, P srtg, VP cem dol, mch M-fn, ltl VC, tr Vfn, tr st
380-385	5		Ss, ol gry, C, VP cem dol, mch M-fn, ltl VC, tr Vfn
385-395	10		Ss, ol gry, C, Srnd, P srtg, VP cem dol, mch M-fn, ltl VC, tr Vfn, "sooty": ltl Vfn gvl: tr glaucic sh
395-400	5		Ss, ol gry, C, VP cem dol, mch M-fn, ltl VC, tr Vfn
400-405	5		Ss, ol gry, C, VP cem dol, mch M-fn, ltl VC, tr Vfn
405-410	5		Ss, ol gry, C, VP cem dol, mch M-fn, ltl VC, tr Vfn
410-420	10		Ss, ol gry, C, Srnd, P srtg, VP cem dol, mch M-fn, ltl VC, tr Vfn: tr Vfn gvl: tr glaucic sh
420-425	5		Ss, ol gry, C, VP cem dol, mch M, fn, & Vfn, ltl VC
425-435	10		Ss, ol gry, C, Srnd, P srtg, VP cem dol, mch M-VC, ltl fn-Vfn: tr Vfn gvl
435-440	5		Cong, lt ol gry, fn, VP cem dol, mch Vfn gvl: mch snd
440-445	5		Ss, Vlt ol gry, M, VP cem dol, mch fn, ltl C, Vfn & VC
445-450	5		Ss, lt ol gry, C, VP cem dol, mch VC & M, ltl fn & Vfn
450-455	5		Cong, lt ol gry, fn, VP cem dol, mch Vfn gvl: mch snd
455-460	5		Ss, lt ol gry, C, VP cem dol, mch VC & M, ltl fn & Vfn
460-465	5		Cong, lt ol gry, fn, VP cem dol, mch Vfn: mch snd
465-470	5		Cong, lt ol gry, fn, VP cem dol, mch Vfn: mch snd & st
470-480	10		Cong, lt ol gry, fn, VP cem dol, mch Vfn: mch snd & st: tr pnk feldspar & gn glaucic sh, ltl pyr & dol
480-485	5		Snd, lt ol gry, C, VP cem dol, mch M-VC, ltl fn-Vfn
485-495	10		Cong, lt ol gry, Vfn, Srnd, P srtg, F cem dol, ltl fn gvl: mch snd: ltl st: tr pyr
495-500	5		Cong, lt ol gry, Vfn, Sang, mch Vfn: ltl snd: tr pyr
500-505	5		Cong, lt ol gry, Vfn, Sang, tr fn: mch snd & st: tr pyr & sh
505-510	5		Cong, lt ol gry, fn, Sang, mch Vfn: ltl snd & st: tr pyr
510-521	11		Cong, lt ol gry, Vfn, Sang, P srtg, P cem dol, tr fn: mch snd & st: ltl gn glaucic sh: tr sndy dol
521-522	1	xxxxxxxxx	Rhyolite, red gray or possibly Red Clastic Series

522'

formations: Drift, Franconia, Ironston, Eau Claire, Mt. Simon, Precambrian  
 ll tested for 15 hours at 600 gpm with 40 feet of drawdown.  
 ecific capacity = 15 gpm per foot of drawdown



ALT 792' ETM

16' hole

## North Hudson, Municipal Well, North Hudson, Wis.

350-355	5	.....	Ss, lt yl bn, M, rnd, P cem, tr VC, mch C, fn, Vfn	
355-360	5	.....	Ss, yl gry, C&M, rnd, P cem, tr VC, mch fn&Vfn; ltl st	
360-370	10	.....	Ss, lt yl bn, M, rnd, P srtg, P cem, tr VC, mch fn&Vfn, C; ltl st	
370-375	5	.....	Ss, dk yl or, C, rnd, P cem, ltl VC, mch M, fn, & Vfn	
375-380	5	.....	Ss, lt yl bn, C&M, P cem, tr VC, mch fn&Vfn; mch st	
380-395	15	.....	Ss, lt yl bn, C&M, rnd, P srtg, P cem, tr VC, mch fn&Vfn, ltl st	
395-400	5	.....	Ss, lt yl bn, M, rnd, P cem, mch C, ltl fn&Vfn; ltl st	
400-405	5	.....	Ss, lt yl bn, M, P cem, tr VC, mch C, ltl fn&Vfn; mch st	
405-410	5	~~~~~	Cl, pl ol, V sndy	
m410-420	10	.....	Ss, lt yl bn, M, rnd, P srtg, P cem, tr VC, mch C, ltl fn&Vfn; mch st	
420-425	5	.....	Ss, lt yl bn, M, rnd, P cem, ltl C, mch fn&Vfn; tr st	
425-435	10	.....	Ss, yl gry, C&M, rnd, P srtg, P cem, tr gran, ltl VC, mch fn&Vfn; tr st	
435-440	5	.....	Ss, yl gry, C&VC, rnd, P cem, tr Vfn gvl; mch gran	
440-445	5	.....	Ss, yl gry, C&VC, P cem, ltl gran, mch M, fn, & Vfn	
445-450	5	.....	Ss, yl bn, C&M, Sang, P cem, ltl gran, mch VC, fn, & Vfn	
450-455	5	.....	Ss, yl bn, C&VC, P cem, tr gran, mch M, ltl fn&Vfn	
455-460	5	.....	Ss, gn gry, M, P cem, tr gran, VC, mch C, fn, & Vfn	
460-465	5	.....	Ss, gn gry, C&M, P cem, ltl gran, mch VC, fn, & Vfn	
465-470	5	.....	Ss, lt yl bn, C&M, P cem, tr gran, ltl VC, fn, & Vfn	
470-475	5	.....	Ss, lt yl bn, C&VC, P cem, ltl Vfn gvl; mch M, fn&Vfn	
475-480	5	.....	Ss, pl yl bn, C&VC, P cem, ltl gran, mch VC, fn, & Vfn	
480-485	5	.....	Ss, lt yl bn, C&M, P cem, ltl gran, mch VC, fn, & Vfn	
485-490	5	.....	Ss, lt yl bn, C, P cem, ltl gran, mch VC, M, fn, & Vfn	
490-495	5	.....	Ss, lt yl bn, C&VC, P cem, ltl gran, mch M, fn, & Vfn	
495-503	8	.....	Ss, lt yl bn, C&VC, P cem, ltl gran, mch M, fn, & Vfn	
503-504	1	.....	Cl, gn gry, mch snd	

16" hole

504'

Formations: Alluvium, Galesville, Eau Claire, Mt. Simon

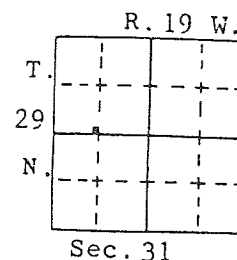
Well tested for 3½ hrs. at 900 gpm with 6 ft. of drawdown. Specific capacity = 150.0 gpm per ft. of drawdown.

Well name Hudson City Well #6

County: St. Croix

City of Hudson  
Address... 505 3rd Street  
Hudson, WI 54016  
Driller... Keys Well Drilling Co.  
Engineer... Short-Elliott-Hendrickson, Inc.  
St. Paul, Minnesota

Completed... 7/26/79  
Field check  
Altitude... 841' ETM  
Use..... municipal  
Static w.l. 124.5'  
Spec. cap.. 14.8 GPM/ft.



Location: SE $\frac{1}{4}$ , SE $\frac{1}{4}$ , SE $\frac{1}{4}$ , SW $\frac{1}{4}$ , NW $\frac{1}{4}$ , Sec. 31, T29N, R19W

Quad. Northline 7 $\frac{1}{2}$ '

Drill Hole						Casing & Liner Pipe or Curbing							
Dia.	from	to	Dia.	from	to	Dia.	Wgt. & Kind	from	to	Dia.	Wgt. & Kind	from	to
3"	0	80'				24"	Bk. Seamless 94.62#/ft.	0	80'				
5"	80'	611'				16"	Bk. Seamless 62.58#/ft.	+30"	294'				

Drilling method: cable tool  
Samples from 0 to 610' Rec'd: 8/9/79

Grout	from	to
Neat Cement	0	80'

Studied by: Mike Sukop (0-280')  
Kathleen Massie (280'-610')

Issued: 8-28-90

Formations: River Falls Formation, Eau Claire Formation, Mt. Simon Formation.

Remarks: Driller reports total well depth of 611'.  
Well tested for 44 hours at 1,000 GPM with 67.5 feet of drawdown.  
DNR Permanent Well #85682.

G OF WELL:

Depths	Graphic Section	Rock Type	Color	Grain Size		Miscellaneous Characteristics
				Mode	Range	
0-5		Silt	Dk yl bn	—	—	Silcs. Mch sand. Ltl gravel(Gran/M peb), clay, organic material.
5-10		Sand	"	C	Vfn/VC	Mch silt. Ltl gravel(Gran/M peb). Tr clay, organic material.
10-15		Silt	"	—	—	Much gravel(Gran/VL peb), sand. Trace clay.
15-20		Sand	Mxd bn yl	C	Vfn/VC	Little gravel(Gran/M peb). Trace silt, clay.
20-25		"	"	M	"	Trace gravel(Gran/S peb), silt, clay.
25-30		"	Mixed	C	"	Much gravel(Gran/L peb). Trace silt, clay.
30-35		"	"	"	"	Same.
35-40		"	"	"	"	Much gravel(Gran/M peb). Trace silt, clay.
40-45		"	"	"	"	Same.
45-50		"	"	"	"	Same minus silt.
50-55		"	"	"	"	Little gravel(Gran/M peb). Trace silt, clay.
55-60		"	"	"	"	Same.
60-65		"	"	"	"	"
65-70		"	"	"	"	Much gravel(Gran/L peb). Trace silt, clay.
70-75		"	"	"	"	Same.
75-80		"	"	"	"	Little gravel(Gran/M peb). Trace silt, clay.
80-85		"	"	"	"	Trace granules, silt.
85-90		"	"	M	"	Trace gravel(Gran/S peb), silt.
90-95		"	"	"	"	Same.
95-100		"	"	C	"	Few granules.
100-105		"	"	"	"	Little gravel(Gran/M peb). Trace silt.
105-110		"	"	"	"	Same.
110-115		"	"	"	"	Much gravel(Gran/L peb). Trace silt.
115-120		"	"	"	"	Little gravel(Gran/M peb). Trace silt.
120-125		"	"	"	"	Same.
125-130		"	"	"	"	Much gravel(Gran/M peb). Trace silt.
130-135		Gravel	"	S peb	Gran/L peb	Rhyolite, granite, trap, chert, glaucic ss. Mch sand. Tr silt.
135-140		"	"	L peb	"	Grnt, lim cemtd ss, qtzt, trap, cht, iron fm, rhy. Mch snd. Tr st.
140-145		"	"	"	"	Granite, rhy, trap, rhy porph, pyroclastics. Ltl sand. Tr silt.
145-150		"	"	VLP	Gran/VL peb	Rhy, granite, rhy porph, iron fm, pyrcl, chert. Ltl sand. Tr silt.
150-155		"	"	S peb	Gran/L peb	Rhy, rhy porph, cht, grnt, volc, pyrcl, hem cemtd ss. Mch snd. Tr st
155-160		"	"	Cob	Gran/Cob	Trap, grnt, cht, rhy porph, micus ss, lim cemtd ss, pyrcl, qtzt. Ltl snd. Tr st.

Well name: Hudson City Well #6

	Depths	Graphic Section	Rock Type	Color	Grain Size		Miscellaneous Characteristics
					Mode	Range	
R	160-165		Sand	Mxd dk yl bn	C	Vfn/VC	Trace gravel(Gran/S peb),silt,clay.
I	165-170		"	"	"	"	Trace gravel(Gran/M peb),silt,clay.
V	170-175		"	"	"	"	Much gravel(Gran/S peb). Trace silt.
E	175-180		"	"	"	"	Much gravel(Gran/L peb). Trace silt.
R	180-185		"	"	"	"	Much gravel(Gran/M peb). Trace silt.
	185-190		"	Mixed	"	"	Much gravel(Gran/M peb). Trace silt,clay.
	190-195		"	Yl brown	M	"	Trace gravel(Gran/L peb),silt,clay.
F	195-200		"	"	"	"	Trace gravel(Gran/S peb),silt,clay.
A	200-205		"	Mxd dk yl bn	VC	"	Little gravel(Gran/L peb). Trace silt,clay.
L	205-210		"	"	"	"	Little gravel(Gran/M peb). Trace silt,clay.
S	210-215		"	Mixed	"	"	Much gravel(Gran/L peb). Trace silt,clay.
	215-220		"	"	"	"	Same.
	220-225		"	"	"	"	Much gravel(Gran/M peb). Trace silt,clay.
	225-230		Gravel	"	L peb	Gran/L peb	Dol,pyrc,volc,cht,grnt,rhy,hem cemtd ss,Fe fm. Mch snd. Tr st.
	230-235		Sand	Yl brown	M	Vfn/VC	Much silt. Little gravel(Gran/M peb),clay.
F	235-240		Gravel	Mixed	S peb	Gran/L peb	Grnt,rhy,pyrc,cht,oolic cht,Fe fm,sil & lim cemtd ss,dol. Tr
M.	240-245		"	"	M peb	"	Rhy,pyrc,cht,sndy dol,dol. Mch snd. Tr st,cl.
	245-250		Sand	Mxdlt yl bn	C	Vfn/VC	Much silt. Little gravel(Gran/M peb),clay.
	250-255		"	Mxd yl bn	"	"	Little gravel(Gran/M peb),silt.
	255-260		Gravel	Mixed	L peb	Gran/VL peb	Pyroclastics,trap,rhy porph,silica cemtd ss,granite. Ltl snd,st.
	260-265		"	"	S peb	Gran/L peb	Rhy,trap,grnt,sndy dol,iron fm,pyrc,rhy porph. Ltl sand,silt.
	265-270		"	"	"	Gran/M peb	Pyrc,trap,granite,rhyolite,dolomite,sndy dol,Fe fm. Ltl snd,st.
80	270-275		"	"	VLP	Gran/VL peb	Pyrc,oolic chert,rhy,dolomite,grnt,trap. Ltl sand. Tr silt.
	275-280		Sand	Brown	C	Vfn/VC	Little gravel(Gran/S peb). Trace silt, uncons grans. One L peb.
E	280-285		Siltstone	Gray brown	—	—	Mch F to G slgtly dol cem,qy micus sh,mica,uncons snd. Tr pyr.
	285-290		"	Gray	—	—	Mch G to F slgtly dol cem,dk qy micus sh,mica,Vfn qtz snd. Tr
	295		"	Brown	—	—	Mch P to F slgtly dol cem,bn sh. Ltl Vfn/M- pyr, fos frags(?).
	300		"	"	—	—	Same plus tr qn qy sh. qtz snd,mica. Tr fos frags. Sfr samp
	300-305		"	"	—	—	Same.
	305-310		"	Gray brown	—	—	Mch F to G slgtly dol cem,bn sh,qn qy sh,mica. Ltl Vfn/M-qtz
	310-315		"	"	—	—	Same but tr qn qy shale. snd. Tr Fn-glauc, fos frags.
	315-320		Shale	Olive gray	—	—	Silcs,micus. Mch qy bn sts & sh as abv. Tr pyrite,fossil frags.
	320-325		"	"	—	—	Same. / Fn-zr,Vfn/Fn-qtz snd. Tr pyr, fos frags,C-snd.
	325-330		Siltstone	"	—	—	Mch VG to F dol cem,mica,qn qy silcs micus sh(as abv). Ltl Vfn/
	330-335		"	"	—	—	Same but much Vfn/Fn-zircon.
	335-340		Shale	"	—	—	Silcs. Micus. Mch st w/ltl cem. Ltl Vfn/Fn-glauc,Vfn/Fn-qtz snd.
	340-345		"	"	—	—	Same. / Tr pyr, fos frags,M/VC qtz snd.
	345-350		"	"	—	—	"
	350-355		"	"	—	—	Silcs. Micus. Mch dolie sts/Vfn dolie ss(fossif,micus,glaucic).
	355-360		"	"	—	—	Same. / mica. Few fos frags. Ltl Vfn/Fn glauc. Tr pyr,M/VC qtz snd
	360-365		"	"	—	—	Tr pyr,Vfn/Fn-glauc,M/C qtz snd.
	365-370		"	"	—	—	Silcs. Micus. Mch dolie sts,Vfn/Fn qtz snd,mica. Few fos frags.
	370-375		"	"	—	—	Silcs. Micus. Mch dolie sts,Vfn/Fn qtz snd,mica,qn qy micus sh.
	375-380		"	"	—	—	See end of log. / Tr pyr, fos frags,Vfn/Fn-glauc,M/VC qtz snd.
	380-385		Sandstone	"	Vfn&C	Vfn/VC	Ang & Wrnd. Mch G to F sil cem,qtz st,sh,mica, / rnd qtz grans.
	385-390		"	"	"	"	Same. / frstg. Few fos frags,pyr incl & fil ctngs. Tr
	390-395		"	"	Fn&C	"	pyr. Cem w/finest grns.
	395-400		"	"	"	Vfn/Gran	"
	400-405		"	Gray	"	"	Sang & Wrnd. Mch G to F sil cem(fines),qtz st,sh,frstg,pyr(as
	405-410		"	"	M/C	"	Same but srnd to Wrnd. / incl,fil ctngs & tr cem). Ltl mica. Few
	410-415		"	"	Fn&C	"	Same but sang & Wrnd. / fos frags,sec qtz grw. Tr mfc incl,qn
	415-420		"	"	"	"	Same. / qy micus sh,Fn-glauc,Fn/M-zr.
	420-425		"	"	"	"	"
	425-430		"	"	Fn/M	"	Sang to rnd. Mch F to G sil cem(fines),qtz st,sh,frstg. Few sec
	430-435		"	"	Fn&C	"	See end of log. / qtz grw,pyr fil ctngs & incl. Ltl mica. Tr mfc
	435-440		"	Lt ol gray	"	"	Same as 430'-35'. / incl,G pyr cem, fos frags,qn qy micus sh,Fn-
0	440-445		"	"	M/C	"	See end of log. / glauc,Fn/M-zr.
	445-450		Shale	"	—	—	Silcs. Micus. Mch mica,qtz st,qtz snd(Vfn/Gran),F to G sil cem
	455		Sandstone	"	M/C	Vfn/Gran	Srnd to Wrnd. Mch F to G sil cem / (w/fines). Ltl qy micus sh.
	455-460		"	"	"	"	Same plus tr G pyr. / (fines),qtz st,mica,sh,frstg. Few sec qtz
	460-465		"	"	"	"	Same. / grw. Tr mfc incl,Fn-zr, fos frags,qy micus
I	465-470		"	"	"	"	sh.
M	470-475		"	"	Fn/M	"	Same but subangular to rounded.
O	475-480		"	Lt bn gray	M/C	"	Same but subrounded to well rounded.
N	480-485		"	"	"	"	Same.
	485-490		"	"	"	"	Same though less shale & silt.

Well name: Hudson City Well #6

	Depths	Graphic Section	Rock Type	Color	Grain Size		Miscellaneous Characteristics
					Mode	Range	
M	490-495		Sandstone	Lt bn gray	M/C	Vfn/Gran	Srnd to Wrnd. Ltl F sil cem,qtz st,mica. Mch sh,frstg. Tr G pyr
T	495-500		"	"	Fn/M	"	Same but subangular to rounded but much quartz silt,mica.
S	500-505		"	"	M/C	"	Same but subrounded to well rounded.
I	505-510		"	"	"	"	Same.
M	510-515		"	"	"	"	"
O	515-520		"	Light gray	"	"	Rnd to Wrnd. Tr P sil cem,mfc incl,pyr incl & fil ctngs,qn gy
N	520-525		"	"	"	"	Same but mch qtz st. micus sh,fos frags,Fn-zr,sec qtz grw. Mch
	525-530		"	"	"	"	Same. frstg. Ltl qtz st,sh,mica.
	530-535		"	"	"	"	"
F	535-540		"	"	"	"	"
O	540-545		"	"	"	"	Same but much shale.
R	545-550		"	"	Fn/M	"	Same.
M	550-555		"	"	M/C	"	"
A	555-560		"	V pl brown	C/VC	"	Wrnd. Tr G pyr cem,G sil cem(fines),mfc incl,sec qtz grw,Fn-zr,
T	560-565		"	"	"	"	Same. fos frags. Mch frstg. Ltl qn gy micus sh,st,sh. Few S pebs.
I	565-570		"	"	"	"	Wrnd. Tr G pyr cem,G sil cem(fines),mfc incl,sec qtz grw,Fn-zr,
O	570-575		"	"	"	"	See end of log. qn gy micus sh. Mch qtz st,sh.
N	575-580		Conglomerate	"	Gran	Gran/S peb	Wrnd. Tr G pyr cem,mfc incl,sec qtz grw. Mch frstg,qtz snd. Ltl
	580-585		"	"	"	"	Same. qtz st,sh.
	585-590		Sandstone	Pkyl&lt;yl bn	Fn	Vfn/VC	Ang(?). Mch V VG lim cem,st,qtz grans & S pebs. Ltl yl lim sh.
	590-595		Conglomerate	Lt yl bn	S peb	Gran/M peb	See end of log. bl micus feldpthc sh(hd to sft),mica(w/cem).
	595-600		"	"	Gran	"	See end of log. Vfn/Fn mfc snds,qn gy micus sh,pyr.
	600-605		Sandstone	"	M&Gr	Vfn/Gran	Srnd & rnd. Mch G limy cem w/mch yl wh feldpthc matx,st. Ltl sh.
	605-610		Ss & sh	Lt yln&lt; qn gy	Fn/M&Gr	"	V micus. Silcs. bl micus feldpthc sh. Tr G pyr cem,mfc & pyr
				END OF LOG			Srnd & rnd. Mch VG limy incl,qn gy micus sh,Wrnd qtz S pebs.
							cem w/mch yl wh feldpthc matx,qn mica,wh to bk fos frags(w/
							sh & sts lyrs),frstg. Few S pebs. Ltl sil cemtd sts(inter-
							lyrd w/sh & fos). Tr pyr(w/sh & sts),G pyr cem,Vfn mfc
							snds,mfc incl,yl bn lim sh,pl bl feldpthc sh.
							"See end of log" samples.
	375-380		Shale	Olive gray	—	—	Siliceous. Micaceous. Much silt,Vfn/VC quartz sand,mica. Few
							fossil fragments, Trace pyrite,Vfn/Fn-glaucinite. Little G to
							F quartz cement.
	430-435		Sandstone	Gray	Fn&C	Vfn/Gran	Same as 425'-430' but subangular & well rounded,plus trace pale
							green micaceous shale.
	440-445		Sandstone	Lt ol gray	M/C	Vfn/Gran	Subrounded to well rounded. Much F to G silica cement(fines),
							quartz silt,shale,frosting. Trace G pyrite cement,pyrite fil
							coatings,mafic inclusions,secondary quartz growths,Fn-zircon,
							green gray micaceous shale,fossil fragments.
	570-575		Sandstone	V pl brown	C/VC	Vfn/Gran	Well rounded. Trace G pyrite cement,G silica cement(fines),mafic
							inclusions,secondary quartz growths,Fn/M-zircon. Little green
							gray micaceous shale,quartz silt,shale. Few well rounded
							quartz pebbles. Much frosting.
	590-595		Conglomerate	Lt yl bn	S peb	Gran/M peb	Rounded. Much quartz sand,frosting. Little silt,green gray micus
							shale. Trace blue micaceous feldspathic shale,mafic inclusions.
	595-600		Conglomerate	Lt yl bn	Gran	Gran/M peb	Rounded. Much quartz sand,frosting,quartz silt. Little shale.
							Trace G dolomite cement(Fn/M sandstone),green gray micaceous
							shale,mafic inclusions,pyrite.

## WELL RECORD

SC - #753

# KEYS WELL DRILLING COMPANY

## WATER PRODUCERS

SAINT PAUL, MINNESOTA

Owner City of Hudson Date Completed December 27, 89  
 Location 4th Street North - North of Summer Street Driller James Sampson  
 Well No. #7 Size 24" x 18" Total Depth 522' Type Sandrock

## DRILLERS LOG

745  
 0' to 18' Sand  
 18' to 138' Sand & Gravel  
 138' to 164' Sandstone & Shale  
 164' to 175' Shale & Gravel  
 175' to 195' Shale  
 195' to 258' Sandstone (grey)  
 258' to 340' Shale (grey & blue)  
 340' to 370' Sandstone & Shale  
 370' to 392' Sandstone (grey)  
 392' to 410' Shale & Sandstone (grey)  
 410' to 517' Sandstone  
 517' to 522' Shale  
 \_\_\_\_\_' to \_\_\_\_\_'  
 \_\_\_\_\_' to \_\_\_\_\_'

## WELL MATERIALS

153' of 24" diameter of Outer Casing  
 369' of 23" diameter of Open Hole  
 381' of 18" diameter of Inner Casing  
 \_\_\_\_\_' of \_\_\_\_\_" diameter of Open Hole  
 0' to 381' Mix grout 35% (yds.) (bags)  
 \_\_\_\_\_' diameter \_\_\_\_\_ Screen

## RECORD OF TEST PUMPING

Static Water Level 90 ft. from Top of Pipe  
 710 GPM 74' 1" D.D. 10 Hours  
 1000 GPM 98' 11" D.D. 24 Hours  
 759 GPM 71' 4" D.D. 8 Hours  
 \_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours  
 \_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

## Remarks:

Well was blasted with 370 lbs of dynamite  
 and bailed out and air developed for  
 35 1/2 hours. Well was tested for total  
 of 87 hours

## PERMANENT PUMP DATA (LATER)

Mfg. \_\_\_\_\_ Type \_\_\_\_\_ Serial No. \_\_\_\_\_  
 Capacity \_\_\_\_\_ GPM \_\_\_\_\_ TDH \_\_\_\_\_  
 Motor Make \_\_\_\_\_ Type \_\_\_\_\_  
 \_\_\_\_\_ H. P. \_\_\_\_\_ Volts \_\_\_\_\_ Ph. \_\_\_\_\_ RPM  
 \_\_\_\_\_ ft. \_\_\_\_\_ in Col. pipe \_\_\_\_\_ in. Shaft  
 \_\_\_\_\_ ft. \_\_\_\_\_ in Bows \_\_\_\_\_ Stages \_\_\_\_\_ Type \_\_\_\_\_  
 \_\_\_\_\_ ft. \_\_\_\_\_ in suction pipe & \_\_\_\_\_  
 \_\_\_\_\_ ft. Total Length of Pump  
 \_\_\_\_\_ ft. \_\_\_\_\_ in. drop pipe & \_\_\_\_\_ No. Cable  
 \_\_\_\_\_ ft. \_\_\_\_\_ in. air line  
 \_\_\_\_\_ in. Pitless \_\_\_\_\_ ft. bury \_\_\_\_\_ in outlet \_\_\_\_\_

**KEYS WELL DRILLING COMPANY**  
**WATER PRODUCERS**  
SAINT PAUL, MINNESOTA

## DRILLERS LOG

0	to	249	Drift
249	to	256	Shale
256	to	261	Sand/trace Sandstone
261	to	278	Shale
278	to	305	Sand & Gravel
305	to	320	Sandstone, some gravel
320	to	325	Sandstone, some shale
325	to	332	Sandstone
332	to	348	Shale
348	to	358	Sandstone, Shale
358	to	423	Shale, fine Sandstone layers
423	to	458	Sandstone with black specks
	to		
	to		

' of \_\_\_\_\_ " diameter of Outer Casing.  
' of 9-7/8 " diameter of Open Hole  
' of 6 " diameter of Inner Casing  
' of 5-7/8 " diameter of Open Hole  
' to \_\_\_\_\_ Mix grout \_\_\_\_\_ (yds.) (Sacks)  
' \_\_\_\_\_ " diameter \_\_\_\_\_ Screen

Static Water Level 175 ft. from top of pipe

\_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

\_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

S \_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

\_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

\_\_\_\_\_ GPM \_\_\_\_\_ D.D. \_\_\_\_\_ Hours

Remarks: \_\_\_\_\_

Mfg. \_\_\_\_\_ Type \_\_\_\_\_ Serial No. \_\_\_\_\_  
Capacity \_\_\_\_\_ GPM \_\_\_\_\_ TDH \_\_\_\_\_  
Motor Make \_\_\_\_\_ Type \_\_\_\_\_  
\_\_\_\_\_ H. P. \_\_\_\_\_ Volts \_\_\_\_\_ Ph. \_\_\_\_\_ RPM \_\_\_\_\_  
\_\_\_\_\_ ft. \_\_\_\_\_ in Col. pipe \_\_\_\_\_ in. Shaft \_\_\_\_\_  
\_\_\_\_\_ ft. \_\_\_\_\_ in Bowls \_\_\_\_\_ Stages \_\_\_\_\_ Type \_\_\_\_\_  
\_\_\_\_\_ ft. \_\_\_\_\_ in suction pipe & \_\_\_\_\_  
\_\_\_\_\_ ft. Total Length of Pump \_\_\_\_\_  
\_\_\_\_\_ ft. \_\_\_\_\_ in. drop pipe & \_\_\_\_\_ No. Cable \_\_\_\_\_  
\_\_\_\_\_ ft. \_\_\_\_\_ in. air line \_\_\_\_\_  
\_\_\_\_\_ in. Pitless \_\_\_\_\_ ft. bury \_\_\_\_\_ in outlet \_\_\_\_\_







MINNESOTA COUNTY WELL INDEX.  
UNIQUE NO.: 420985 (CONTINUED)

315	SANDSTONE SHALE SEAMS GREEN	GRAY	MEDIUM	
[ 460]	[SANDSTONE	][CMTS][MT.SIMON		] [CAM]
315	335 SANDSTONE RED + GRN SHALE SEAMS	GRAY	MED-SFT	
[ 435]	[SANDSTONE	][CMTS][MT.SIMON		] [CAM]
335	365 SANDSTONE RED + GRN SHALE SEAMS	GRAY	SOFT	
[ 415]	[SANDSTONE	][CMTS][MT.SIMON		] [CAM]
365	380 SANDSTONE SHALE SEAMS	BROWN	MED-HRD	
[ 385]	[SANDSTONE	][CMTS][MT.SIMON		] [CAM]

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MINNESOTA COUNTY WELL INDEX/WELL LOG.

UN.NO./CD. : 420985/82

NAME : LAKELAND 1

EO.INTRP: NGS

GEOLOGST: BB

METHOD : GEO.STUDY<1:100X

WELL CONSTRUCTION.

DRILLER'S NAME: WENDT, F.

DRV.SH.: YES

DRILLING METHOD: CABLE TOOL

FLUID :

CASING MATERIAL: STEEL

JOINTING: WELDED

TOP: 2.58 FT.

[GROUT-----]

	DIAM(IN)	FROM(FT)	TO(FT)	MATERIAL	AMNT	UNITS
CASING 1 :	20	0	220			
CASING 2 :	14	0	245			

SCREEN.

PRESENT?: NO

OPEN HOLE FROM: 245 FT. TO: 380FT.

PUMP : DATA UNAVAILABLE.

PUMPAGE TEST(S).

	STATIC WATER LEVEL:	65 FT.	DATE: 1990/11/08
	LEVEL(FT)	HOURS	GPM
			DRAWDOWN(FT)
TEST 1:	110	3	600
TEST 2:	159	8	1200

DRILLER'S/GEOLOGIC LOG

Depth

INTERVAL	DRILLER'S DESCRIPTION	COLOR	HARDNESS
[EL.TOP]	[INTERPRETED LITHOLOGY]	[[CODE]]	[STRATIGRAPHIC UNIT(S)] [AGE]
0	3 TOPSOIL SANDY DRY	BLACK	SOFT
[ 750]	[SOIL, ORGANIC DEPOSITS, SA]	[RUUX]	[BLACK] [REC]
3	20 COARSE GRAVEL MED-LG BOULDERS		
[ 747]	[GRAVEL, BOULDER	[GBUU]	[GRAVEL] [QUA]
20	43 COARSE SAND + GRAVEL + LG BOULDER		
[ 730]	[SAND, GRAVEL, BOULDER	[GHUU]	[SAND+GRAVEL] [QUA]
43	63 FINE SAND CLAY LAYERS	GRAY	SOFT
[ 707]	[SAND, CLAY	[BLUG]	[CLAY+SAND,GRAY] [QUA]
63	69 MEDIUM TO COARSE SAND & GRAVEL		
[ 687]	[SAND, GRAVEL	[GHUU]	[SAND+GRAVEL] [QUA]
69	79 FINE SAND CLAY LAYERS	BROWN	
[ 681]	[SAND, CLAY	[BLVB]	[CLAY+SAND,BROWN] [QUA]
79	105 MEDIUM TO COARSE GRAVEL		
[ 671]	[GRAVEL	[GBUU]	[GRAVEL] [QUA]
105	145 MEDIUM TO FINE SAND & GRAVEL		
[ 645]	[SAND, GRAVEL	[GHUU]	[SAND+GRAVEL] [QUA]
145	165 MEDIUM TO COARSE SAND	BROWN	
[ 605]	[SAND	[GBVB]	[SAND,BROWN] [QUA]
165	216 COARSE SAND + GRAVEL + BOULDERS		
[ 585]	[SAND, GRAVEL, BOULDER	[GHUU]	[SAND+GRAVEL] [QUA]
216	217 LIMESTONE (SHELL)	BROWN	HARD
[ 547]	[SANDSTONE	[CHTS]	[MT.SIMON] [CAM]
217	270 SANDSTONE SHALE SEAMS	GRAY	MED-SFT
[ 533]	[SANDSTONE	[CHTS]	[MT.SIMON] [CAM]
270	290 SANDSTONE	GRAY	HARD
[ 480]	[SANDSTONE	[CHTS]	[MT.SIMON] [CAM]

MINNESOTA COUNTY WELL INDEX.  
 UNIQUE NO.: 420985 (CONTINUED)

\*\*\*\*\*  
 MINNESOTA COUNTY WELL INDEX.

UN.NO./CO. : 420985/82 ENTERED: 1991/05/20  
 NAME : LAKELAND 1 UPDATED: 1993/12/02

COUNTY : WASHINGTON USE : MUNICIPAL DRILLED: 1990/12/28  
 T/R/SEC. : 29/20/26DCBDCA DEPTH : 380 FT. DEPTH D: 380 FT.  
 ELEVATION: 750 FT.(TOPO ) CASD : 245 FT. GROUT : YES  
 DIAM. : 14 IN. DRL/DS : 27010 :LAYNE WELL CO.  
 LOC.METH.: INFO.OWNER LOC.BY : MGS COORDS.:  
 STATUS : ACTIVE WHPA : DNR PA#:

DPH BDRK: 216 FT. REDROCK: MT.SIMON  
 OPEN HOLE: MT.SIMON  
 AQUIFER : MT.SIMON

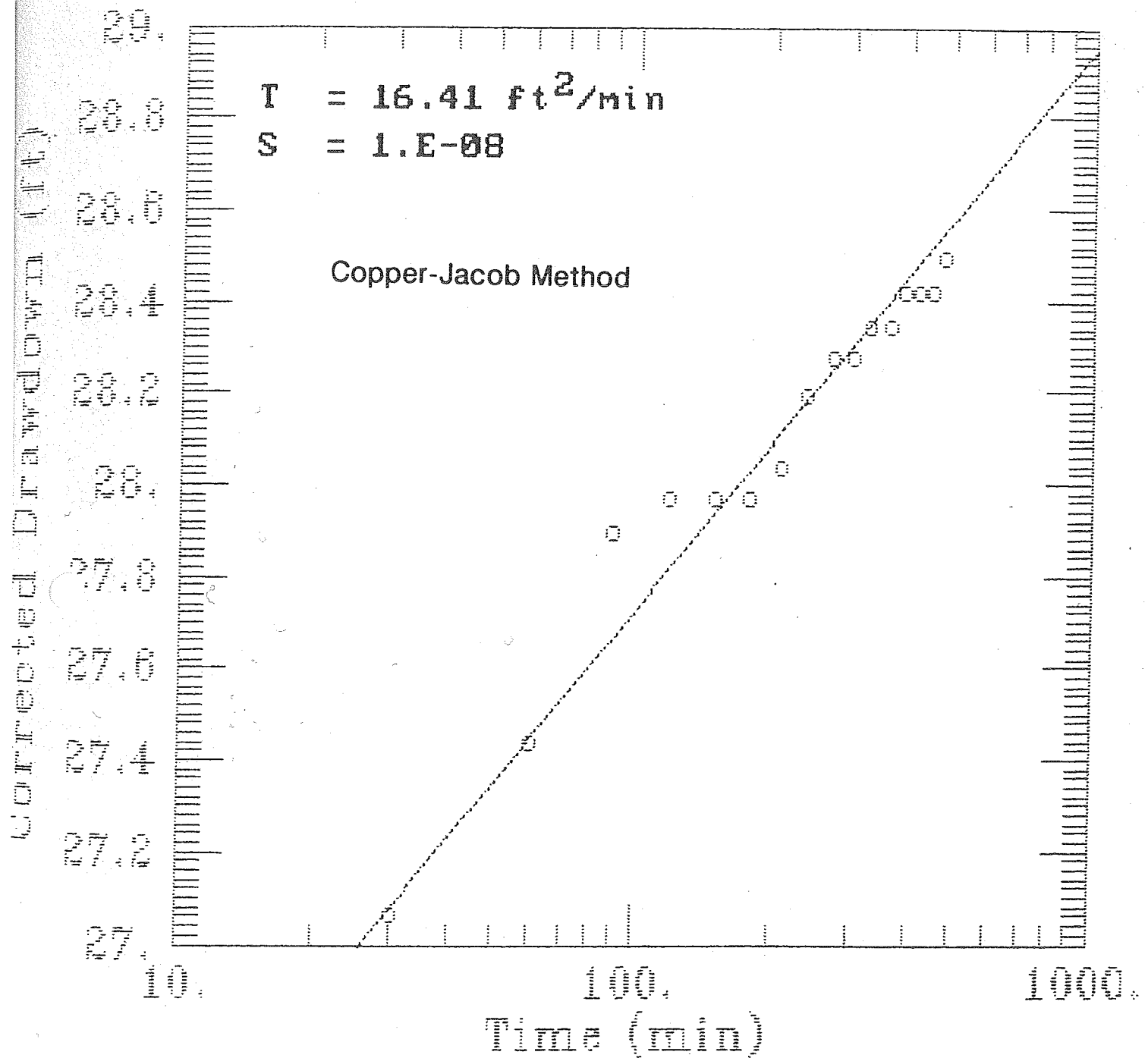
QUAD(7.5): HUDSON CONTACT:  
 CWI/WL: YES CWI/WC: NO CORE/CTINGS/GP.: CUTINGS/GEOPHYS

DATE	NITRATE	BACTERIA	SOURCE	SWL	ELEV	SOURCE
1990/11/08				65	685	27010

COMMENTS: GAMMA LOGGED 10-26-90.  
 M.S.S. NO. 3033.

\*\*\*\*\*

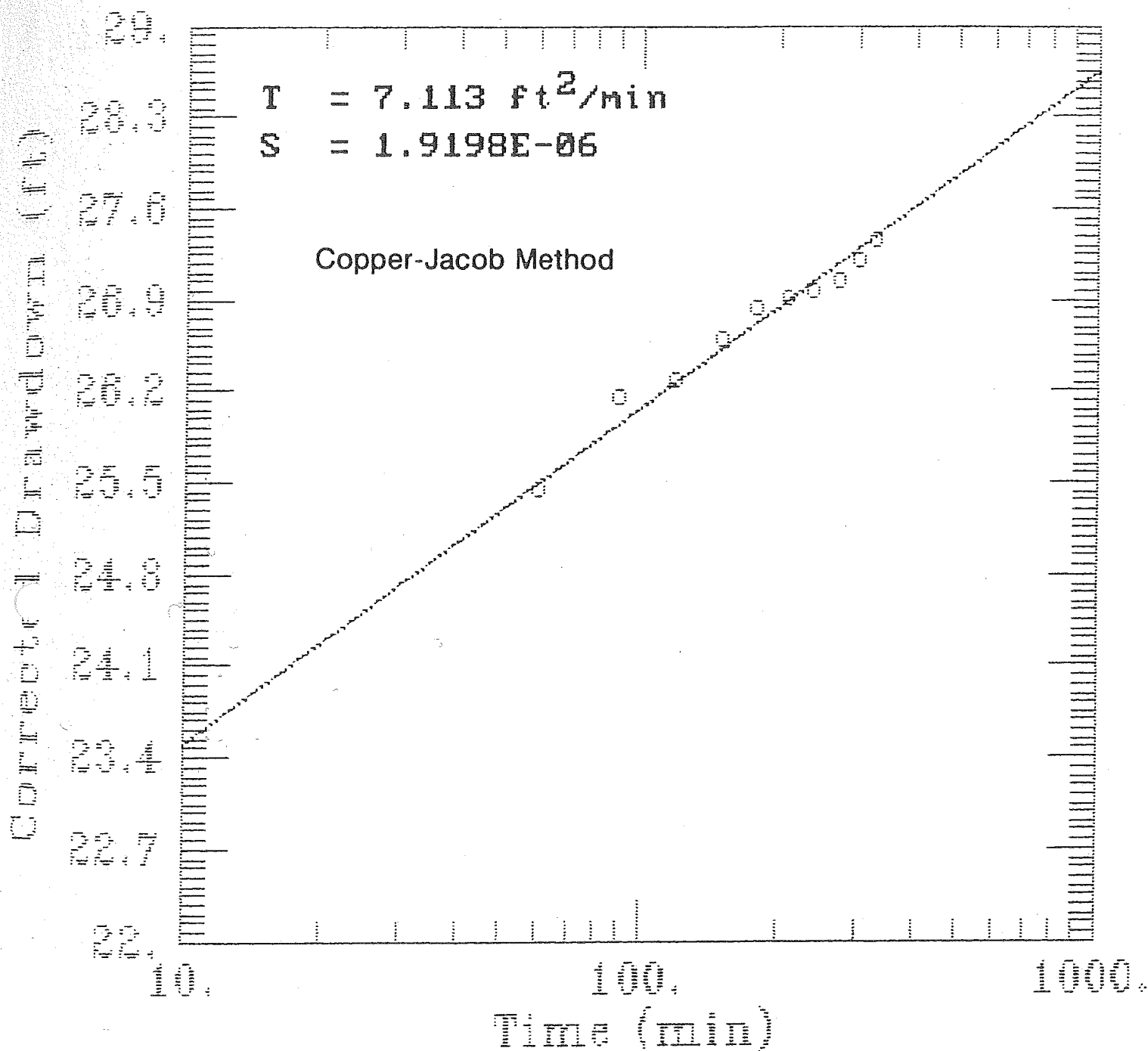
# Hudson Test Well # 8



# Hudson Test Well # 8 (3/25/94)

$T = 7.113 \text{ ft}^2/\text{min}$   
 $S = 1.9198\text{E-}06$

Copper-Jacob Method



# Hudson Test Well # 8

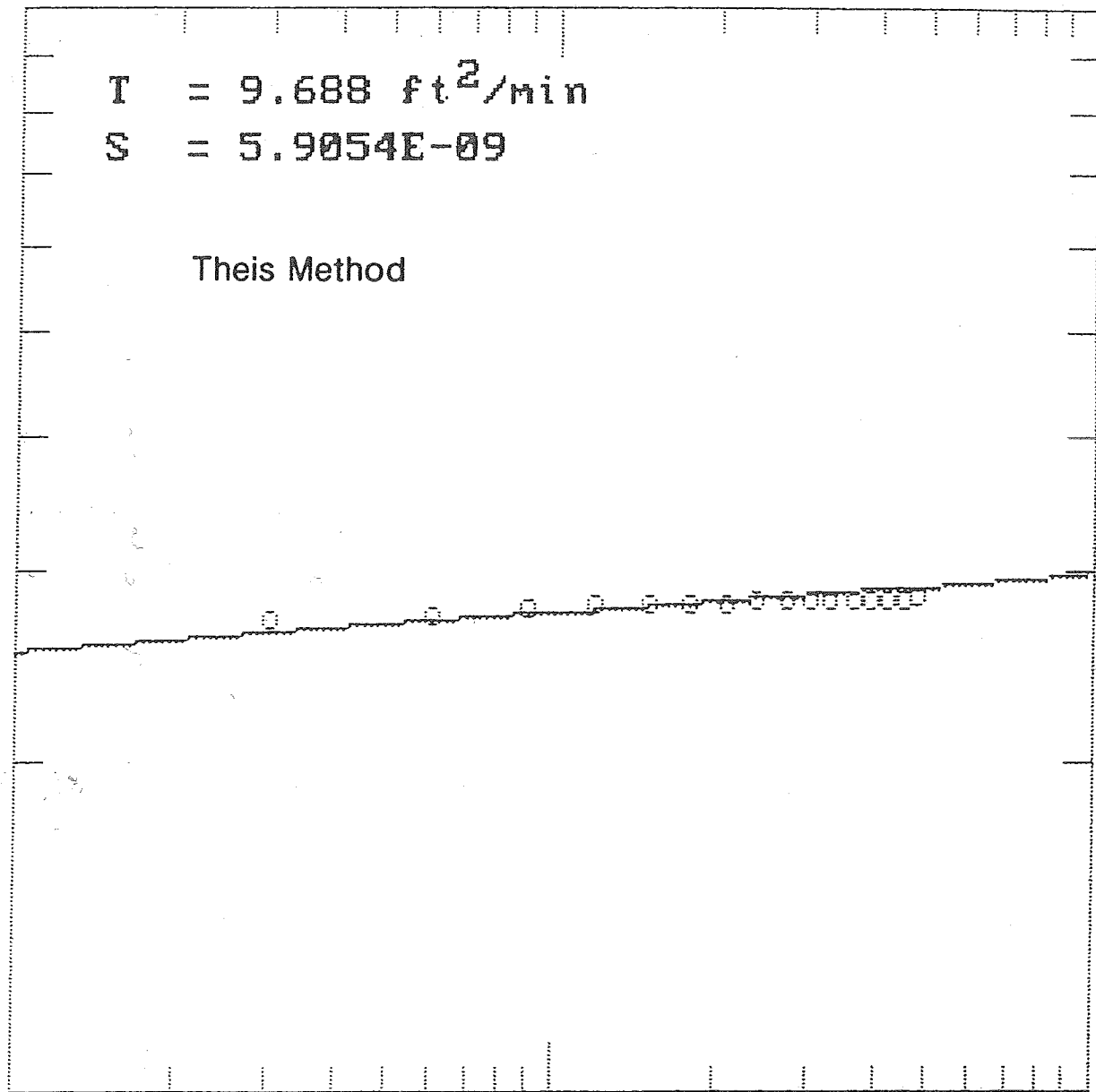
$$T = 9.688 \text{ ft}^2/\text{min}$$

$$S = 5.9054\text{E-}09$$

Theis Method

Corrected Drawdown (ft)

Time (min)



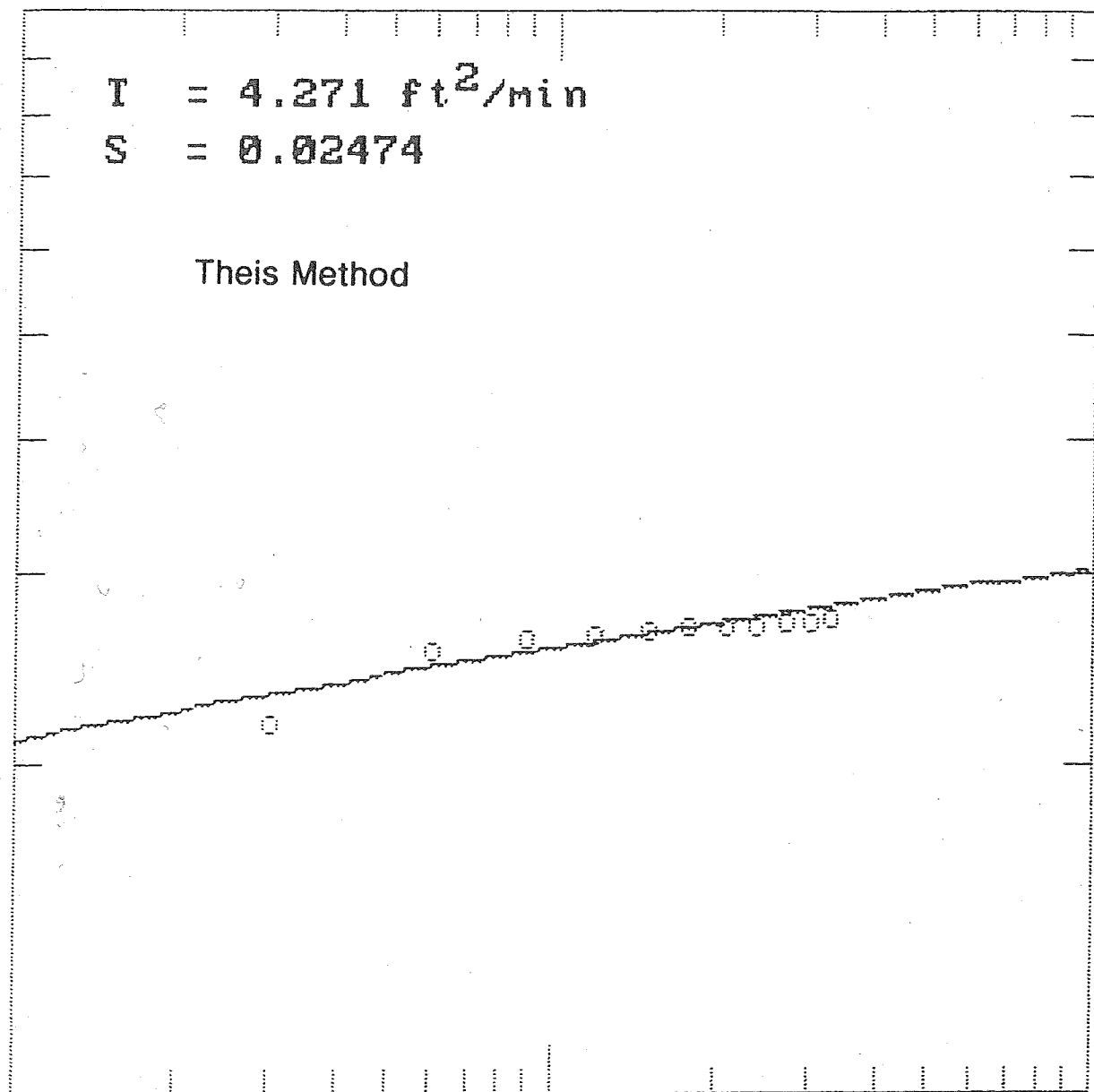
# Hudson Test Well # 8 (3/25/94)

$$T = 4.271 \text{ ft}^2/\text{min}$$

$$S = 0.02474$$

Theis Method

Corrected Drawdown (ft)



Time (min)

WELL TEST REPORT  
by KEYS WELL DRILLING CO., ST. PAUL, MINN.

Job City of Hudson, Wisconsin Job No. 9330

Place \_\_\_\_\_ Well No. \_\_\_\_\_ Test Hole # 8

Static Water Level 170'6" From Top of Pipe

Start of Test 8:30 (AM) ~~(PM)~~ . Stop 4:30 ~~(AM)~~ (PM)

[illegible]

Total Hour Tested Today 8 Hours

Date March 24, 1993

Day of Week Wednesday

1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 26



WELL TEST REPORT  
by KEYS WELL DRILLING CO., ST. PAUL, MINN.

Job City of Hudson, Wisconsin Job No. 9330

Place \_\_\_\_\_ Well No. \_\_\_\_\_ Test Hole #8

Static Water Level 171'8" From                     

Start of Test 10:30 (AM) ~~(PM)~~ Stop 3:30 ~~(AM)~~ (PM)

[illegible]

Total Hour Tested Today 5 Hours

Date 03/25/93

Day of Week Thursday

Sheet No. 2

Signed

William Murray

3. Groundwater elevations range between 990 and 945 feet above MSL. Groundwater elevations appear to decrease as a function well depth which would suggest the presence of downward gradients within the Prairie Du Chien aquifer. This phenomenon can be seen when comparing the DNFC MW-2 with the Ellsworth Creamery well (WUWN FD902).
4. Ellsworth Frozen Foods well, located approximately 300 feet north of DNFC was reported as abandoned.

Of the seventeen Leaking Underground Storage Tank (LUST) sites located in the study area, only the Super America gas station and the Pierce County Courthouse sites installed monitoring wells. The Pierce County Courthouse case is closed and the Super America case is active. The Cenex Farmers Union gas station, located directly south of DNFC conducted borings to bedrock during its LUST investigation, but did not encounter groundwater (Collins, Personal Interview). Ken's Mobil Petroleum Bulk Plant, located north of DNFC, recently initiated an environmental investigation, though no investigation of groundwater has been conducted to date.

### Local Groundwater Quality

Five of the fifteen wells depicted in figure 2 have been sampled for agricultural chemicals, and all five have detected herbicides and nitrates. Figures 6 through 8 illustrate the trends in agrichemicals detected in the two municipal wells and the creamery well. The analytical data was obtained from the WDNR Groundwater Retrieval Network (GRN) and the WDATCP Groundwater database. The Cenex (fka Ellsworth Farm Supply) well was recently sampled as part of a property transfer assessment, and the DNFC MW-2 was recently sampled.

The following tables represents a summary of the agrichemical concentrations reported from each of the above mentioned five wells.

Municipal Well#2 WUWN AY376

	Atrazine ug/l	Alachlor ug/l	Cyanazine ug/l	Metolachlor ug/l	Nitrate mg/l
Highest	3.1	0.4	Ø ND	1.0	5.09
Average	2.2	0.2	Ø ND	0.6	4.7
Sample size (n)	14	11	3	7	3

Municipal Well#3 WUWN BG675

	Atrazine ug/l	Alachlor ug/l	Cyanazine ug/l	Metolachlor ug/l	Nitrate mg/l
Highest	1.3	0.1	Ø ND	0.21	4.18
Average	0.77	0.03	Ø ND	0.18	3.38
Sample size (n)	9	4	2	4	4

*metolachlor?*

## Conclusions

Due to the thin or non-existence of overlying unconsolidated material and the presence of karst features in this agricultural region, groundwater is susceptible to agrichemical impacts. Within the study area the Prairie Du Chien (Lower Magnesian) carbonate sequence begins at approximately 984 feet above mean sea level (MSL). The first water bearing unit at DNFC is the dolomite within the Prairie Du Chien, which is consistent with the WGNHS generalized water-table map of Pierce County. Groundwater elevations appear to be influenced by well depth. When comparing the DNFC MW-2 and nearby creamery well, it appears that a downward vertical gradient could exist at DNFC.

True  
may or may not be true  
NO - SS

Herbicides and nitrate groundwater concentrations are widespread throughout the City of Ellsworth and nearby areas. Herbicide concentrations in the two municipal wells and creamery well are trending downward over the last seven years, while nitrate concentrations are trending slightly upward over the same time period. These public water supply wells are currently in compliance with state and federal standards with respect to herbicides and nitrates. The Ellsworth Creamery well is the nearest point of standards application to the DNFC.

## Recommendations

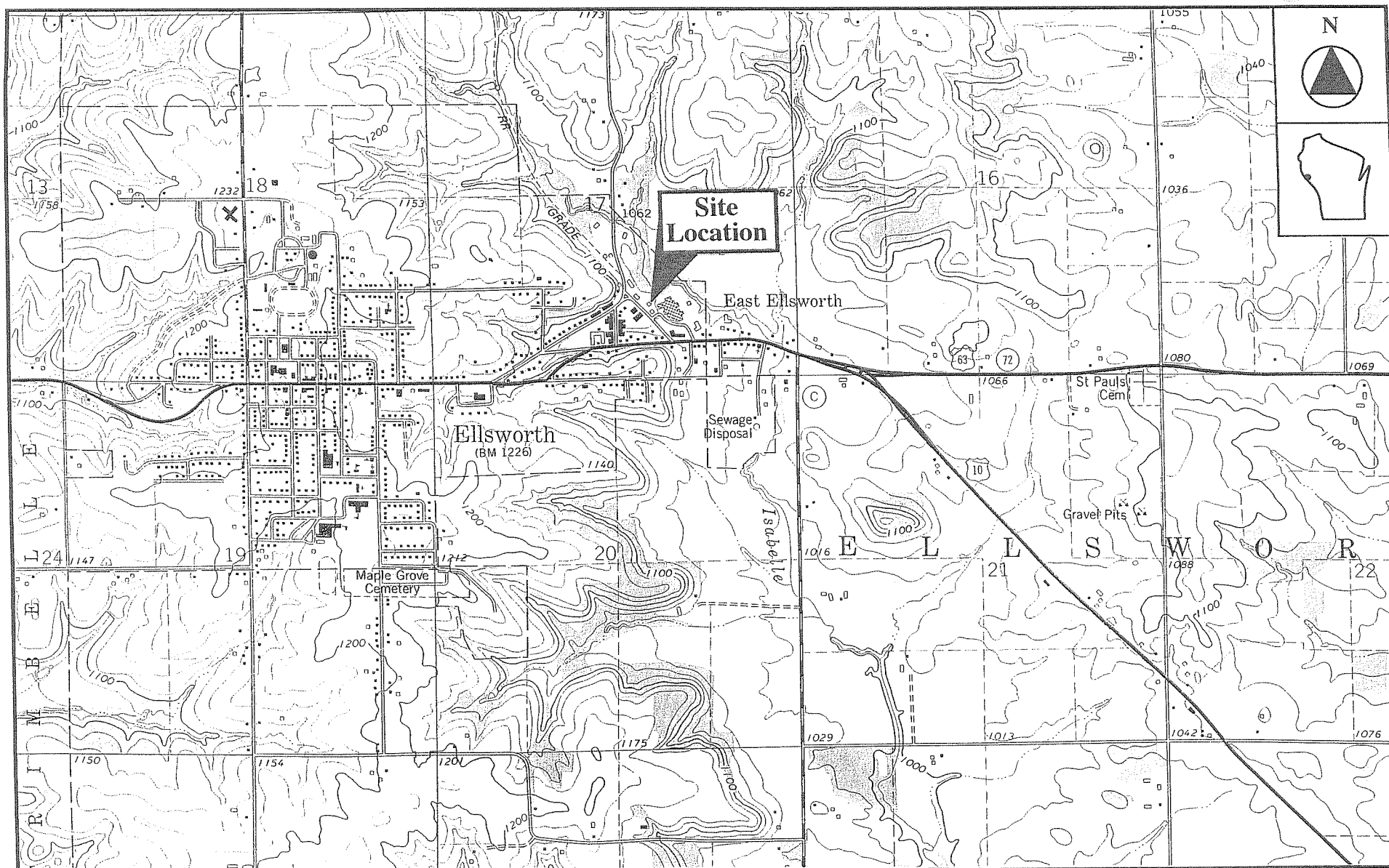
Because agrichemical concentrations are widespread throughout the area surrounding DNFC, it would be appropriate to consider those background concentrations when determining compliance with groundwater standards and determining the need for any further actions. Due to the presence of background concentrations of agrichemicals, the high cost of additional well construction (>\$12,000 per well), and the nearby creamery well testing consistently below drinking water standards, we are not recommending any additional monitoring well construction.

NO: ES's  
and ES

In an effort to lessen groundwater contamination concerns at DNFC, we propose to collect groundwater samples from MW-2 and the nearby creamery well in April and October 1998. The samples will be analyzed for atrazine, alachlor, metolachlor, and nitrate as nitrogen. Furthermore, DNFC is moving their fertilizer and chemical operations to a new facility in July 1998 and will conduct the soil remedy as previously proposed in August 1998. If after completion of the soil remedy, the groundwater concentrations are below or within groundwater standards when considering background concentrations, DNFC will request case closure.

?

1997



**Midwest Environmental  
Management Company**

**Deiss & Nugent Facility  
270 North Morse Street  
Ellsworth, Wisconsin**

## **FIGURE 1**

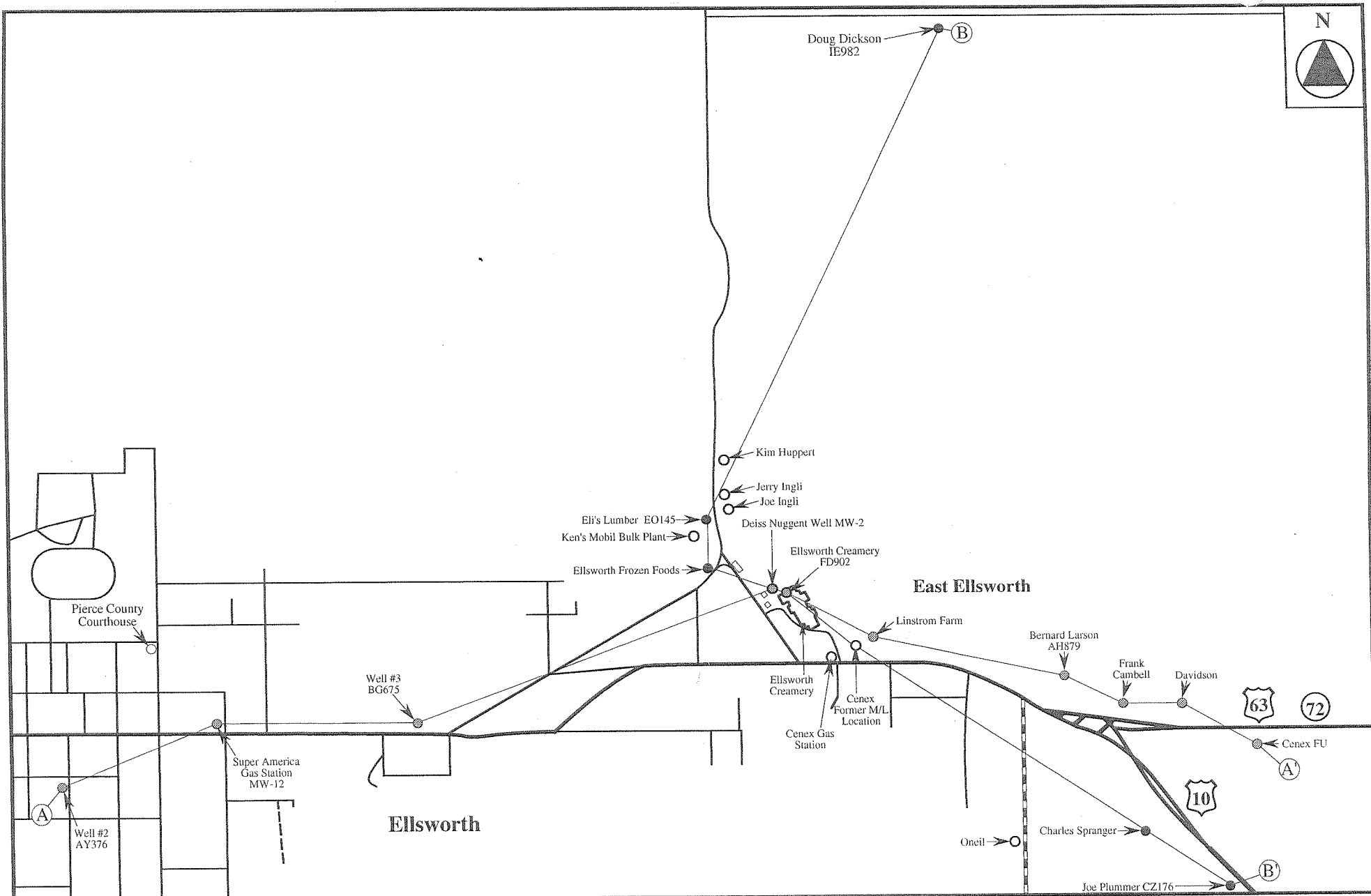
### **Site Location Map**

Source: USGS Ellsworth, WI 7.5' Quadrangle Map  
Scale: 1"=2,000' Contour Interval: 20 Feet

**Project Number: AG971038**

**Date: 1-6-98**

**By: RdM**



**Midwest Environmental  
Management Company**

**Deiss & Nugent Facility  
270 North Morse Street  
Ellsworth, Wisconsin**

**FIGURE 2  
Site Layout Map**

**Legend**

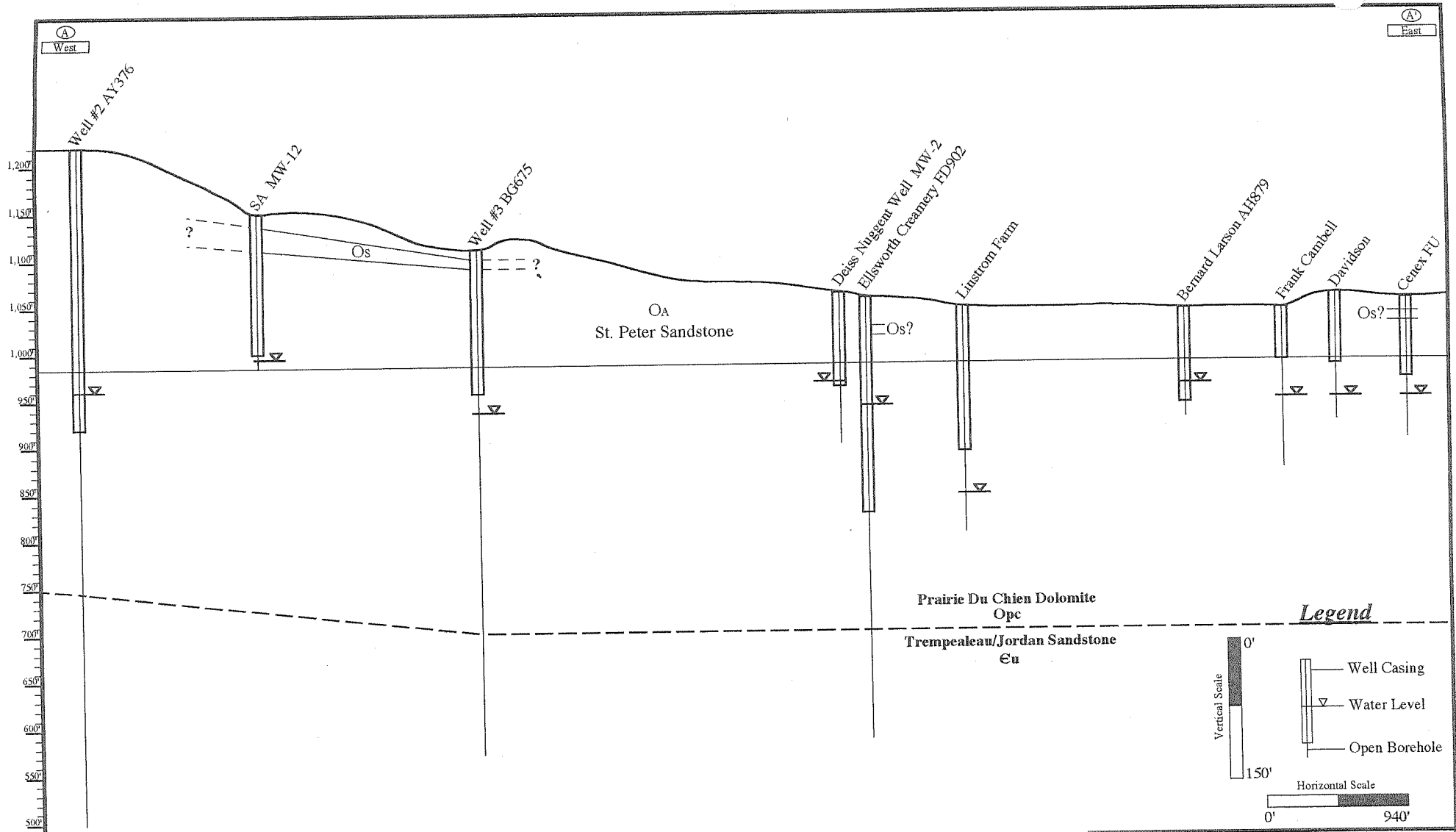
- A - A' Groundwater Wells
- B - B' Groundwater Wells
- Both A - A' and B - B' Wells

Project Number: AG971038

Date: 1-6-98

Approved By:

Prepared By: RdM



**Midwest Environmental  
Management Company**

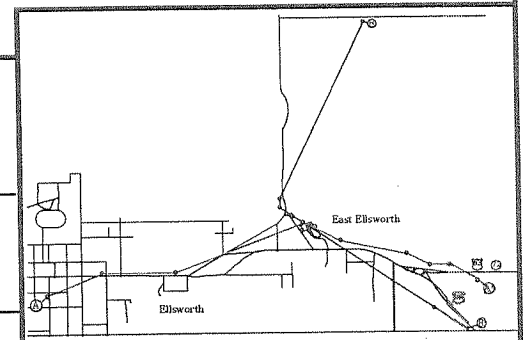
**Deiss & Nugent Feed Company, Inc.  
270 North Morse Street  
East Ellsworth, Wisconsin**

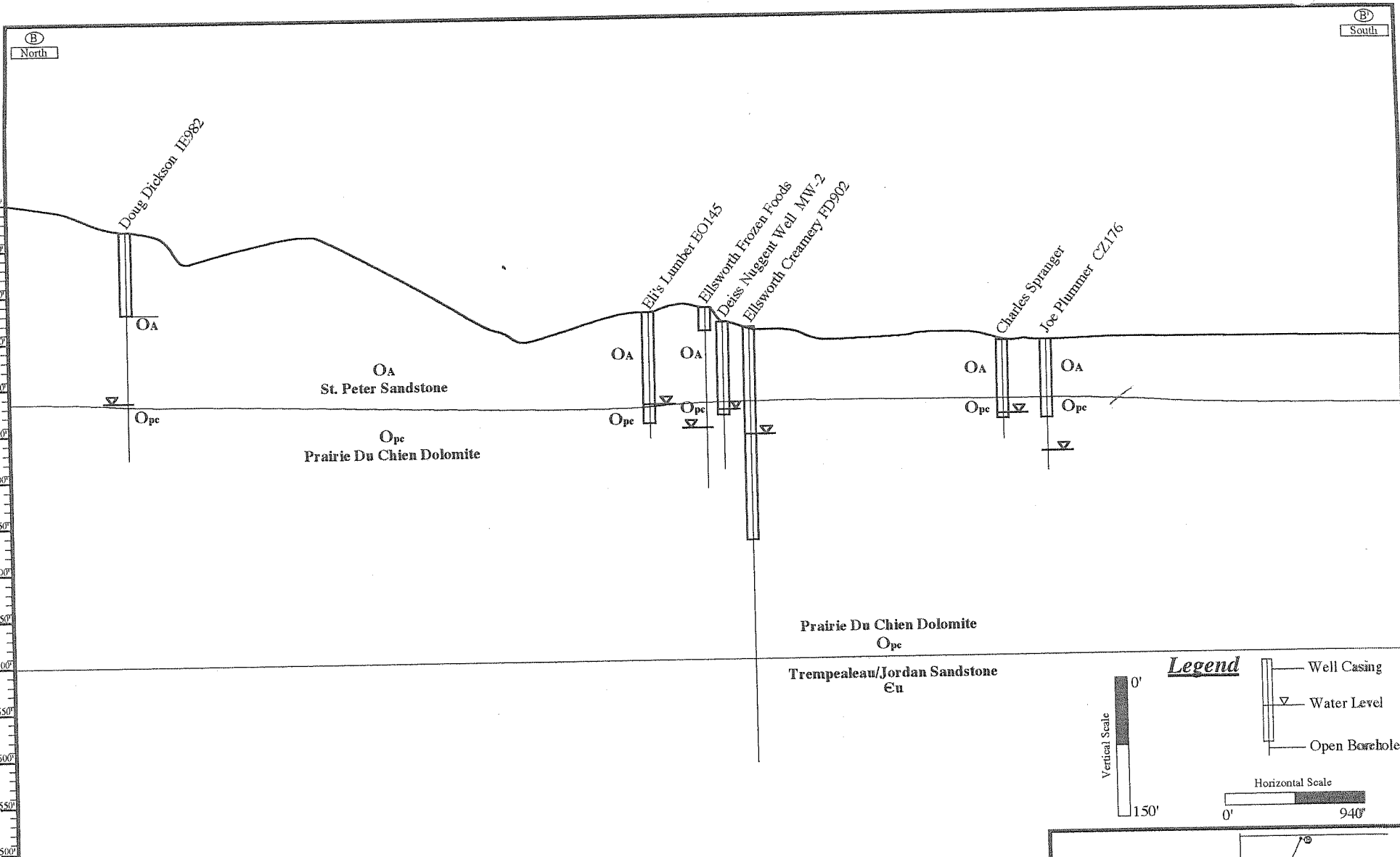
**FIGURE 3  
Cross Section Map A - A'**

Project Number: AG971038

Date: 12-30-97

Drawn By: RdM





**Midwest Environmental  
Management Company**

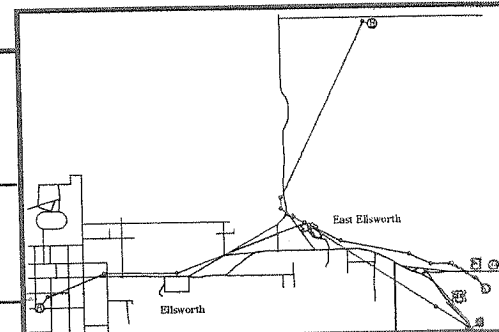
**Deiss & Nugent Feed Company, Inc.  
270 North Morse Street  
East Ellsworth, Wisconsin**

**FIGURE 4  
Cross Section Map B - B'**

Project Number: AG971038

Date: 12-30-97

Drawn By: RdM



Well Data

Well Name	Surface Elev.	GW Depth	GW Elev.	Total Depth	Depth to PDU	PDU Elev.	Status
Ellsworth Well 2 AY376	1220	-246	974	718	-225	995	Active
Ellsworth Well 3 BG675	1108	-173	935	540	-135	973	Active
Superamerica MW-12	1160	-165	995	172	-172	988	Active
Deiss & Nuggent MW-2	1062	-93	969	159	-90	972	Active
Ellsworth Frozen Foods	1090	-130	960	199	-100	990	Abandoned
Ellsworth Creamery FD902	1053	-110	943	466	-70	983	Active
Eli's Lumber EO145	1075	-103	972	135	-108	967	Active
Lindstrom (H. Campbell)	1055	-211	844	241			Unknown
Frank Campbell	1060	-113	947	172	-52	1008	Active
Bernard Larson	1040	-82	958	115	-43	997	Active
Maxine Davidson	1055	-109	946	135	-74	981	Active
Cenex (Ellsworth Farm Supply)	1050	-105	945	150	-70	980	Active
Charles Spranger	1040	-79	961	105	-62	978	Active
Doug Dickson	1175	-190	985	250	-195	980	Active
Joe Plummer CZ176	1040	-121	919	140	-62	978	Active
					Ave. PDU Elev.	983.571	
					Std. Dev.	11.0364	
Other Wells w/o const. reports							
Kim Huppert							Active
Joe Ingli							Active
Jerry Ingli							Active
O'Neil							Active



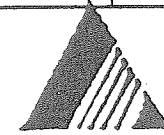
Alt ~ 1160

PROJECT NAME / LOCATION  SuperAmerica Station #4241 Ellsworth, Wisconsin	PROJECT NUMBER: 10-89-160	BORING NUMBER: MW-12	SHEET 1 OF 1
	CONTRACTOR: Mantylla Well Drilling		DRILLING METHOD: Air Rotary
	DRILLER: Bud Mantylla		DRILLING RIG: Air Rotary
	START: 9:00 AM 3-27-90		COMPLETED: 16:00 3-27-90

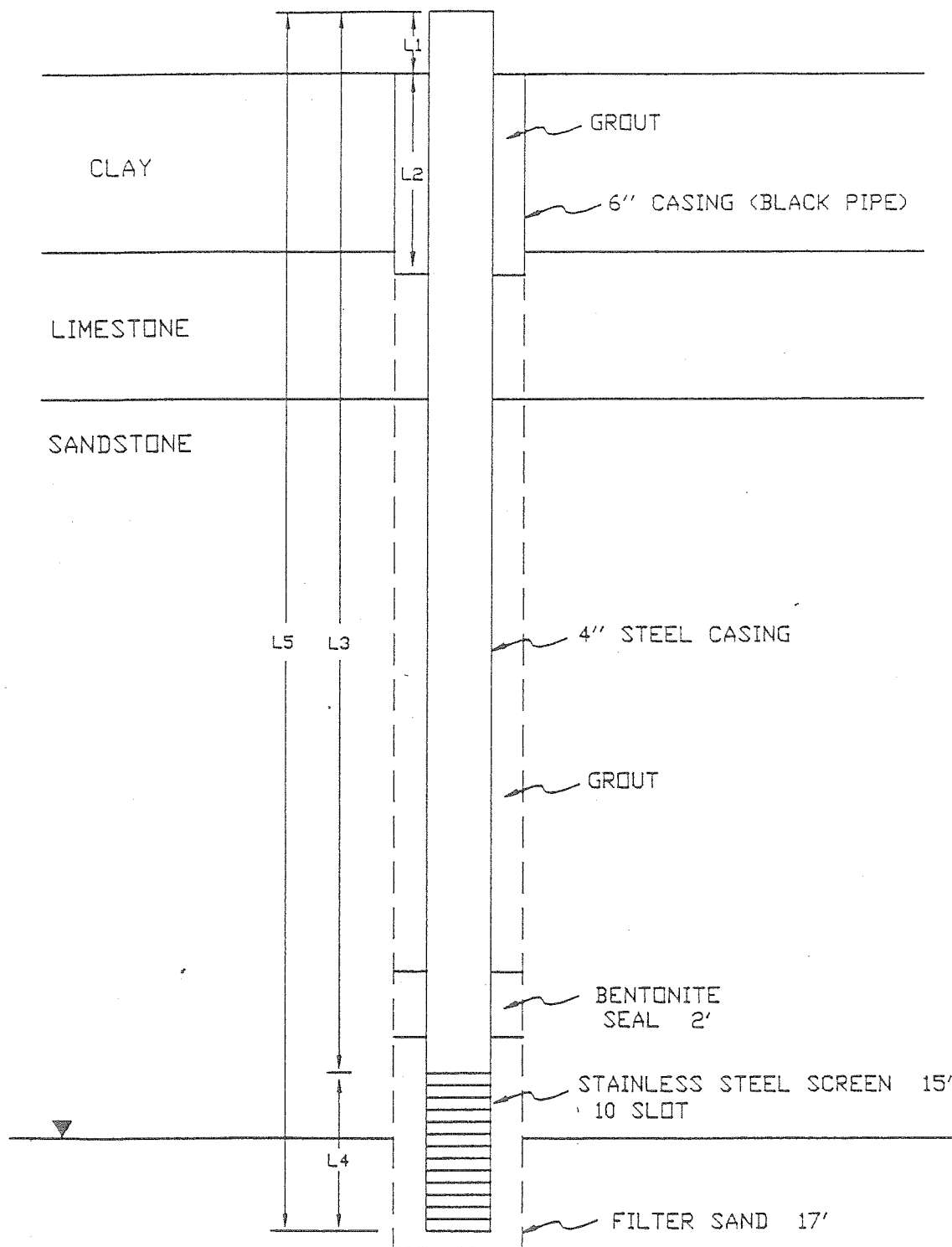
LAND OWNER: SuperAmerica Group, Inc.	SURFACE ELEVATION: 94.0 (approx.)	LOGGED BY: Scott Williams
--------------------------------------	-----------------------------------	---------------------------

TYPE	SNAUM PMB ELER	BLOU WNTS	SI AN MT PL E(ft)	SR AE MC PO LV E(in)	DEPTH  SCALE 1"=30'	DESCRIPTIONS OF MATERIALS AND CONDITIONS	CONTAMINANT OBSERVATIONS	
							INSTRUMENT:  UNITS: None	NOTES:
			0		10	Grayish green silty clay 0-16' moist <i>Petrol odor</i>		Gasoline odor 10'-16'
			16		20	Platteville Limestone 16'-40'		
					30	Dry		
			40		40			
					50	St. Peter Sandstone 40'-162'		
					60	Tan to orange poorly cemented sandstone. Well sorted, medium grained, dry to slightly moist, 40'-166.5'		
					70			
					80	saturated at 166.5'		
					90			
					100			
					110			
					120			
					130			
					140			
					150			
					160			
			172		170	Prarie Du Chien Dolomite		
					180	End of Boring at 172'		
					190			
					200			
					210			
					220			
					230			

BOREHOLE WATER LEVEL DATA					
DATE	3-27-90	3-27-90	3-27-90		
TIME	13:30	13:45	14:00		
GWL	166.83	166.50	166.50		
CASING DEPTH	170	170	170		



Delta  
Environmental  
Consultants, Inc.



L1 = 2.5'  
 L2 = 17'  
 L3 = 155'  
 L4 = 15'  
 L5 = 170'

APPENDIX E  
 MONITORING WELL MW-12  
 CONSTRUCTION DIAGRAM  
 SUPERAMERICA #4213  
 ELLSWORTH, WISCONSIN

PROJECT NO.  
 10-89-160

PREPARED BY  
 SAW/DD

DATE  
 7/5/90

REVIEWED BY



Delta  
 Environmental  
 Consultants, Inc.

VILLAGE WELL NO. 2, ELLSWORTH, WIS.

H. T. Hagestad, Engineer

Mc Carthy Well Co., Contractors, 1940

Samples examined by F. T. Thwaites, Nos. 109707-109812

Elevation 1103

SW $\frac{1}{4}$ , SE $\frac{1}{4}$ , SW $\frac{1}{4}$ , SW $\frac{1}{4}$ , Sec 17, T26N, R17W

Alt: 1120'

S	20	0-12	12		Earth, black
		12-20	8		Dolomite, brown-gray, broken (talus)
S	115	20-125	105		Sandstone, medium to fine, light gray
		125-135	10		Sandstone, medium to fine, yel-gy; shale, gy.
		135-150	15		Dolomite, gray
L	275	150-255	105		Dolomite, light gray
		255-285	30		Dolomite, light gray and gray; chert, oolitic
		285-300	15		Dolomite, light gray
		300-305	5		Dol, lt. gy; sandstone, medium, light gray
		305-325	20		Dolomite, light gray
		325-340	15		Dolomite, gray; chert, white
		340-350	10		Dolomite, light gray
		350-395	45		Dolomite, gray
		395-410	15		Dolomite, gray sandy; shale, green
		410-415	5		Sandstone, coarse to fine, lt. gray; shale, gn
T	130	415-420	5		Sandstone, coarse to fine, lt. gray
		420-430	10		Sandstone, coarse to fine, lt. gray, dolomitic
		430-465	35		Sandstone, coarse to fine, white
		465-470	5		Sandstone, fine, light gray
		470-500	30		Siltstone, light gray, dolomitic
		500-505	5		No sample
		505-510	5		Siltstone, light gray, dolomitic
		510-540	30		Siltstone, gray, dolomitic
		540-553	13		Siltstone, green-gray, dolomitic, glauconitic

Pi-1  
New Well #3  
BEGIS

150 E. 11W

18" pipe

17" hole

12" g.w.  
pipe  
cement

151

173 water

12" hole

Formations: Surface (drift, talus, filling); St. Peter; Lower Magnesian (Prairie du Chien or Oneota-Shakopee); Trempealeau (includes Jordan); Franconia  
Tested 2 1/4 hours at 448 g.p.m. specific capacity 53.5 g.p.m.  
later struck at 132 cemented off

- ☐ Solid Waste ☐ Haz. Waste  
☐ Emergency Response ☐ Underground Tanks  
☐ Wastewater ☐ Water Resources  
☒ Other DATCP

Facility/Project Name <u>Deiss &amp; Nugent Leach Co.</u>		License/Permit/Monitoring Number		Boring Number	
Boring Drilled By (Firm name and name of crew chief) <u>Donnyl Trout Hydro-Tech</u>		Date Drilling Started <u>03/04/97</u> M M D D Y Y		Date Drilling Completed <u>03/19/97</u> M M D D Y Y	
DNR Facility Well No. <u>WI Unique Well No.</u>		Common Well Name <u>MW-2</u>		Final Static Water Level ____ Feet MSL	
				Surface Elevation ____ Feet MSL	
				Borehole Diameter <u>8 1/4</u> inches	
Boring Location State Plane _____ N. _____ E S/C/N Lat _____		Local Grid Location (If applicable) ____ Feet _____ Feet		<input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W	
SW 1/4 of SE 1/4 of Section <u>17</u> , T <u>26</u> N, R <u>17</u> E/W Long _____		County <u>PIERCE</u>		DNR County Code <u>48</u> Civil Town/City/ or Village <u>Ellsworth</u>	

Sample		Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					ROD/ Comments
Number	Length Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	
			5	Brown silty clay, firm, plastic, moist										
			10	clayey silt, brown, friable, slightly damp										
				same as above less silt though										
				same as above										
				Brown to grey moist silty clay										
				Silty clay brown										
				same as above										
			20	Sandstone Bedrock										
				St. Peter sandstone										
				loosely cemented										
			30											
			40											
			50											
			60											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

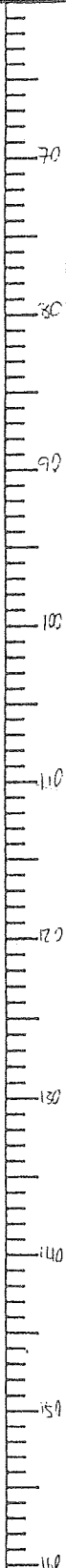
Signature

[Signature]

Firm

CEDAR CORPORATION

This form is authorized by Chapters 144.147 and 162, Wis. Stats. Completion of this report is mandatory. Penalties: Forfeit not less than \$10 nor more than \$5,000 for each violation. Fined not less than \$10 or more than \$100 or imprisoned not less than 30 days, or both for each violation. Each day of continued violation is a separate offense, pursuant to ss 144.99 and 162.06, Wis. Stats.

Sample		Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments	
Number	Length Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200		
				<p>Bentonite Slurry</p> <p>Well Cemented</p> <p>Dallas were going to change over to mud rotary to add sidewalls from collapsing when they reached 106.00'.</p> <p>Switched over to mud rotary. Dallas lost <del>200</del> two - 1,000 gallon batches of mud through formation without drilling past 97.0'.</p> <p>Drillers had tried to plug voids in formation with 4 bags of 3/4" chipped bentonite to no avail.</p> <p>3/14/92 Drillers set 4 inch steel casing into bedrock at 109.0' Then drilled with 4 inch trimcone with aim to lift cuttings. Drillers completed hole to 159.0 feet bbs</p> <p>E.O. 3 @ 159.0'</p>											
							<p>4" (1.19 METER) STEEL CASING</p> <p>3/4" chipped bentonite</p> <p>OPEN BORE HOLE</p>								

Facility/Project Name  
DeSS & August Feed Co.  
City License, Permit or Monitoring Number

Local Grid Location of Well  
\_\_\_\_\_ ft. ☐ N \_\_\_\_\_ ft. ☐ E  
\_\_\_\_\_ ft. ☐ S \_\_\_\_\_ ft. ☐ W

Well Name  
MW-2  
Wis. Unique Well Number DNR Well Number

Type of Well Water Table Observation Well ☒ 11  
Piezometer ☐ 12

Grid Origin Location  
Lat. \_\_\_\_\_ Long. \_\_\_\_\_ or

Date Well Installed  
3/19/97  
m m d d y y

Distance Well Is From Waste/Source Boundary  
\_\_\_\_\_ ft.

Section Location of Waste/Source  
SW 1/4 of SE 1/4 of Sec. 17, T. 26 N, R. 17 E.

Well Installed By: (Person's Name and Firm)  
Danny I  
TRAUT HYDRO-TECH

Is Well A Point of Enforcement Std. Application?  
☒ Yes ☐ No

Location of Well Relative to Waste/Source  
u ☐ Upgradient s ☐ Sidegradient  
d ☐ Downgradient n ☒ Not Known

A. Protective pipe, top elevation 190.00 ft. MSL  
B. Well casing, top elevation \_\_\_\_\_ ft. MSL  
C. Land surface elevation \_\_\_\_\_ ft. MSL  
D. Surface seal, bottom \_\_\_\_\_ ft. MSL or 5.0 ft.

12. USCS classification of soil near screen:  
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐  
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐  
Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No  
14. Drilling method used: Rotary ☒ 50  
Hollow Stem Auger ☐ 41  
Other ☐

15. Drilling fluid used: Water ☐ 02 Air ☒ 01  
Drilling Mud ☒ 03 None ☐ 99  
16. Drilling additives used? ☐ Yes ☒ No

Describe \_\_\_\_\_  
17. Source of water (attach analysis):  
City of Ellsworth

E. Bentonite seal, top \_\_\_\_\_ ft. MSL or 85.0 ft.

F. Fine sand, top \_\_\_\_\_ ft. MSL or N/A ft.

G. Filter pack, top \_\_\_\_\_ ft. MSL or N/A ft.

H. Screen joint, top \_\_\_\_\_ ft. MSL or N/A ft.

I. Well bottom \_\_\_\_\_ ft. MSL or N/A ft.

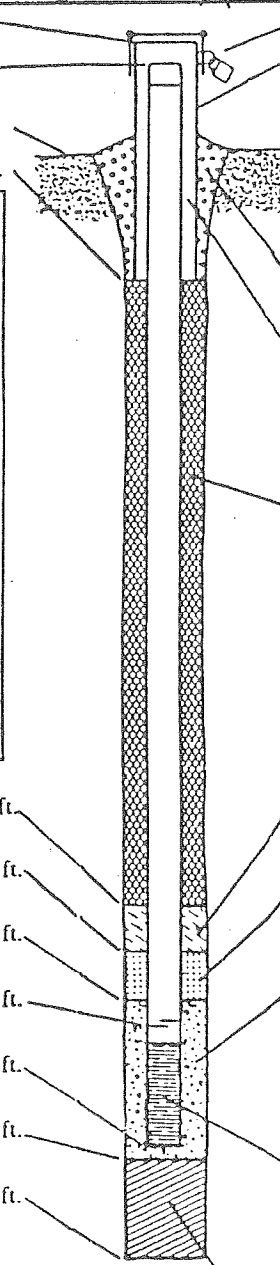
J. Filter pack, bottom \_\_\_\_\_ ft. MSL or N/A ft.

K. Borehole, bottom \_\_\_\_\_ ft. MSL or 159.0 ft.

L. Borehole, diameter 8.0 in.

M. O.D. well casing 4.50 in.

I.D. well casing 4.03 in.



1. Cap and lock? ☒ Yes ☐ No  
2. Protective cover pipe:  
a. Inside diameter: 6.0 in.  
b. Length: 7.0 ft.  
c. Material: Steel ☒ 04  
Other ☐  
d. Additional protection? ☒ Yes ☐ No  
If yes, describe: 2 Bumper Posts  
3. Surface seal: Bentonite ☒ 30  
Concrete ☐ 01  
Other ☐  
4. Material between well casing and protective pipe: Bentonite ☐ 30  
Annular space seal ☐  
Other ☐  
5. Annular space seal: a. Granular Bentonite ☐ 33  
b. \_\_\_\_\_ Lbs/gal mud weight ... Bentonite-sand slurry ☐ 35  
c. 9 Lbs/gal mud weight ... Bentonite slurry ☒ 31  
d. \_\_\_\_\_ % Bentonite ... Bentonite-cement grout ☐ 50  
e. 21 Ft<sup>3</sup> volume added for any of the above  
f. How installed: Tremie ☐ 01  
Tremie pumped ☒ 02  
Gravity ☐ 08  
6. Bentonite seal: a. Bentonite granules ☐ 33  
b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite pellets ☐ 32  
c. \_\_\_\_\_ Other ☐  
7. Fine sand material: Manufacturer, product name & mesh size  
a. N/A  
b. Volume added \_\_\_\_\_ ft<sup>3</sup>  
8. Filter pack material: Manufacturer, product name and mesh size  
a. N/A  
b. Volume added \_\_\_\_\_ ft<sup>3</sup>  
9. Well casing: Flush threaded PVC schedule 40 ☐ 23  
Flush threaded PVC schedule 80 ☐ 24  
4" welded steel Other ☒  
10. Screen material: Open borehole  
a. Screen type: Factory cut ☐ 11  
Continuous slot ☐ 01  
Other ☐  
b. Manufacturer \_\_\_\_\_  
c. Slot size: \_\_\_\_\_ in.  
d. Slotted length: \_\_\_\_\_ ft.  
11. Backfill material (below filter pack): None ☐ 14  
Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.  
Signature [Signature] Firm CEDAR CORPORATION

T. 26 N., R. 17 W.

SECT. 17  
NW, SE, SE

PIERCE

Pi-46  
USGS

Well at Ellsworth Cooperative Creamery, Ellsworth, Wis.

McCarthy Well Co., 1944 Copy from State Board of Health

Well is about 55 ft. lower than city well of 1940

Thickness Depth

Blue clay	15	15
Sandrock	20	35
Limerock	10	45
Sandrock	20	65
Limerock	3	68
Sa ndrock	7	75
Limerock	45	120
Lime and sandrock	40	160
Limerock	145	305
Sandrock	95	400
Limerock	25	425
Sandrock	15	440
Limerock	25	465
Shale	1	466

Tested 3 hours at 200 g.p.m. Static level 110 ft. Pumping level 114 ft.  
Specific capacity = 50 g.p.m.

20" hole to 95 filled with cement 12" pipe to 95, 12" hole below



May 8, 2001

RE: City of Hudson, Wisconsin  
Municipal Well 8  
SEH No. A-HUDSO0008.00  
A-HUDSO0104.00

Mr. Denny Christophersen  
Hudson Water Department  
505 - 3rd Street  
Hudson, Wisconsin 54016

Dear Denny:

This letter summarizes the results of the two pumping tests conducted by Short Elliott Hendrickson Inc.® (SEH) for Municipal Well 8, on behalf of the City of Hudson, Wisconsin. The first test was conducted during the week of March 19, 2001, and the second test was conducted during the week of April 9, 2001.

### Background

The approximate locations of Municipal Well 8 and Test Well 8A are shown in Figure 1. Both wells are only open to the Jordan Sandstone aquifer. The Jordan Sandstone is beneath the Oneota Formation, a karst and fractured limestone, and above the St. Lawrence Formation, a relatively impermeable shale. To determine the characteristics of the Jordan aquifer, a three-day pumping test was conducted.

SEH, with the assistance of Traut Well Company, conducted the first pumping test. Municipal Well 8 was used as the pumping well and Test Well 8A, located 540 feet west of the municipal well, was used as the observation well. Municipal Well 8 was pumped at an average rate of 932 gallons per minute (gpm) for approximately 44 hours. Groundwater levels were measured from the municipal well and the observation well before, during, and after the pumping phase of the test. The data collected during the test was analyzed by SEH using AQTESOLV® software. Time-drawdown graphs from the first pumping test and well logs for the two wells are enclosed in Attachment A. The table in Attachment B summarizes the specifications of the wells, and the maximum drawdown readings from each well.

Although the first pumping test resulted in an adequate characterization of the Jordan aquifer, predictions could not be made regarding the drawdown effects of pumping Municipal Well 8 on local wells screened in the Oneota Formation. Therefore, a second pumping test was performed.

### Pumping Test 2

SEH, with the assistance of Traut Well Company and Mantyla Well Company, conducted the second pumping test. On April 11 and 12, 2001, Municipal Well 8 was pumped continuously at an average rate of 1200 gpm, for a 24-hour period. Groundwater levels were recorded from six nearby, domestic-supply wells identified as Clymer, Delano, City of Hudson Farmhouse, Nelson, Schultz, and Ulbricht. Groundwater levels were measured in all six wells before, during, and after the pumping phase of the test. Four of the six domestic-supply wells are screened in the Oneota Formation. The Nelson and Schultz wells are screened in the Jordan Sandstone.

Figure 1 depicts the actual and predicted drawdowns at each well. The table in Attachment B details the approximate locations and specifications of the wells, and the measured drawdown data from the second pumping test. Drawdown data was also collected from the Clymer, City of Hudson Farmhouse, and



Ulbricht wells when their wells were pumping at the same time as the municipal well. This data is also provided in the Attachment B table. Graphs of time-drawdown data from four of the domestic-supply wells are enclosed in Attachment C. Well logs for the Clymer, Delano, Nelson, and Schultz wells are also enclosed in Attachment C.

### **Conclusions**

The tests indicate that the Jordan aquifer is leaky/semi-confined, indicating that groundwater within the overlying Oneota Formation is hydraulically connected to the Jordan Sandstone at most of the domestic-supply wells monitored. Based on the results of the first pumping test, the specific capacity of Municipal Well 8 is approximately 23 gpm per foot of drawdown. In addition, the representative transmissivity and storativity values for the Jordan aquifer appear to be 10,080 feet squared per day and 0.00054 respectively. Based on these values, the radius of influence (0.5 feet or more of drawdown in the Jordan aquifer) for 24 hours of continuous pumping from Municipal Well 8 is predicted to be 7,600 feet. After 24 hours of continuously pumping at a rate of 1000 gpm, the drawdown at the municipal well is calculated to be 20 feet.

Information regarding each of the domestic-supply wells was collected during the second pumping test. Figures 2 through 7 schematically show the details of the domestic-supply wells and their respective groundwater levels. Based on the results of the second pumping test, it appears that the measured groundwater drawdown values at the six domestic-supply wells were less than predicted. Other than the Ulbricht well, all of the domestic-supply wells monitored during the second pumping test when the municipal well was pumping, had at least 14 feet of groundwater above their respective pump intakes. When the municipal well was pumping, and the Ulbricht well was simultaneously pumping to supply the house/veterinary clinic, the groundwater level dropped to approximately four feet above the pump intake.

Upon approval from Bob Ulbricht, the City asked Mantyla Well Company to lower the pump in the Ulbricht well as deep as possible. The pump was lowered 5.2 feet, but could not be lowered further due to an obstruction in the well. After lowering the pump, and five days after the second pumping test, a yard hydrant connected to the Ulbricht well was turned on while the Ulbricht well was also being used to supply the house/veterinary clinic. Under these conditions, the groundwater level in the Ulbricht well dropped to the pump intake.

### **Feasibility of a Second Municipal Well**

The preliminary feasibility of constructing a second municipal well approximately 400 feet southeast of Municipal Well 8 was evaluated. Based on the data collected during the first pumping test, predictions were made regarding groundwater drawdown, in the Jordan Sandstone aquifer, at various distances from the municipal wells. If a second municipal well is constructed 400 feet southeast of Municipal Well 8 the drawdown would be approximately 35 feet at each municipal well, assuming 24 hours of continuous pumping at rates of 1000 gpm from each well. Figure 8 depicts the predicted groundwater drawdown values at distances of 1,000, 2,500, 5,000 and 10,000 feet away from the municipal wells, assuming the wells are pumping continuously for 24 hours at a combined rate of 2000 gpm. Using these same parameters, the radius of influence (0.5 feet of drawdown or more in the Jordan aquifer) would be approximately 10,000 feet with both wells pumping.

Accurate groundwater drawdown predictions can not be made for the nearby, domestic-supply wells that are screened in the Oneota Formation. To accurately determine the drawdown in the local wells with a

second municipal well pumping, it would be necessary to collect field data during the third pumping test (scheduled to be performed after the second municipal well is installed) while both municipal wells are pumping. However, using the aquifer characteristics determined from the first pumping test, and assuming that both municipal wells were pumping continuously for 24 hours at 1000 gpm each, worst-case, predicted groundwater drawdowns can be estimated for the Jordan aquifer at the six, domestic-supply wells. These predictions are shown on Figure 1. Using these conservative predictions, SEH determined that the six domestic-supply wells would have at least 6½ feet of groundwater head above their pumps when two municipal wells are pumping at a combined rate of 2000 gpm.

#### Uncertainty

Predicted groundwater drawdown at specific distances from the municipal well(s) are based on a series of mathematical and scientific assumptions. Specifically, the drawdown predictions are based on the assumptions that the Jordan aquifer is confined, homogeneous and laterally extensive, and the nearby wells are screened in the Jordan aquifer. In reality, the geology in the vicinity of the municipal well is complex. A fault zone exists within ½-mile of the well and the thickness of the Jordan Sandstone and Oneota Formation has significant variation. Although the presence of the fault as a recharging area or impermeable barrier was not indicated by the pumping test data, the nature and conditions of the fault zone itself may either promote or diminish groundwater flow.

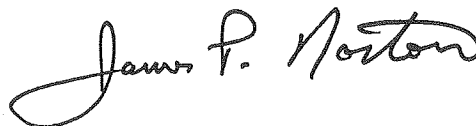
Calculated groundwater drawdown values are only approximations and should be used with caution. Actual groundwater drawdown near the municipal well(s) may be more or less than the calculated values due to the local geologic complexity. SEH recommends relying on the data collected from the second pumping test in which actual drawdown measurements were made in nearby domestic-supply wells.

If you have any questions, or need additional information regarding the pumping tests, please contact me at 651.490.2022.

Sincerely,  
Short Elliott Hendrickson Inc.



Craig L. Kurtz  
Hydrogeologist



James P. Norton, P.E.  
Principal/Manager, Water Department

CLK/clk/AHS

Figures & Attachments

- c: Al Sunderman, SEH Inc. w/enclosures
- Steve Heth, SEH Inc. w/enclosures
- Steve Campbell, SEH Inc. w/enclosures
- Catherine Munkittrick, City Attorney w/enclosures
- Public Utility Commission w/enclosures

DATE: 05-03-TIME: 4:08 pm USER: CPU291SP

K:\WASTE\HUDSON\0104\HUDSFLM4.DWG

# LEGEND



PROPERTY BOUNDARY



DOMESTIC SUPPLY WELL



CITY WELL

-4.12'

PREDICTED DRAWDOWN (WHEN MUNICIPAL WELL 8 IS PUMPING AT 1200 GPM)

-3.77'

DRAWDOWN FROM PUMPING TEST 2

-6.87'

PREDICTED DRAWDOWN (WHEN 2 MUNICIPAL WELLS ARE PUMPING AT 1000 GPM EACH - MUNICIPAL WELLS 8 AND 9)

N

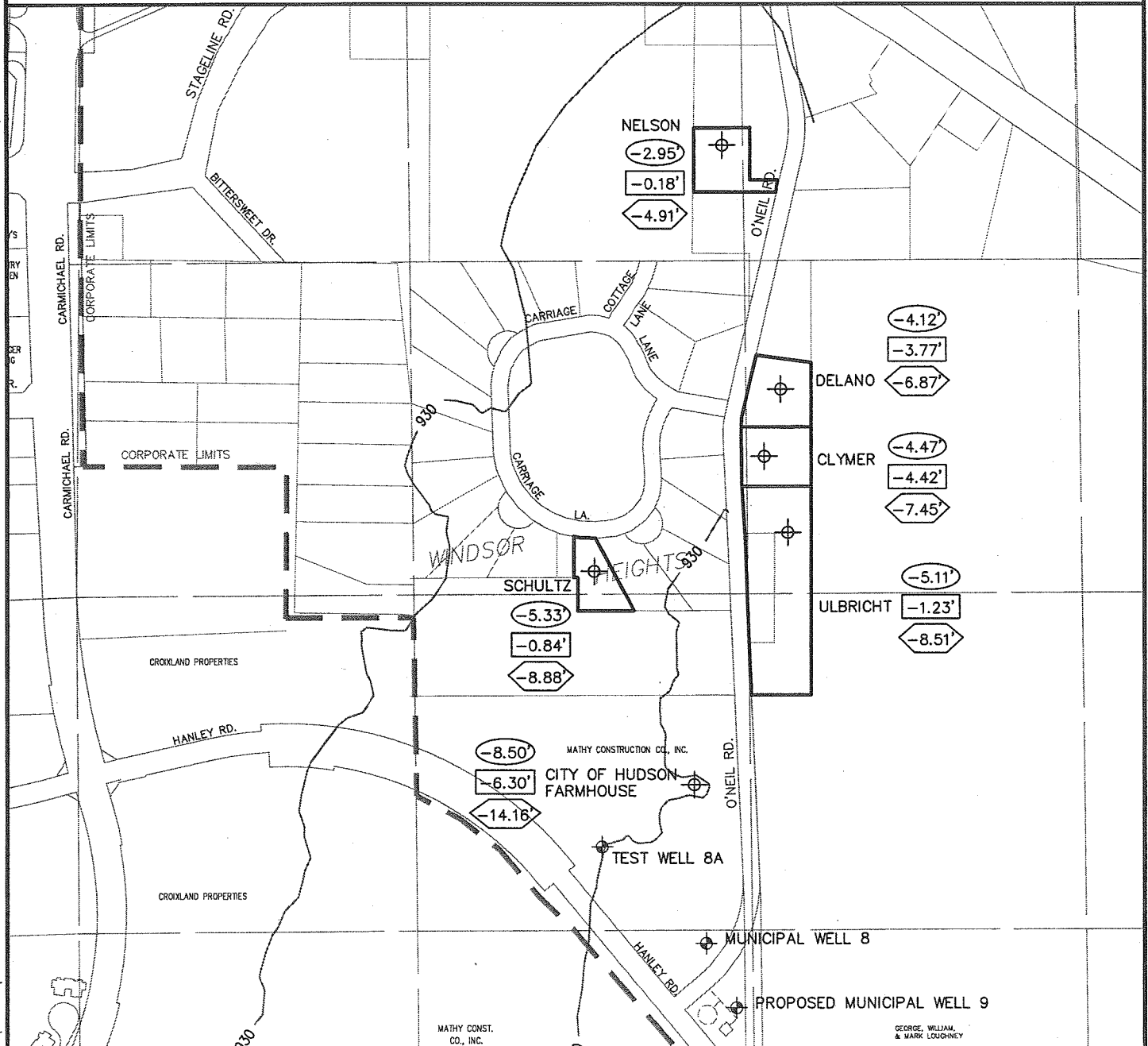


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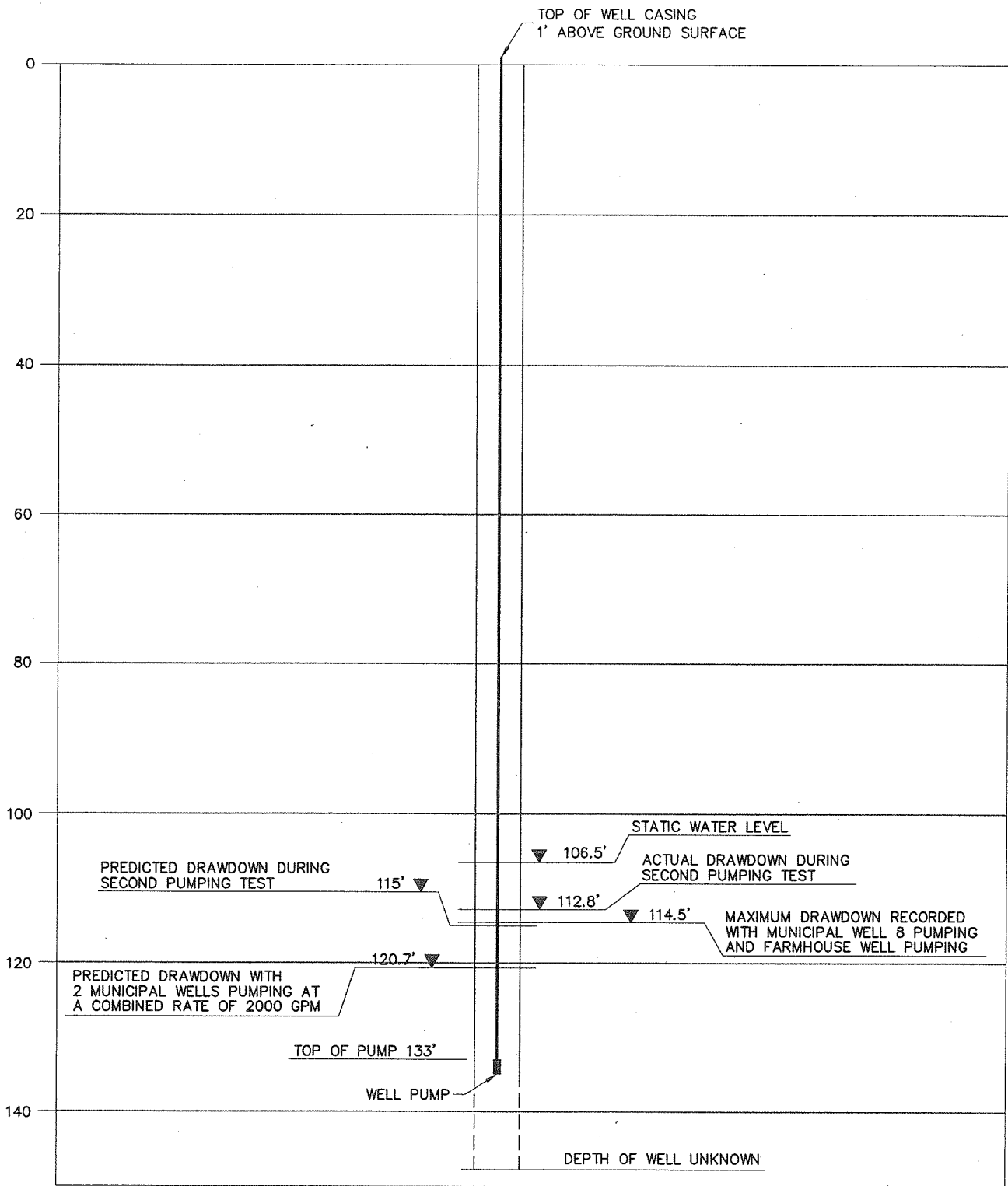


SCALE IN FEET

NOTE: ALL WELL LOCATIONS ARE APPROXIMATE.




1	5/3/01	ORIGINAL ISSUE	BRH	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK	
			SITE LOCATION		PROJ. NO. HUDS00104 DATE 5/3/01	FIGURE 1

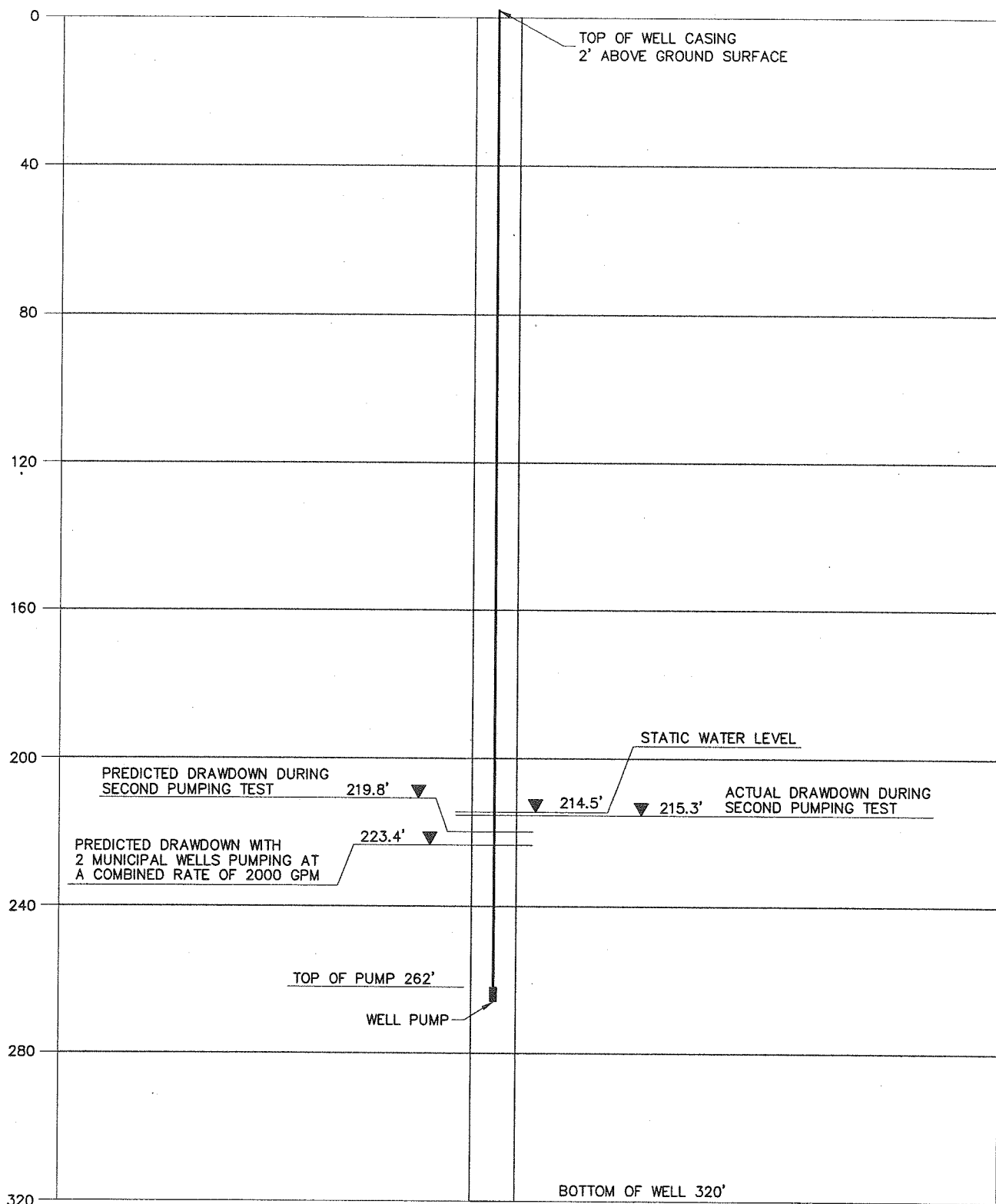


**NOTES:**

1. GROUNDWATER HEAD ABOVE PUMP = 26.5'
2. GROUNDWATER HEAD ABOVE PUMP AFTER MAXIMUM DRAWDOWN = 18.5'
3. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN WITH A PUMPING RATE OF 2000 GPM = 12.3'
4. ALL DEPTHS FROM GROUND SURFACE.


1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			<b>AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN</b>			<b>CITY OF HUDSON FARMHOUSE WELL INFORMATION</b>		
						PROJ. NO. HUDS00104 DATE 5/3/01		
						<b>FIGURE 2</b>		

DATE: 05-03-TIME: 4:39 pm USER: CPU291SP

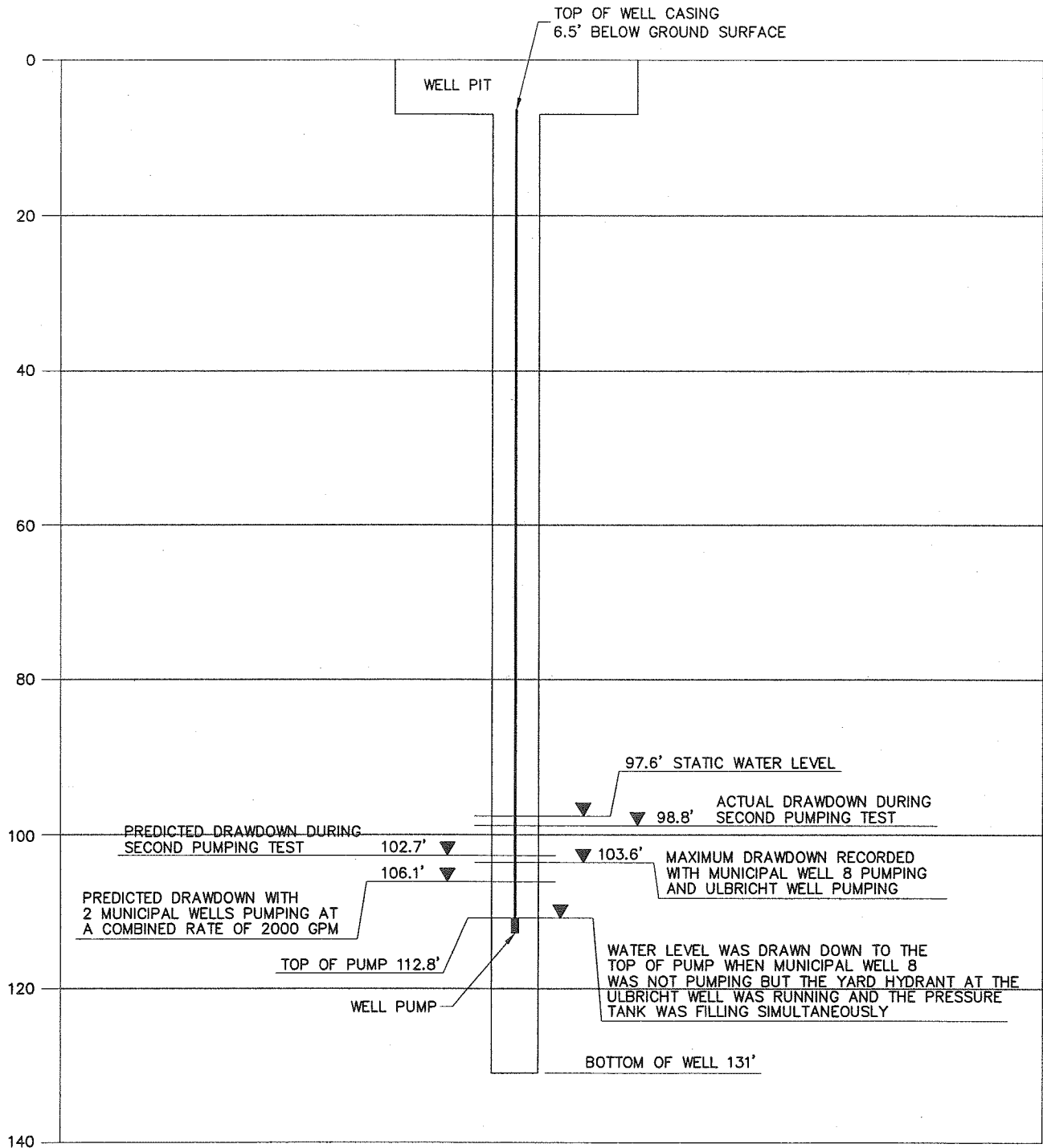


**NOTES:**


1. GROUNDWATER HEAD ABOVE PUMP = 47.5'
2. GROUNDWATER HEAD ABOVE PUMP AFTER ACTUAL DRAWDOWN = 46.7'
3. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN WITH A PUMPING RATE OF 2000 GPM = 38.6'
4. ALL DEPTHS FROM GROUND SURFACE.

1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			<b>AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN</b>			<b>SCHULTZ WELL INFORMATION</b>		
						PROJ. NO. HUDS00104 DATE 5/3/01		
						<b>FIGURE</b>  <b>3</b>		

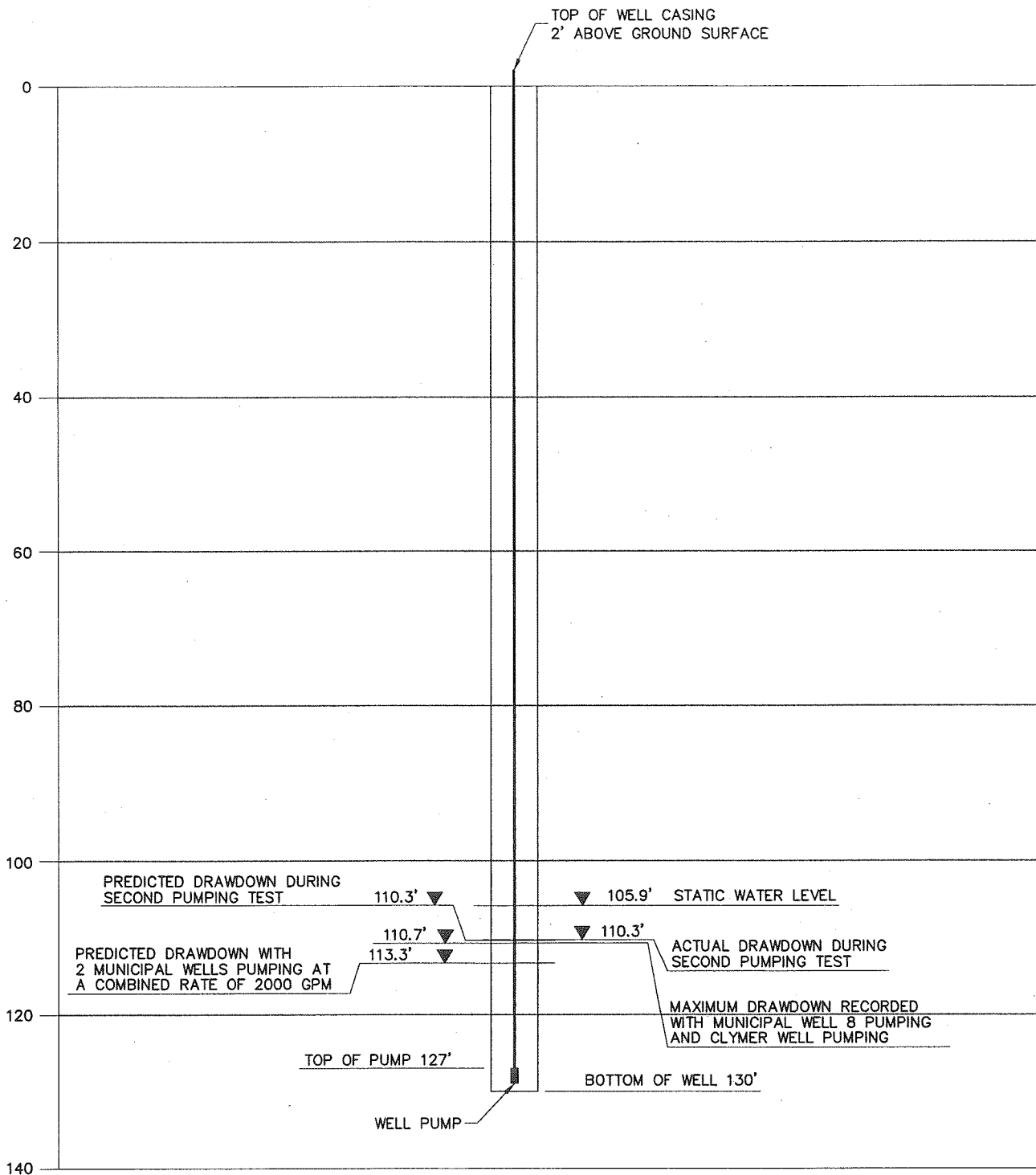
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**NOTES:**

1. GROUNDWATER HEAD ABOVE PUMP = 15.2'
2. GROUNDWATER HEAD ABOVE PUMP AFTER ACTUAL DRAWDOWN = 14'
3. GROUNDWATER HEAD ABOVE PUMP WITH MUNICIPAL WELL AND ULBRICHT WELL PUMPING = 9.2'
4. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN WITH A PUMPING RATE OF 2000 GPM = 6.7'
5. ALL DEPTHS FROM GROUND SURFACE.

1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
 <b>AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN</b>			<b>ULBRICHT WELL INFORMATION</b>			PROJ. NO. HUDS00104	<b>FIGURE 4</b>	
						DATE 5/3/01		

DATE: 05-03-TIME: 4:39 pm USER: CPU291SP



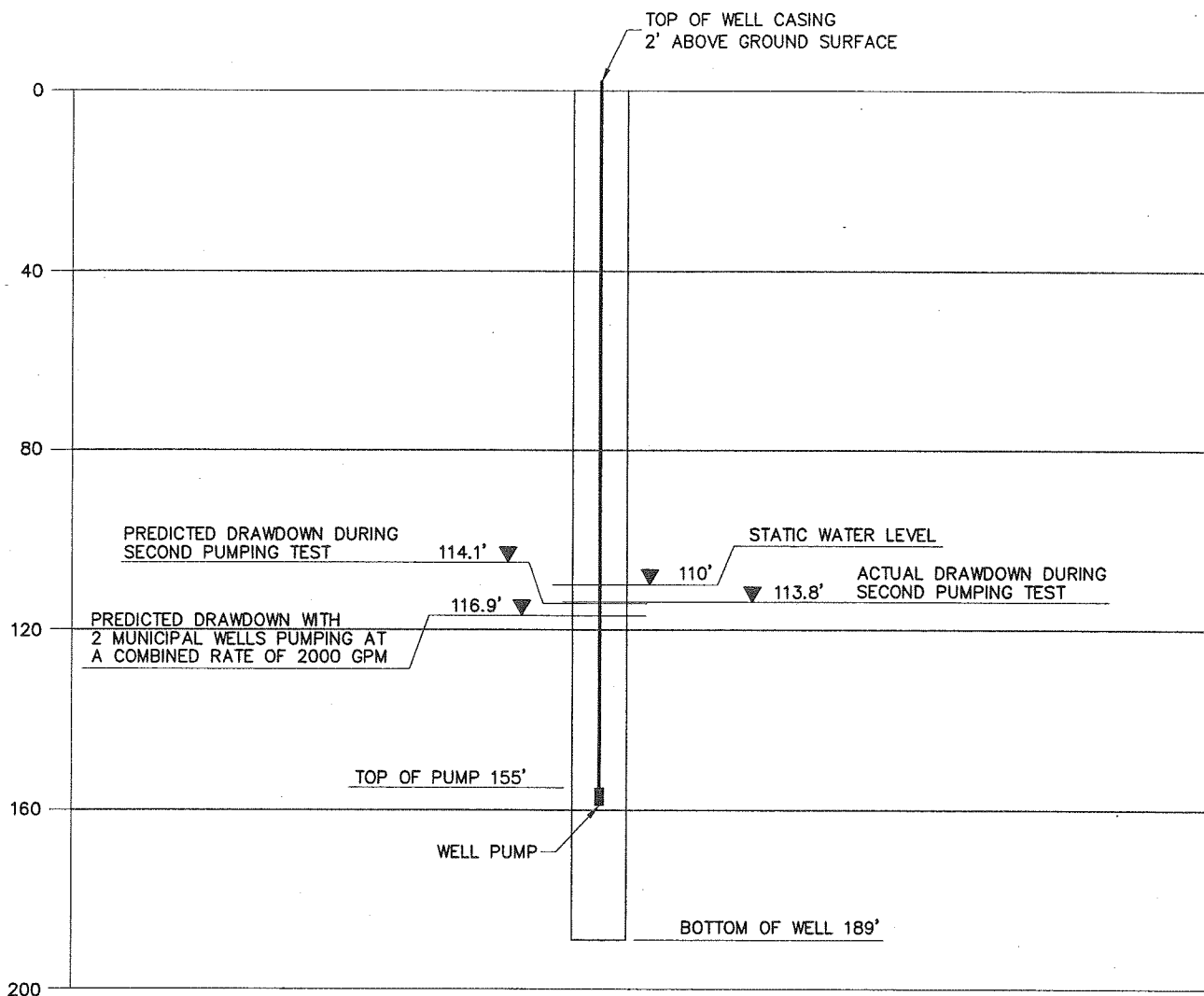
NOTES:

1. GROUNDWATER HEAD ABOVE PUMP = 21.1'
2. GROUNDWATER HEAD ABOVE PUMP AFTER MAXIMUM DRAWDOWN = 16.3'
3. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN  
WITH A PUMPING RATE OF 2000 GPM = 13.7'
4. ALL DEPTHS FROM GROUND SURFACE.

1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN			CLYMER WELL INFORMATION		
			PROJ. NO. HUDS00104			DATE 5/3/01		
						FIGURE 5		


K:\WASTE\HUDSON\0104\HUSDFLX1.DWG

DATE: 05-03-01 TIME: 4:39 pm USER: CPU291SP



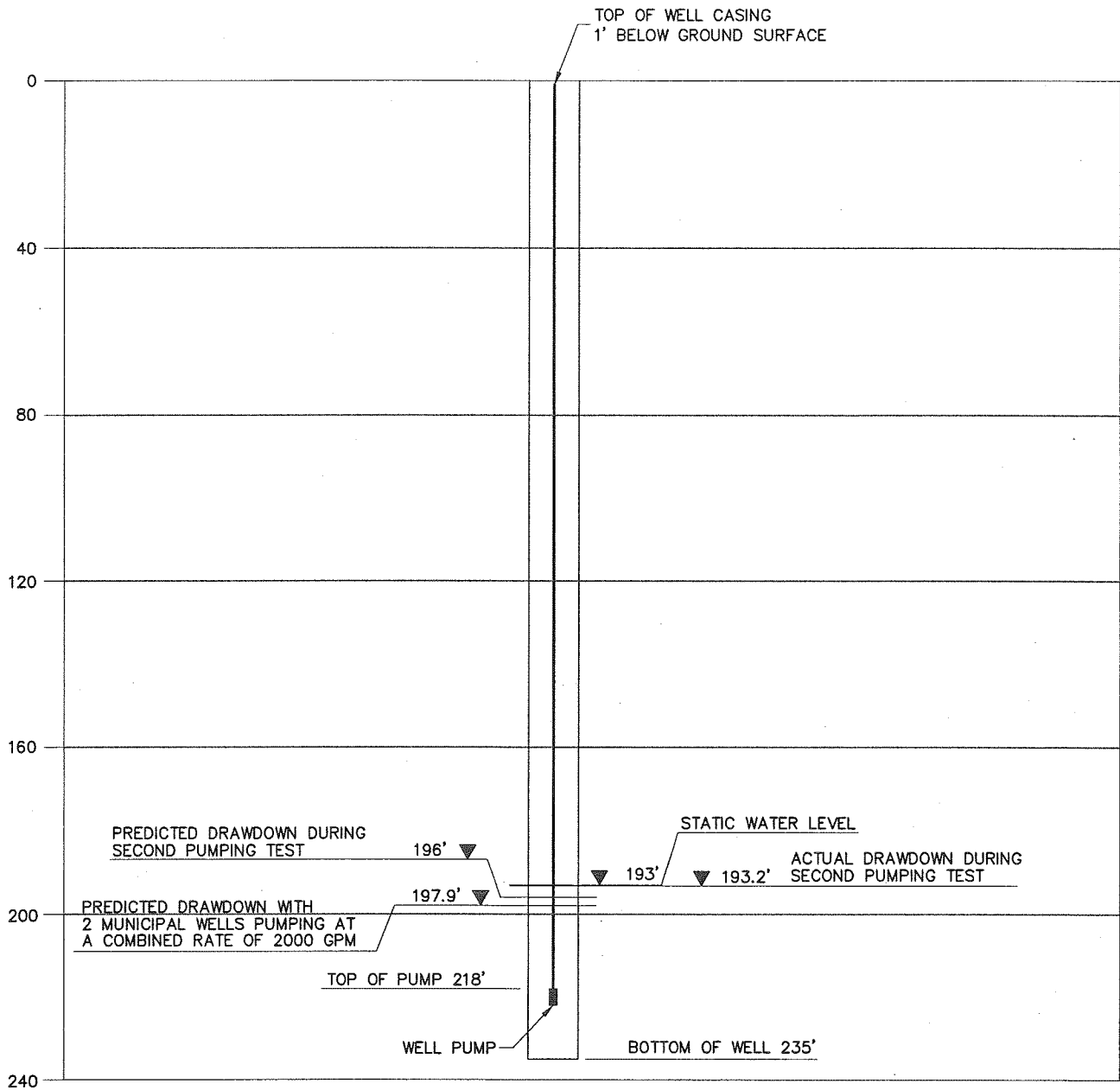
NOTES:

1. GROUNDWATER HEAD ABOVE PUMP = 45'
2. GROUNDWATER HEAD ABOVE PUMP AFTER ACTUAL DRAWDOWN = 41.2'
3. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN WITH A PUMPING RATE OF 2000 GPM = 38.1'
4. ALL DEPTHS FROM GROUND SURFACE.

1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			<b>AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN</b>			<b>DELANO WELL INFORMATION</b>		
						PROJ. NO. HUDS00104	<b>FIGURE</b>  6	
						DATE 5/3/01		


K:\WASTE\HUDSON\0104\HUSDFLX1.DWG





NOTES:

1. GROUNDWATER HEAD ABOVE PUMP = 25'
2. GROUNDWATER HEAD ABOVE PUMP AFTER ACTUAL DRAWDOWN = 24.8'
3. PREDICTED GROUNDWATER HEAD ABOVE PUMP AFTER DRAWDOWN WITH A PUMPING RATE OF 2000 GPM = 20.1'
4. ALL DEPTHS FROM GROUND SURFACE.

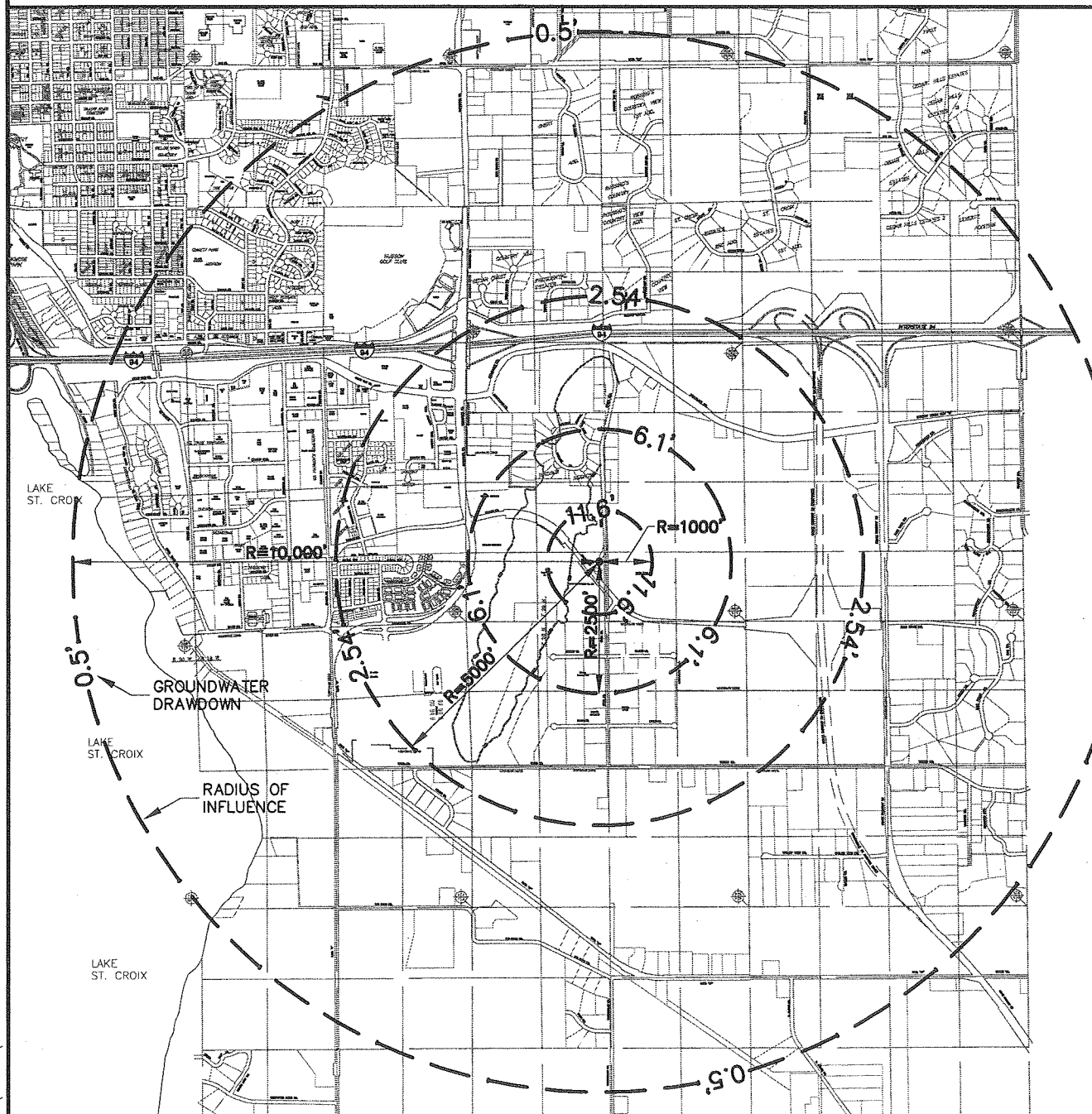
1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN			PROJ. NO. HUDS00104		<b>FIGURE</b>  7
			NELSON WELL INFORMATION			DATE 5/3/01		

DATE: 05-07-TIME: 7:12 am USER: CPU291SP

K:\WASTE\HUDSON\0104\HUDSFLM3.DWG

**NOTE:** GROUNDWATER DRAWDOWN ASSUMES 24 HOURS  
CONTINUOUS PUMPING AT 2000 GPM  
AT THE MUNICIPAL WELLS.

0 750 1500 3000  
SCALE IN FEET



1	5/3/01	ORIGINAL ISSUE	BRH	5/01	PJK	5/01	CLK	5/01
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK			
			<b>AQUIFER PUMPING TEST WELLHEAD PROTECTION HUDSON, WISCONSIN</b>			<b>MUNICIPAL WELLS RADIUS OF INFLUENCE</b>		
			PROJ. NO. HUDS00104 DATE 5/3/01			<b>FIGURE</b>  8		

# ATTACHMENT A

# Hudson Aquifer Pumping Test March 2001

Prepared By:

SEH Inc.

Project:

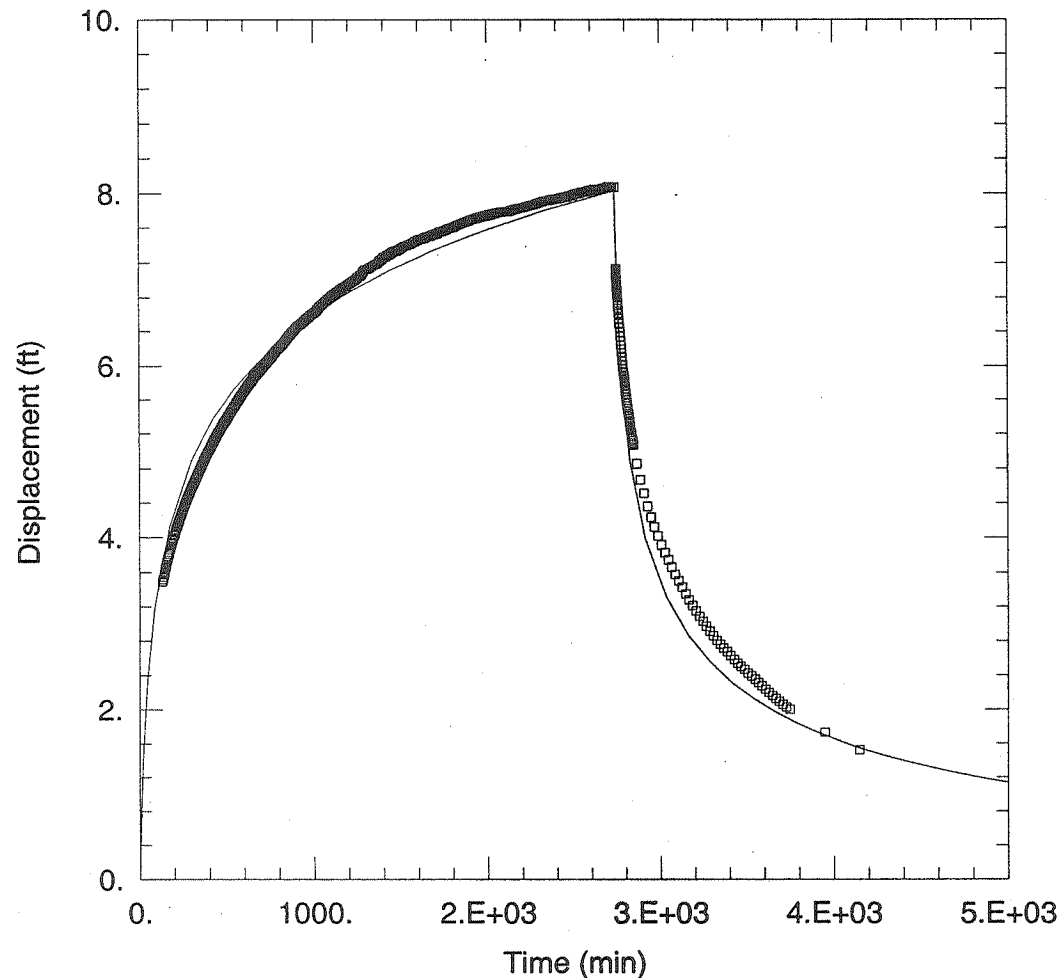
A-HUDSO0104.00

Prepared For:

City of Hudson, WI

Location:

Hudson, Wisconsin



## SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

$T = 6.923 \text{ ft}^2/\text{min}$

$S = 0.0005395$

$r/B = 4.389\text{E-}05$

## AQUIFER DATA

Saturated Thickness: 64. ft

Anisotropy Ratio ( $K_z/K_r$ ): 1.

## WELL DATA

### Pumping Wells

Well Name	X (ft)	Y (ft)
PW8	0	0

### Observation Wells

Well Name	X (ft)	Y (ft)
□ TW8	540	0



# Hudson Aquifer Pumping Test March 2001

Prepared By:

**SEH Inc.**

Project:

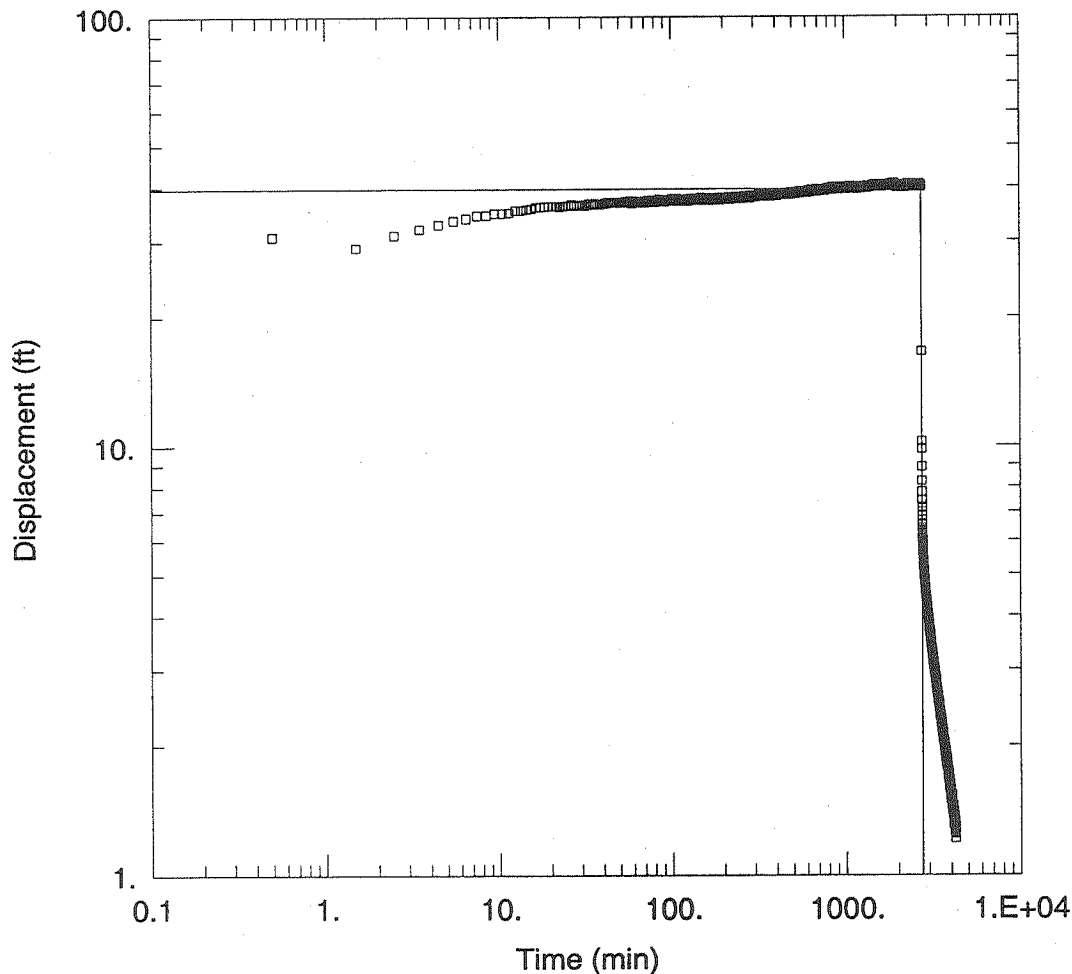
**A-HUDSO0104.00**

Prepared For:

**City of Hudson, WI**

Location:

**Hudson, Wisconsin**



## SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

$T = 5.824 \text{ ft}^2/\text{min}$

$S = 1.E-15$

$r/B = 1.E-05$

## AQUIFER DATA

Saturated Thickness: 64. ft

Anisotropy Ratio ( $K_z/K_r$ ): 1.

## WELL DATA

### Pumping Wells

Well Name	X (ft)	Y (ft)
PW8	0	0

### Observation Wells

Well Name	X (ft)	Y (ft)
□ PW8	10	0



# Hudson Aquifer Pumping Test March 2001

Prepared By:

SEH Inc.

Project:

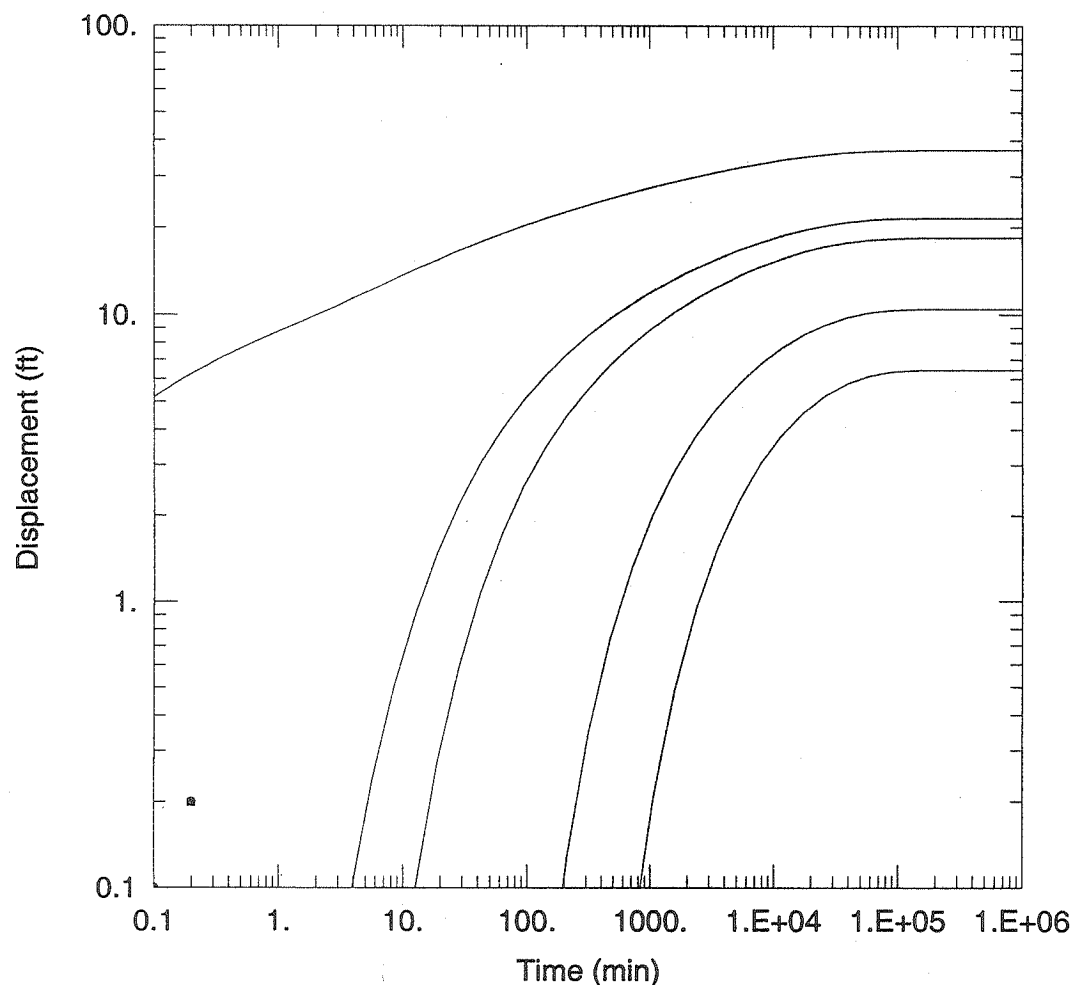
A-HUDSO0104.00

Prepared For:

City of Hudson, WI

Location:

Hudson, Wisconsin



## SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

$T = 6.92 \text{ ft}^2/\text{min}$

$S = 0.00054$

$1/B = 4.4\text{E-}05 \text{ ft}^{-1}$

## AQUIFER DATA

Saturated Thickness: 64. ft

Anisotropy Ratio ( $K_z/K_r$ ): 1.

## WELL DATA

### Pumping Wells

Well Name	X (ft)	Y (ft)
PW8	0	0
PW 2	400	0

### Observation Wells

Well Name	X (ft)	Y (ft)
+ OW 2	1000	0
o OW 3	5000	0
△ OW 1	1E+004	0
△ OW 4	10	0
◇ OW 5	1500	0



Well Construction Report For <b>WISCONSIN UNIQUE WELL NUMBER</b> <b>NV 300</b>																		
Property Owner <b>City of Hudson</b>		Telephone Number <b>715 386-4760</b>																
Mailing Address <b>505 3rd Street</b>																		
City <b>Hudson</b>		State <b>WI</b>	Zip Code <b>54016</b>															
County of Well Location <b>St. Croix</b>	Co. Well Permit No. <b>W</b>	Well Completion Date (mm-dd-yy) <b>05-18-00</b>																
Well Constructor (Business Name) <b>Mark J. Traut Wells, Inc</b>		License # <b>5911</b>	2. Mark well location with a dot in correct 40-acre parcel of section.  <div style="text-align: center;"> N  <table border="1" style="margin: auto;"> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td></tr> </table>   W E  S </div>															
Address <b>141 28th Ave So.</b>																		
City <b>Waite Park</b>	State <b>MN</b>	Zip Code <b>56387</b>																

State Wisconsin  
Private Water Systems-DG/2  
Department of Natural Resources  
Box 7921  
Madison, WI 53707 (Please type or print using a black pen.)

## 1. Well Location Please use decimals instead of fractions.

☐ Town ☒ City ☐ Village Fire # (If avail.)  
of

Grid or Street Address or Road Name and Number

**Oncil Rd. & Hanley Rd.**

Subdivision Name Lot # Block #

Gov't Lot # or 1/4 of SW 1/4 of  
Section **32** T **29** N; R **19** ☐ E ☒ W

3. Well Type ☒ New test well

☐ Replacement ☐ Reconstruction  
(see item 13 below)

of previous unique well # constructed in 19

Reason for replaced or reconstructed well?

**test well for city well**

☒ Drilled ☐ Driven Point ☐ Jetted ☐ Other

Well serves # of homes and or **N/A**  
(Eg: barn, restaurant, church, school, industry, etc.)

High Capacity:  
Well? ☒ Yes ☐ No  
Property? ☒ Yes ☐ No

5. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? ☒ Yes ☐ No If no, explain on back side.  
Well located in floodplain? ☐ Yes ☒ No **N/A**

Distance in Feet From Well To Nearest: (include proposed)

- |   |   |  |
|---|---|--|
| 1. Landfill                             | 9. Downspout/Yard Hydrant   | 17. Wastewater Sump  |
| 2. Building Overhang                    | 10. Privy   | 18. Paved Animal Barn Pen  |
| 3. Septic or Holding Tank (circle one)  | 11. Foundation Drain to Clearwater  | 19. Animal Yard or Shelter   |
| 4. Sewage Absorption Unit               | 12. Foundation Drain to Sewer   | 20. Silo   |
| 5. Nonconforming Pit                    | 13. Building Drain  | 21. Barn Gutter  |
| 6. Buried Home Heating Oil Tank         | <input type="checkbox"/> Cast Iron or Plastic <input type="checkbox"/> Other          | 22. Manure Pipe <input type="checkbox"/> Gravity <input type="checkbox"/> Pressure |
| 7. Buried Petroleum Tank                | 14. Building Sewer <input type="checkbox"/> Gravity <input type="checkbox"/> Pressure | <input type="checkbox"/> Cast Iron or Plastic <input type="checkbox"/> Other       |
| 8. Shoreline/Swimming Pool (circle one) | <input type="checkbox"/> Cast Iron or Plastic <input type="checkbox"/> Other          | 23. Other Manure Storage   |
|   | 15. Collector Sewer: units in diameter  | 24. Ditch  |
|   | 16. Clearwater Sump   | 25. Other NR 812 Waste Source  |

## 6. Drillhole Dimensions

Dia. (in.)	From (ft.)	To (ft.)	Upper Enlarged Drillhole: Method of Construction
10"	surface	220	<input type="checkbox"/> 1. Rotary - Mud Circulation
			<input type="checkbox"/> 2. Rotary - Air
			<input type="checkbox"/> 3. Rotary - Foam
			<input type="checkbox"/> 4. Reverse Rotary
5 7/8	149	220	<input type="checkbox"/> 5. Cable-tool Bit in dia.
			<input type="checkbox"/> 6. Temp. Outer Casing in dia. depth
			Removed? <input type="checkbox"/> Yes <input type="checkbox"/> No
			If no, explain why not
			<input type="checkbox"/> 7. Other

## 7. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6"	A53B PE Sch 40	surface	163
	.280 well 18.97 lbs/ft		
	valley steel		
Dia. (in.)	screen type, material & slot size	From	To

## 8. Grout or Other Sealing Material

Method	Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	pressure grout trimie			
	neat cement	surface	163	10 yds

## 9. Geology

Type, Caving/Noncaving, Color, Hardness, Etc.	From (ft.)	To (ft.)
	surface	
black topsoil	0	2
brown sandy clay	2	14
decomposed limestone	14	19
tan limestone	19	149
sandstone soft, tan, loose	149	211
sandstone med. soft, lt. brn & white	211	220

10. Static Water Level  
ft. above ground surface  
**102** ft. below ground surface

11. Pump Test  
Pumping Level **119** ft. below surface  
Pumping at **150** GPM for **2** hours

12. Well Is: ☒ Above Grade ☐ Below  
Developed? ☒ Yes ☐ No  
Disinfected? ☒ Yes ☐ No  
Capped? ☒ Yes ☐ No

13. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?  
☒ Yes ☐ No If no, explain

14. Signature of Point Driver or Licensed Supervisory Driller

Date Signed

Signature of Drill Rig Operator (Mandatory unless same as above)

Date Signed

Make additional comments on reverse side about geology, additional screens, water quality, etc.  
Comments on reverse side (CHECK ✓, IF YES)

WELL CONSTRUCTION REPORT  
Form 3300-77A Rev. 8-98

# Well Construction Report For WISCONSIN UNIQUE WELL NUMBER

## NV 207

State of Wisconsin  
Private Water Systems-DG/2  
Department of Natural Resources  
Box 7921  
Madison, WI 53707

6 1251 WELL

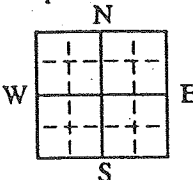
8B

(Please type or print  
using a black pen.)

Property Owner City of Hudson		Telephone Number (715) 386-4760	
Mailing Address 505 Third Street			
City Hudson		State WI	Zip Code 54016
County of Well Location St Croix	Co. Well Permit No. W	Well Completion Date (mm-dd-yy) 08-30-00	

Well Constructor (Business Name) Mark J. Traut Wells, Inc.			License # 5911
Address 141 28th Ave So. Maple Park, MN 56387			
City Maple Park	State MN	Zip Code 56387	

2. Mark well location  
with a dot in correct  
40-acre parcel of section.



1. Well Location Please use decimals instead of fractions.

☐ Town ☒ City ☐ Village Fire # (If avail.)  
of

Grid or Street Address or Road Name and Number

Oncil Rd & Hanley Rd

Subdivision Name Lot # Block #

Gov't Lot # or 1/4 of SW 1/4 of

Section 32 T 29 R 19 E W

3. Well Type ☒ New Test Well 8B

☐ Replacement (see item 13 below) ☐ Reconstruction

of previous unique well # constructed in 19 Reason for replaced or reconstructed well?

4. Well serves # of homes and or N/A  
(Eg: barn, restaurant, church, school, industry, etc.)

High Capacity:

Well? ☒ Yes ☐ No  
Property? ☒ Yes ☐ No

☐ Drilled ☐ Driven Point ☐ Jetted ☐ Other

5. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? ☒ Yes ☐ No If no, explain on back side.

Well located in floodplain? ☐ Yes ☒ No

Distance in Feet From Well To Nearest: (include proposed)

- Landfill
- Building Overhang
- Septic or Holding Tank (circle one)
- Sewage Absorption Unit
- Nonconforming Pit
- Buried Home Heating Oil Tank
- Buried Petroleum Tank
- Shoreline/Swimming Pool (circle one)

- Downspout/Yard Hydrant
- Privy
- Foundation Drain to Clearwater
- Foundation Drain to Sewer
- Building Drain
- Cast Iron or Plastic ☐ Other ☐
- Building Sewer ☐ Gravity ☐ Pressure ☐ Cast Iron or Plastic ☐ Other ☐
- Collector Sewer: units in diameter
- Clearwater Sump

- Wastewater Sump
- Paved Animal Barn Pen
- Animal Yard or Shelter
- Silo
- Barn Gutter
- Manure Pipe ☐ Gravity ☐ Pressure ☐ Cast Iron or Plastic ☐ Other ☐
- Other Manure Storage
- Ditch
- Other NR 812 Waste Source

Borehole Dimensions		
Dia. (in.)	From (ft.)	To (ft.)
10	surface	311
6		375

Upper Enlarged Drillhole:  
Method of Construction  
☒ 1. Rotary - Mud Circulation  
☐ 2. Rotary - Air  
☐ 3. Rotary - Foam  
☐ 4. Reverse Rotary  
☐ 5. Cable-tool Bit in dia.  
☒ 6. Temp. Outer Casing 12 in. dia. 32 depth  
 Removed? ☒ Yes ☐ No  
 If no, explain why not  
☐ 7. Other

9. Geology	Type, Caving/Noncaving, Color, Hardness, Etc.	From (ft.)	To (ft.)
Clay	Brn	surface	5
Sand & Gravel	Brn	5	29
Clay	Brn	29	32
Limestone	Brn	32	301
Sandstone	Tan	301	320
Sandstone	Yellow	320	340
Sandstone	White	340	365
Shale	Gray	365	375

7. Casing, Liner, Screen			
Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
6"	A53B Sch 40 PE	surface	311
	18.97/1b Ft Sawhill		

8. Grout or Other Sealing Material			
Method	Kind of Sealing Material	From (ft.)	To (ft.)
	Pressure grout trimie	surface	311

10. Static Water Level ft. above ground surface 100 ft. below ground surface	12. Well Is: <input checked="" type="checkbox"/> Above Grade <input type="checkbox"/> Below Developed? <input type="checkbox"/> Yes <input type="checkbox"/> No Disinfected? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Capped? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
11. Pump Test Pumping Level ft. below surface Pumping at GPM for hours	

13. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If no, explain	14. Signature of Point Driver or Licensed Supervisory Driller Date Signed 8/31/00 Signature of Drill Rig Operator (Mandatory unless same as above) Date Signed Robbie Terrés
---	--

Make additional comments on reverse side about geology, additional screens, water quality, etc.

(CHECK ✓ IF YES)

WELL CONSTRUCTION REPORT  
Form 3300-77A Rev. 8-98





## ATTACHMENT B

### Hudson Municipal Well Pumping Test 4-11-01 to 4-12-01

Well	Static Water Level from top of casing (ft)	Maximum drawdown from municipal well pumping (ft)	Maximum drawdown with private and municipal well pumping (ft)	Depth of well from top of casing (ft)	Approximate depth of pump from top of casing (ft)	Groundwater head above the pump with one municipal well pumping (ft)	Predicted amount of groundwater head above pump with two municipal wells pumping (ft)	Distance from Municipal Well 8 (ft) (+/- 50)
City of Hudson Farmhouse	107.50	6.3	8.04	Unknown	134	20.2	12.3	634
Schultz	216.54	0.84*	NA	322	264	46.7	38.6	1531
Ulbricht	91.10	1.23	6.0***	124.5	106.3****	14	6.7	1637
Clymer	107.85	4.42	4.84	132	129	16.7	13.7	1954
Delano	112.02	3.77	NA	191	157	41.2	38.1	2165
Nelson	193.93	0.18	NA	234	219	24.9	20.1	3168
Test Well 8A**	107.91	8.1	NA	222.5	NA	NA	NA	540
Municipal Well 8**	97.40	40.3	NA	371	NA	NA	NA	0

- Notes:
- \* Well pump may have been on at end of test which would influence this reading
  - \*\* Data from first pumping test
  - \*\*\* When the municipal well was not pumping but the Ulbricht yard hydrant was running and pressure tank was filling simultaneously, the groundwater level dropped to the pump.
  - \*\*\*\* Originally the pump in the Ulbricht well was set at 101.1 feet below the top of casing. The pump was lowered 5.2 feet after the pumping test.
  - NA - Not applicable

RECEIVED MAY 29 2002  
MEMORANDUM

3535 Vadnais Center Drive, St. Paul, MN 55110-5196

651.490.2000

800.325.2055

651.490.2150 FAX

TO: Denny Christophersen

FROM: Craig Kurtz

DATE: May 17, 2002

RE: Pumping Test 3 - Municipal Wells 8 & 9  
SEH No. A-HUDSO0104.00 SPWM

This Technical Memorandum summarizes the results of the third pumping test, conducted by Short Elliott Hendrickson Inc.® (SEH) on behalf of the City of Hudson, Wisconsin, Public Utilities Commission (PUC), involving Municipal Wells 8 & 9. The test was conducted in accordance with the April 22, 2002 scope of the work submitted to the PUC.

### Background

Two pumping tests on Municipal Well 8 were performed in March and April 2001. The purpose of the first test was to determine the characteristics of the Jordan Sandstone Aquifer. The second test was performed to determine if the pumping of the municipal well would adversely affect privately-owned wells nearby.

The results of the two initial pumping tests indicated the following:

- The Jordan Aquifer is leaky/semi-confined, indicating that groundwater within the overlying Oneota Formation is hydraulically connected to the Jordan Sandstone. However, the groundwater leakage from the Oneota Formation to the Jordan Sandstone appears to be negligible.
- The representative transmissivity and storativity of the aquifer was calculated to be 10,080 ft<sup>2</sup>/day and 0.00054 respectively.
- When pumped at 1,200 gallons per minute (gpm) continuously for 24 hours, Municipal Well 8 did not significantly affect the six domestic-supply wells. It appeared that the measured groundwater drawdown at the six wells was less than predicted, and the wells remained operational and fully functional.
- The aquifer appeared capable of sustaining a second municipal well that could pump at 1,000 gpm. The pumping of both municipal wells would not likely adversely affect the operation and functionality of nearby privately-owned wells.

### Pumping Test 3

With the construction of Municipal Well 9, approximately 400 feet southeast of Municipal Well 8, the PUC decided to conduct a third pumping test to determine what affect, if any, the two wells would have on neighboring, domestic-supply wells when pumped at their maximum rates. In addition, the test would provide additional information regarding the characteristics of the

Pumping Test 3 - Municipal Wells 8 & 9  
May 17, 2002  
Page 2

aquifer that could be used to determine if the aquifer could sustain the two wells when they were pumped at the same time.

Working with Traut Wells, Inc. (Traut), Municipal Wells 8 and 9 were pumped concurrently and continuously for 24 hours, at a rate of 1,000 gpm each. With the verbal permission of the private well owners, the groundwater levels of six domestic-supply wells, located near the municipal wells, were monitored by SEH throughout the pumping phase of the test. The six wells included the Ulbricht well, the Clymer well, the Delano well, the Grekoff well (Winsor Heights model home), the Gilbert well, and the Foster well. The Grekoff and Gilbert wells are open to the Jordan Aquifer, but the other wells are assumed to be only open to the Oneota Formation, overlying the Jordan Sandstone.

Mantyla Well Company (Mantyla) was retained to assist in gaining access to the private wells. In addition, SEH and Traut monitored the groundwater levels in both municipal wells and a Test Well 8A located northwest of Municipal Well 8. The locations of the wells are depicted in Figure 1.

With the assistance of Mantyla personnel, SEH gained access to the six private wells on May 6, 2002. In addition, SEH and Traut installed pressure transducers and data loggers in the two municipal wells and the test well on that day. On May 7, 2002, at 3:00 p.m., Traut began pumping Municipal Wells 8 and 9 at 1,000 gpm each. Both wells were pumped continuously for 24 hours while maintaining the pumping rates. During the 24 hours of pumping, groundwater levels in all six private wells were monitored hourly by SEH personnel. At 3:00 p.m. on May 8, 2002 the pumps in Municipal Wells 8 and 9 were turned off. Groundwater levels in the municipal wells and the test well were monitored for an additional 24-hour recovery period. SEH and Mantyla reclosed the six private wells and removed the equipment from the municipal wells and the test well. The groundwater level data collected by SEH from the municipal wells and the test well were analyzed by SEH using AQTESOLV For Windows® software.

### Results and Conclusions

The static depth to groundwater in Municipal Wells 8 and 9 were 93.5 and 94 feet respectively. After 24 hours of continuous pumping at 1,000 gpm each, the depths to groundwater were 146.6 and 148.5 feet respectively. This results in total groundwater drawdowns of 53.1 and 54.5 feet, and a specific capacity ranging from 18.3 to 18.8 gpm/ft of drawdown for each well when both wells are pumping.

Based on the data collected from the observation well (Test Well 8A), the test indicated that the aquifer's transmissivity and storativity were similar to previous estimates (10,000 ft<sup>2</sup>/day and 0.00077 respectively). The groundwater level data also indicate that the presumed fault zone located west of the municipal wells appears to be a zone of higher transmissivity, and could be a recharge area for the aquifer.

Using the calculated transmissivity for the aquifer (10,080 ft<sup>2</sup>/day), SEH estimated the predicted groundwater drawdown in the six private wells. These predictions are shown on Figure 1. Using the recently calculated transmissivity would have resulted in higher predicted drawdowns. The

Pumping Test 3 - Municipal Wells 8 & 9  
May 17, 2002  
Page 3

actual measured groundwater drawdowns in the private wells recorded during the test were significantly less than the predictions.

No groundwater drawdown was observed in the Grekoff or Gilbert wells. The groundwater level in the Foster well only decreased 0.10 feet during the test. This negligible drawdown may be due to a weather system that moved through the area during the test.

After the 24 hours of pumping, the Delano and Clymer wells had groundwater drawdowns of 4.77 and 5.53 feet respectively. However, the groundwater heads remaining above the pumps of the two wells, after the drawdown, were approximately 41 and 16 feet respectively. Approximately 1.61 feet of groundwater drawdown was observed at the Ulbricht well, but approximately 16 feet of groundwater head remained above the pump in this well after 24 hours of continuous pumping from Municipal Wells 8 and 9.

#### Uncertainty

The predicted groundwater drawdown at specific distances from the municipal wells are based on a series of mathematical and scientific assumptions. Specifically, the drawdown predictions are based on the assumptions that the Jordan Aquifer is confined, homogeneous, and laterally extensive, and the nearby wells are fully screened in the same aquifer. In reality, the geology in the vicinity of the municipal wells is complex. A fault zone exists within 1/2-mile of the municipal wells and the thicknesses of the Jordan Sandstone and Oneota Formation have significant variation. Although the presence of the fault may be a recharging area for the aquifer, based on the data from the most recent pumping test, the nature and conditions of the fault zone itself may either promote or diminish groundwater flow.

Calculated groundwater drawdown values are only approximations and should be used with caution. Actual groundwater drawdown near the municipal wells may be more or less than the calculated values due to the local geologic complexity. SEH recommends relying on the data collected from the pumping tests, in which actual drawdown measurements were made in nearby domestic-supply wells, in addition to the municipal wells themselves.








clk

#### Attachments

c: Jim Norton, P.E., SEH Inc.  
Steve Nelson, P.E., SEH Inc.  
Steve Heth, P.E., SEH Inc.  
Paul Kubesh, SEH Inc.

i:\hudson\techmemo502.doc

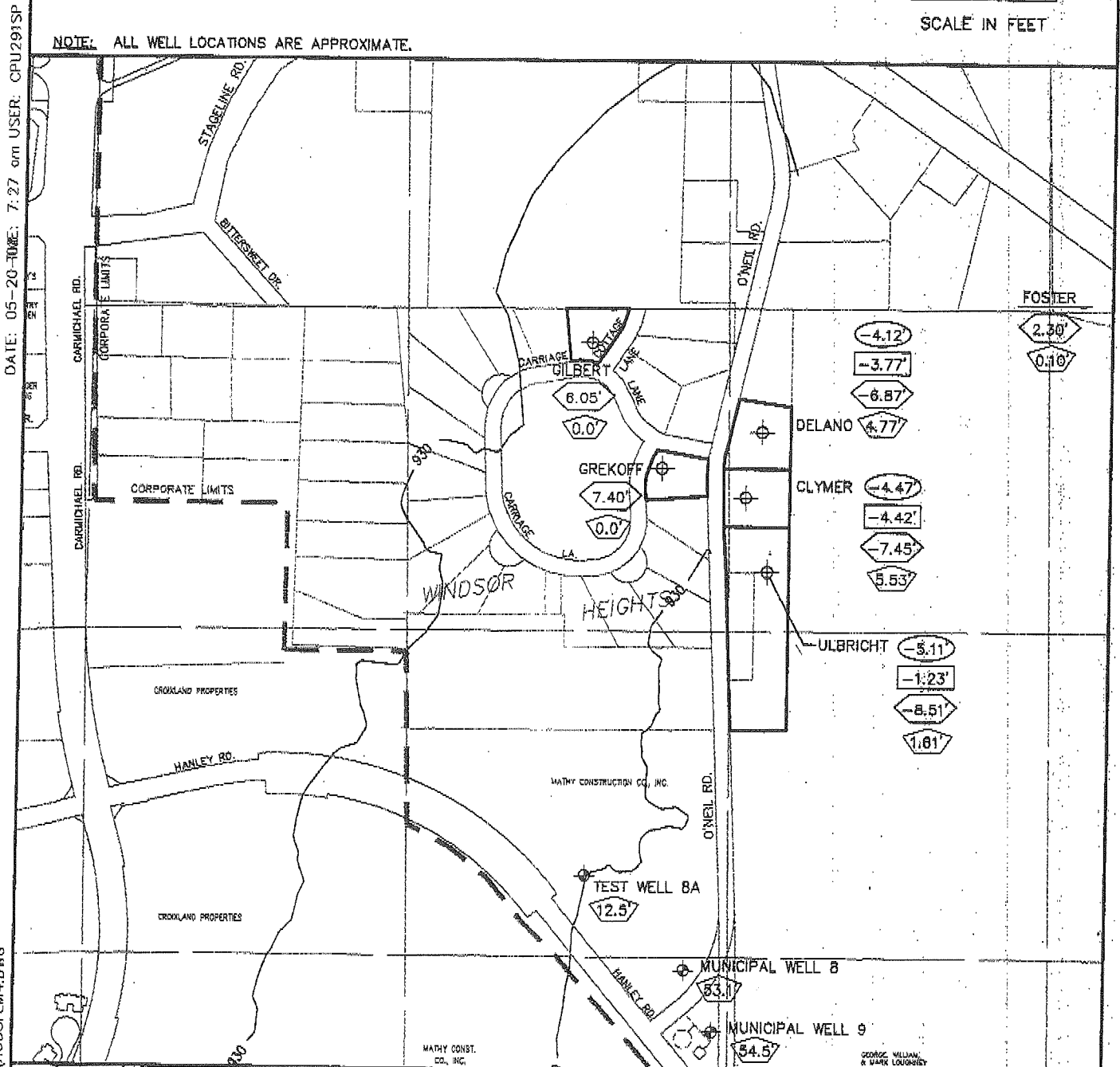
**LEGEND**

-  PROPERTY BOUNDARY  
 DOMESTIC SUPPLY WELL  
 MUNICIPAL WELL  
 PREDICTED DRAWDOWN (WHEN MUNICIPAL WELL 8 IS PUMPING AT 1200 GPM)  
 DRAWDOWN FROM PUMPING TEST 2  
 PREDICTED DRAWDOWN (WHEN 2 MUNICIPAL WELLS ARE PUMPING AT 1000 GPM EACH - MUNICIPAL WELLS 8 AND 9)  
 DRAWDOWN FROM PUMPING TEST 3

N

0 150 300 600  
SCALE IN FEET

NOTE: ALL WELL LOCATIONS ARE APPROXIMATE.



1	5/18/02	ORIGINAL ISSUE	BRN	5/02	CLK	5/02
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK	



AQUIFER PUMPING TEST 3  
HUDSON, WISCONSIN

WELL LOCATIONS AND  
GROUNDWATER DRAWDOWNS

PROJ. NO.  
HUDS00104  
DATE  
5/18/02

FIGURE  
1

DATE: 05-20-2002 7:27 am USER: CPU291SP

I:\HUDSON\0104\HUDSEL4.DWG

# ATTACHMENT C



# City of Hudson Production Well 8 Pump Test

Ulbricht Well  
4-11-01 to 4-12-01

Date	Time	Elapsed Time	feet over pressure transducer	Water level from bottom of pit (ft)	Remarks
1/4/11	10:30:46	-225.00	16.59	91.59	
1/4/11	10:35:46	-220.00	17.16	91.02	
1/4/11	10:40:46	-215.00	17.26	90.92	
1/4/11	10:45:46	-210.00	17.29	90.89	
1/4/11	10:50:46	-205.00	17.31	90.87	
1/4/11	10:55:46	-200.00	17.33	90.85	
1/4/11	11:00:46	-195.00	17.32	90.86	
1/4/11	11:05:46	-190.00	17.34	90.84	
1/4/11	11:10:46	-185.00	17.36	90.82	
1/4/11	11:15:46	-180.00	17.38	90.80	
1/4/11	11:20:46	-175.00	14.82	93.36	
1/4/11	11:25:46	-170.00	15.00	93.18	
1/4/11	11:30:46	-165.00	16.99	91.19	
1/4/11	11:35:46	-160.00	17.26	90.92	
1/4/11	11:40:46	-155.00	17.33	90.85	
1/4/11	11:45:46	-150.00	14.49	93.69	
1/4/11	11:50:46	-145.00	16.21	91.97	
1/4/11	11:55:46	-140.00	17.05	91.13	
1/4/11	12:00:46	-135.00	17.24	90.94	
1/4/11	12:05:46	-130.00	17.29	90.89	
1/4/11	12:10:46	-125.00	17.29	90.89	
1/4/11	12:15:46	-120.00	13.85	94.33	
1/4/11	12:20:46	-115.00	16.93	91.25	
1/4/11	12:25:46	-110.00	17.20	90.98	
1/4/11	12:30:46	-105.00	17.29	90.89	
1/4/11	12:35:46	-100.00	17.34	90.84	
1/4/11	12:40:46	-95.00	17.34	90.84	
1/4/11	12:45:46	-90.00	17.36	90.82	
1/4/11	12:50:46	-85.00	17.40	90.78	
1/4/11	12:55:46	-80.00	17.38	90.80	
1/4/11	13:00:46	-75.00	17.40	90.78	
1/4/11	13:05:46	-70.00	17.35	90.83	
1/4/11	13:10:46	-65.00	17.39	90.79	
1/4/11	13:15:46	-60.00	17.42	90.76	
1/4/11	13:20:46	-55.00	13.20	94.98	
1/4/11	13:25:46	-50.00	16.75	91.43	
1/4/11	13:30:46	-45.00	17.13	91.05	
1/4/11	13:35:46	-40.00	17.29	90.89	
1/4/11	13:40:46	-35.00	17.34	90.84	
1/4/11	13:45:46	-30.00	17.35	90.83	
1/4/11	13:50:46	-25.00	17.37	90.81	
1/4/11	13:55:46	-20.00	17.36	90.82	
1/4/11	14:00:46	-15.00	17.39	90.79	
1/4/11	14:05:46	-10.00	17.37	90.81	
1/4/11	14:10:46	-5.00	17.39	90.79	
1/4/11	14:15:46	0.00	17.38	90.80	Production Well 8 on at 2:15pm on 4-11-01
1/4/11	14:20:46	5.00	17.38	90.80	
1/4/11	14:25:46	10.00	12.78	95.40	
1/4/11	14:30:46	15.00	16.53	91.65	
1/4/11	14:35:46	20.00	17.04	91.14	
1/4/11	14:40:46	25.00	17.25	90.93	

1/4/11	14:45:46	30.00	17.27	90.91
1/4/11	14:50:46	35.00	13.43	94.75
1/4/11	14:55:46	40.00	16.69	91.49
1/4/11	15:00:46	45.00	17.12	91.06
1/4/11	15:05:46	50.00	17.22	90.96
1/4/11	15:10:46	55.00	17.29	90.89
1/4/11	15:15:46	60.00	17.34	90.84
1/4/11	15:20:46	65.00	17.34	90.84
1/4/11	15:25:46	70.00	17.34	90.84
1/4/11	15:30:46	75.00	17.32	90.86
1/4/11	15:35:46	80.00	17.34	90.84
1/4/11	15:40:46	85.00	17.33	90.85
1/4/11	15:45:46	90.00	17.31	90.87
1/4/11	15:50:46	95.00	17.34	90.84
1/4/11	15:55:46	100.00	17.34	90.84
1/4/11	16:00:46	105.00	14.18	94.00
1/4/11	16:05:46	110.00	15.55	92.63
1/4/11	16:10:46	115.00	16.98	91.20
1/4/11	16:15:46	120.00	17.19	90.99
1/4/11	16:20:46	125.00	17.27	90.91
1/4/11	16:25:46	130.00	17.29	90.89
1/4/11	16:30:46	135.00	14.52	93.66
1/4/11	16:35:46	140.00	16.93	91.25
1/4/11	16:40:46	145.00	17.21	90.97
1/4/11	16:45:46	150.00	17.24	90.94
1/4/11	16:50:46	155.00	17.27	90.91
1/4/11	16:55:46	160.00	17.29	90.89
1/4/11	17:00:46	165.00	17.30	90.88
1/4/11	17:05:46	170.00	17.32	90.86
1/4/11	17:10:46	175.00	17.33	90.85
1/4/11	17:15:46	180.00	17.31	90.87
1/4/11	17:20:46	185.00	17.34	90.84
1/4/11	17:25:46	190.00	17.28	90.90
1/4/11	17:30:46	195.00	17.30	90.88
1/4/11	17:35:46	200.00	17.27	90.91
1/4/11	17:40:46	205.00	17.29	90.89
1/4/11	17:45:46	210.00	17.29	90.89
1/4/11	17:50:46	215.00	17.29	90.89
1/4/11	17:55:46	220.00	17.31	90.87
1/4/11	18:00:46	225.00	17.32	90.86
1/4/11	18:05:46	230.00	17.36	90.82
1/4/11	18:10:46	235.00	17.34	90.84
1/4/11	18:15:46	240.00	17.35	90.83
1/4/11	18:20:46	245.00	17.32	90.86
1/4/11	18:25:46	250.00	17.31	90.87
1/4/11	18:30:46	255.00	17.30	90.88
1/4/11	18:35:46	260.00	17.32	90.86
1/4/11	18:40:46	265.00	17.31	90.87
1/4/11	18:45:46	270.00	17.33	90.85
1/4/11	18:50:46	275.00	17.33	90.85
1/4/11	18:55:46	280.00	17.31	90.87
1/4/11	19:00:46	285.00	17.31	90.87
1/4/11	19:05:46	290.00	17.33	90.85
1/4/11	19:10:46	295.00	17.34	90.84
1/4/11	19:15:46	300.00	17.32	90.86
1/4/11	19:20:46	305.00	17.31	90.87
1/4/11	19:25:46	310.00	17.31	90.87
1/4/11	19:30:46	315.00	17.34	90.84
1/4/11	19:35:46	320.00	17.30	90.88
1/4/11	19:40:46	325.00	17.34	90.84

1/4/11	19:45:46	330.00	17.30	90.88
1/4/11	19:50:46	335.00	17.33	90.85
1/4/11	19:55:46	340.00	17.31	90.87
1/4/11	20:00:46	345.00	17.34	90.84
1/4/11	20:05:46	350.00	17.28	90.90
1/4/11	20:10:46	355.00	17.29	90.89
1/4/11	20:15:46	360.00	17.27	90.91
1/4/11	20:20:46	365.00	17.28	90.90
1/4/11	20:25:46	370.00	14.64	93.54
1/4/11	20:30:46	375.00	16.78	91.40
1/4/11	20:35:46	380.00	17.05	91.13
1/4/11	20:40:46	385.00	17.15	91.03
1/4/11	20:45:46	390.00	17.20	90.98
1/4/11	20:50:46	395.00	17.20	90.98
1/4/11	20:55:46	400.00	17.20	90.98
1/4/11	21:00:46	405.00	17.22	90.96
1/4/11	21:05:46	410.00	12.57	95.61
1/4/11	21:10:46	415.00	16.75	91.43
1/4/11	21:15:46	420.00	16.96	91.22
1/4/11	21:20:46	425.00	17.05	91.13
1/4/11	21:25:46	430.00	17.11	91.07
1/4/11	21:30:46	435.00	17.13	91.05
1/4/11	21:35:46	440.00	17.14	91.04
1/4/11	21:40:46	445.00	17.17	91.01
1/4/11	21:45:46	450.00	17.12	91.06
1/4/11	21:50:46	455.00	17.14	91.04
1/4/11	21:55:46	460.00	17.18	91.00
1/4/11	22:00:46	465.00	17.19	90.99
1/4/11	22:05:46	470.00	17.16	91.02
1/4/11	22:10:46	475.00	17.15	91.03
1/4/11	22:15:46	480.00	17.16	91.02
1/4/11	22:20:46	485.00	17.15	91.03
1/4/11	22:25:46	490.00	17.16	91.02
1/4/11	22:30:46	495.00	17.14	91.04
1/4/11	22:35:46	500.00	17.16	91.02
1/4/11	22:40:46	505.00	17.17	91.01
1/4/11	22:45:46	510.00	17.16	91.02
1/4/11	22:50:46	515.00	17.16	91.02
1/4/11	22:55:46	520.00	17.14	91.04
1/4/11	23:00:46	525.00	17.18	91.00
1/4/11	23:05:46	530.00	17.17	91.01
1/4/11	23:10:46	535.00	17.14	91.04
1/4/11	23:15:46	540.00	17.13	91.05
1/4/11	23:20:46	545.00	17.14	91.04
1/4/11	23:25:46	550.00	17.12	91.06
1/4/11	23:30:46	555.00	17.16	91.02
1/4/11	23:35:46	560.00	17.17	91.01
1/4/11	23:40:46	565.00	17.12	91.06
1/4/11	23:45:46	570.00	17.14	91.04
1/4/11	23:50:46	575.00	17.14	91.04
1/4/11	23:55:46	580.00	17.12	91.06
1/4/12	0:00:46	585.00	17.13	91.05
1/4/12	0:05:46	590.00	17.13	91.05
1/4/12	0:10:46	595.00	17.15	91.03
1/4/12	0:15:46	600.00	17.12	91.06
1/4/12	0:20:46	605.00	17.10	91.08
1/4/12	0:25:46	610.00	17.13	91.05
1/4/12	0:30:46	615.00	17.10	91.08
1/4/12	0:35:46	620.00	17.12	91.06
1/4/12	0:40:46	625.00	17.13	91.05

1/4/12	0:45:46	630.00	17.10	91.08
1/4/12	0:50:46	635.00	17.08	91.10
1/4/12	0:55:46	640.00	17.08	91.10
1/4/12	1:00:46	645.00	17.09	91.09
1/4/12	1:05:46	650.00	17.05	91.13
1/4/12	1:10:46	655.00	17.08	91.10
1/4/12	1:15:46	660.00	17.08	91.10
1/4/12	1:20:46	665.00	17.10	91.08
1/4/12	1:25:46	670.00	17.07	91.11
1/4/12	1:30:46	675.00	17.06	91.12
1/4/12	1:35:46	680.00	17.05	91.13
1/4/12	1:40:46	685.00	17.08	91.10
1/4/12	1:45:46	690.00	17.06	91.12
1/4/12	1:50:46	695.00	17.04	91.14
1/4/12	1:55:46	700.00	16.08	92.10
1/4/12	2:00:46	705.00	16.83	91.35
1/4/12	2:05:46	710.00	16.93	91.25
1/4/12	2:10:46	715.00	16.97	91.21
1/4/12	2:15:46	720.00	17.00	91.18
1/4/12	2:20:46	725.00	16.99	91.19
1/4/12	2:25:46	730.00	16.99	91.19
1/4/12	2:30:46	735.00	17.01	91.17
1/4/12	2:35:46	740.00	16.98	91.20
1/4/12	2:40:46	745.00	16.97	91.21
1/4/12	2:45:46	750.00	16.98	91.20
1/4/12	2:50:46	755.00	17.00	91.18
1/4/12	2:55:46	760.00	17.00	91.18
1/4/12	3:00:46	765.00	16.97	91.21
1/4/12	3:05:46	770.00	17.00	91.18
1/4/12	3:10:46	775.00	16.97	91.21
1/4/12	3:15:46	780.00	16.91	91.27
1/4/12	3:20:46	785.00	16.98	91.20
1/4/12	3:25:46	790.00	16.97	91.21
1/4/12	3:30:46	795.00	16.99	91.19
1/4/12	3:35:46	800.00	16.94	91.24
1/4/12	3:40:46	805.00	16.96	91.22
1/4/12	3:45:46	810.00	16.94	91.24
1/4/12	3:50:46	815.00	16.95	91.23
1/4/12	3:55:46	820.00	16.92	91.26
1/4/12	4:00:46	825.00	16.94	91.24
1/4/12	4:05:46	830.00	16.93	91.25
1/4/12	4:10:46	835.00	16.90	91.28
1/4/12	4:15:46	840.00	16.92	91.26
1/4/12	4:20:46	845.00	16.91	91.27
1/4/12	4:25:46	850.00	16.92	91.26
1/4/12	4:30:46	855.00	16.93	91.25
1/4/12	4:35:46	860.00	16.88	91.30
1/4/12	4:40:46	865.00	16.92	91.26
1/4/12	4:45:46	870.00	16.91	91.27
1/4/12	4:50:46	875.00	16.90	91.28
1/4/12	4:55:46	880.00	16.87	91.31
1/4/12	5:00:46	885.00	16.87	91.31
1/4/12	5:05:46	890.00	16.85	91.33
1/4/12	5:10:46	895.00	16.84	91.34
1/4/12	5:15:46	900.00	16.83	91.35
1/4/12	5:20:46	905.00	16.84	91.34
1/4/12	5:25:46	910.00	16.83	91.35
1/4/12	5:30:46	915.00	16.85	91.33
1/4/12	5:35:46	920.00	16.83	91.35
1/4/12	5:40:46	925.00	16.83	91.35

1/4/12	5:45:46	930.00	16.83	91.35
1/4/12	5:50:46	935.00	16.81	91.37
1/4/12	5:55:46	940.00	16.82	91.36
1/4/12	6:00:46	945.00	16.78	91.40
1/4/12	6:05:46	950.00	16.81	91.37
1/4/12	6:10:46	955.00	16.79	91.39
1/4/12	6:15:46	960.00	16.78	91.40
1/4/12	6:20:46	965.00	16.76	91.42
1/4/12	6:25:46	970.00	16.76	91.42
1/4/12	6:30:46	975.00	16.77	91.41
1/4/12	6:35:46	980.00	16.77	91.41
1/4/12	6:40:46	985.00	16.75	91.43
1/4/12	6:45:46	990.00	16.74	91.44
1/4/12	6:50:46	995.00	16.74	91.44
1/4/12	6:55:46	1000.00	16.75	91.43
1/4/12	7:00:46	1005.00	16.76	91.42
1/4/12	7:05:46	1010.00	16.71	91.47
1/4/12	7:10:46	1015.00	16.72	91.46
1/4/12	7:15:46	1020.00	16.72	91.46
1/4/12	7:20:46	1025.00	16.72	91.46
1/4/12	7:25:46	1030.00	16.70	91.48
1/4/12	7:30:46	1035.00	15.13	93.05
1/4/12	7:35:46	1040.00	16.49	91.69
1/4/12	7:40:46	1045.00	16.59	91.59
1/4/12	7:45:46	1050.00	16.61	91.57
1/4/12	7:50:46	1055.00	16.61	91.57
1/4/12	7:55:46	1060.00	16.62	91.56
1/4/12	8:00:46	1065.00	16.62	91.56
1/4/12	8:05:46	1070.00	16.63	91.55
1/4/12	8:10:46	1075.00	16.62	91.56
1/4/12	8:15:46	1080.00	16.61	91.57
1/4/12	8:20:46	1085.00	16.62	91.56
1/4/12	8:25:46	1090.00	11.98	96.20
1/4/12	8:30:46	1095.00	15.35	92.83
1/4/12	8:35:46	1100.00	16.34	91.84
1/4/12	8:40:46	1105.00	16.43	91.75
1/4/12	8:45:46	1110.00	16.46	91.72
1/4/12	8:50:46	1115.00	16.50	91.68
1/4/12	8:55:46	1120.00	16.52	91.66
1/4/12	9:00:46	1125.00	16.52	91.66
1/4/12	9:05:46	1130.00	16.53	91.65
1/4/12	9:10:46	1135.00	16.52	91.66
1/4/12	9:15:46	1140.00	12.18	96.00
1/4/12	9:20:46	1145.00	13.90	94.28
1/4/12	9:25:46	1150.00	16.24	91.94
1/4/12	9:30:46	1155.00	16.35	91.83
1/4/12	9:35:46	1160.00	16.38	91.80
1/4/12	9:40:46	1165.00	12.59	95.59
1/4/12	9:45:46	1170.00	14.95	93.23
1/4/12	9:50:46	1175.00	16.23	91.95
1/4/12	9:55:46	1180.00	16.35	91.83
1/4/12	10:00:46	1185.00	16.33	91.85
1/4/12	10:05:46	1190.00	16.38	91.80
1/4/12	10:10:46	1195.00	16.38	91.80
1/4/12	10:15:46	1200.00	16.39	91.79
1/4/12	10:20:46	1205.00	16.40	91.78
1/4/12	10:25:46	1210.00	16.40	91.78
1/4/12	10:30:46	1215.00	16.39	91.79
1/4/12	10:35:46	1220.00	16.40	91.78
1/4/12	10:40:46	1225.00	16.39	91.79

1/4/12	10:45:46	1230.00	16.38	91.80
1/4/12	10:50:46	1235.00	16.43	91.75
1/4/12	10:55:46	1240.00	16.38	91.80
1/4/12	11:00:46	1245.00	16.41	91.77
1/4/12	11:05:46	1250.00	16.38	91.80
1/4/12	11:10:46	1255.00	16.36	91.82
1/4/12	11:15:46	1260.00	16.38	91.80
1/4/12	11:20:46	1265.00	16.40	91.78
1/4/12	11:25:46	1270.00	16.36	91.82
1/4/12	11:30:46	1275.00	16.39	91.79
1/4/12	11:35:46	1280.00	16.36	91.82
1/4/12	11:40:46	1285.00	16.36	91.82
1/4/12	11:45:46	1290.00	16.38	91.80
1/4/12	11:50:46	1295.00	16.36	91.82
1/4/12	11:55:46	1300.00	12.43	95.75
1/4/12	12:00:46	1305.00	15.85	92.33
1/4/12	12:05:46	1310.00	16.20	91.98
1/4/12	12:10:46	1315.00	16.24	91.94
1/4/12	12:15:46	1320.00	16.26	91.92
1/4/12	12:20:46	1325.00	16.27	91.91
1/4/12	12:25:46	1330.00	16.31	91.87
1/4/12	12:30:46	1335.00	16.28	91.90
1/4/12	12:35:46	1340.00	16.29	91.89
1/4/12	12:40:46	1345.00	11.29	96.89
1/4/12	12:45:46	1350.00	15.67	92.51
1/4/12	12:50:46	1355.00	16.09	92.09
1/4/12	12:55:46	1360.00	16.16	92.02
1/4/12	13:00:46	1365.00	16.17	92.01
1/4/12	13:05:46	1370.00	11.41	96.77
1/4/12	13:10:46	1375.00	15.62	92.56
1/4/12	13:15:46	1380.00	16.01	92.17
1/4/12	13:20:46	1385.00	16.05	92.13
1/4/12	13:25:46	1390.00	16.09	92.09
1/4/12	13:30:46	1395.00	16.13	92.05
1/4/12	13:35:46	1400.00	16.13	92.05
1/4/12	13:40:46	1405.00	16.11	92.07
1/4/12	13:45:46	1410.00	16.15	92.03
1/4/12	13:50:46	1415.00	10.74	97.44
1/4/12	13:55:46	1420.00	7.00	101.18
1/4/12	14:00:46	1425.00	7.00	101.18
1/4/12	14:05:46	1430.00	7.21	100.97
1/4/12	14:10:46	1435.00	10.26	97.92
1/4/12	14:15:46	1440.00	15.28	92.90
1/4/12	14:20:46	1445.00	15.65	92.53
1/4/12	14:25:46	1450.00	15.76	92.42
1/4/12	14:30:46	1455.00	15.80	92.38
1/4/12	14:35:46	1460.00	15.87	92.31
1/4/12	14:40:46	1465.00	15.88	92.30
1/4/12	14:45:46	1470.00	15.89	92.29
1/4/12	14:50:46	1475.00	15.93	92.25
1/4/12	14:55:46	1480.00	12.75	95.43
1/4/12	15:00:46	1485.00	13.36	94.82
1/4/12	15:05:46	1490.00	15.66	92.52
1/4/12	15:10:46	1495.00	15.84	92.34
1/4/12	15:15:46	1500.00	14.20	93.98
1/4/12	15:20:46	1505.00	13.62	94.56
1/4/12	15:25:46	1510.00	15.64	92.54
1/4/12	15:30:46	1515.00	15.79	92.39
1/4/12	15:35:46	1520.00	15.85	92.33
1/4/12	15:40:46	1525.00	15.86	92.32

Ulbricht well started recharging pressure tank  
and running hydrant at the well

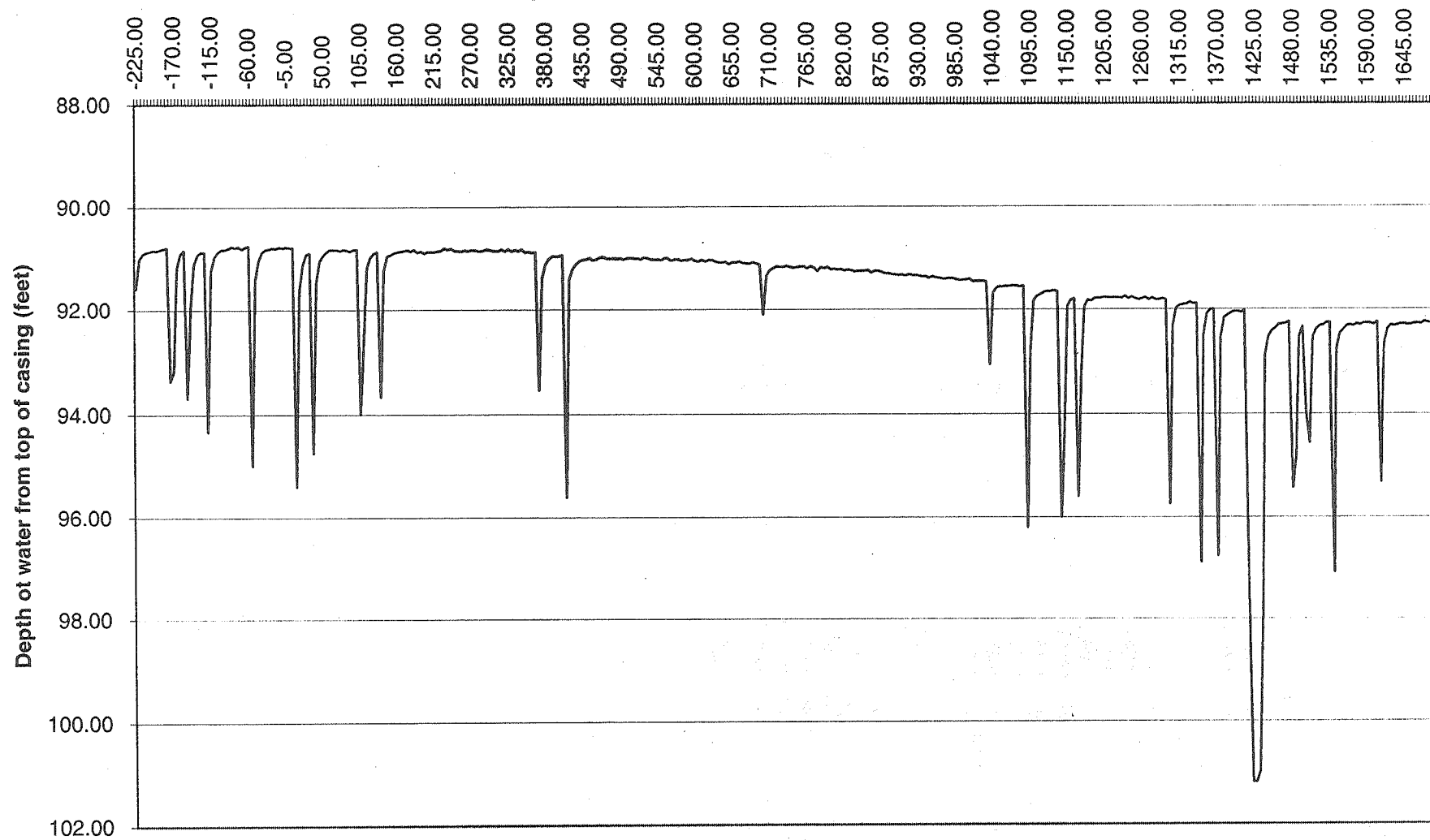
Ulbricht well turned off

1/4/12	15:45:46	1530.00	15.91	92.27
1/4/12	15:50:46	1535.00	15.91	92.27
1/4/12	15:55:46	1540.00	11.09	97.09
1/4/12	16:00:46	1545.00	15.42	92.76
1/4/12	16:05:46	1550.00	15.72	92.46
1/4/12	16:10:46	1555.00	15.78	92.40
1/4/12	16:15:46	1560.00	15.85	92.33
1/4/12	16:20:46	1565.00	15.87	92.31
1/4/12	16:25:46	1570.00	15.85	92.33
1/4/12	16:30:46	1575.00	15.88	92.30
1/4/12	16:35:46	1580.00	15.87	92.31
1/4/12	16:40:46	1585.00	15.90	92.28
1/4/12	16:45:46	1590.00	15.89	92.29
1/4/12	16:50:46	1595.00	15.90	92.28
1/4/12	16:55:46	1600.00	15.87	92.31
1/4/12	17:00:46	1605.00	15.92	92.26
1/4/12	17:05:46	1610.00	12.86	95.32
1/4/12	17:10:46	1615.00	15.50	92.68
1/4/12	17:15:46	1620.00	15.79	92.39
1/4/12	17:20:46	1625.00	15.86	92.32
1/4/12	17:25:46	1630.00	15.85	92.33
1/4/12	17:30:46	1635.00	15.87	92.31
1/4/12	17:35:46	1640.00	15.88	92.30
1/4/12	17:40:46	1645.00	15.88	92.30
1/4/12	17:45:46	1650.00	15.87	92.31
1/4/12	17:50:46	1655.00	15.87	92.31
1/4/12	17:55:46	1660.00	15.89	92.29
1/4/12	18:00:46	1665.00	15.89	92.29
1/4/12	18:05:46	1670.00	15.88	92.30
1/4/12	18:10:46	1675.00	15.93	92.25
1/4/12	18:15:46	1680.00	15.91	92.27
1/4/12	18:20:46	1685.00	15.90	92.28
1/4/12	18:25:46	1690.00	15.93	92.25

Maximum drawdown with just pressure tank refilling

# Ulbricht Well (Depth to Water From Top of Casing)

Elapsed time in minutes from start of Production Well 8





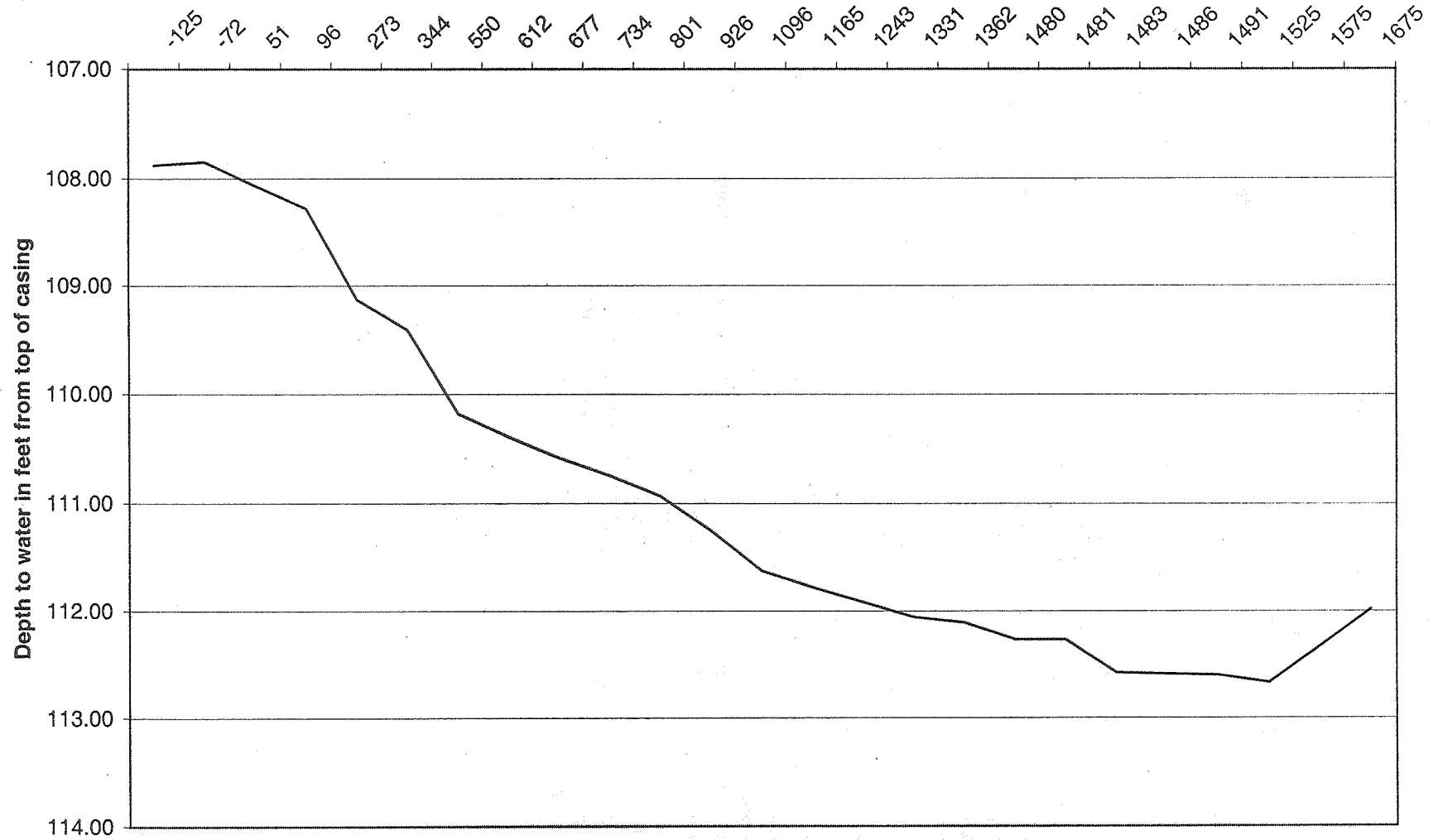
# City of Hudson Production Well 8 Pumping Test

Clymer well drawdown  
4-11-01 to 4-12-01

Date	Elapsed Time since starting pump	Depth to Water	Remarks
11-Apr-01	-125	107.88	
11-Apr-01	-72	107.85	
11-Apr-01	51	108.07	Production Well 8 on at 4-11-01 2:15pm
11-Apr-01	96	108.28	
11-Apr-01	273	109.13	
11-Apr-01	344	109.41	
11-Apr-01	550	110.18	
12-Apr-01	612	110.39	
12-Apr-01	677	110.58	
12-Apr-01	734	110.74	
12-Apr-01	801	110.93	
12-Apr-01	926	111.25	
12-Apr-01	1096	111.63	
12-Apr-01	1165	111.78	
12-Apr-01	1243	111.92	
12-Apr-01	1331	112.06	
12-Apr-01	1362	112.11	
12-Apr-01	1480	112.27	
12-Apr-01	1481	112.27	Start house pump (8.6 gal/min)
12-Apr-01	1483	112.58	
12-Apr-01	1486	112.59	
12-Apr-01	1491	112.60	
12-Apr-01	1525	112.67	House pump off
12-Apr-01	1575	112.33	Production Well 8 off at 1540.5 min
12-Apr-01	1675	111.98	

# Clymer Well (Depth to Water From Top of Casing)

Elapsed time in minutes from start of Production Well 8



# City of Hudson Production Well 8 Pump Test

Delano Well  
4-11-01 to 4-12-01

Date	Elapsed time from start of production well 8 (min)	Drawdown on Hermit data logger	Drawdown below static water level (feet)	Remarks
4/11/01	-405	-5.856	0.00	
4/11/01	-395	-5.862	-0.01	
4/11/01	-385	-5.862	-0.01	
4/11/01	-375	-5.869	-0.01	
4/11/01	-365	-5.869	-0.01	
4/11/01	-355	-5.875	-0.02	
4/11/01	-345	-5.878	-0.02	
4/11/01	-335	-5.878	-0.02	
4/11/01	-325	-5.884	-0.03	
4/11/01	-315	-5.887	-0.03	
4/11/01	-305	-5.897	-0.04	
4/11/01	-295	-5.906	-0.05	
4/11/01	-285	-5.903	-0.05	
4/11/01	-275	-5.916	-0.06	
4/11/01	-265	-5.827	0.03	
4/11/01	-255	-5.894	-0.04	
4/11/01	-245	-5.878	-0.02	
4/11/01	-235	-5.881	-0.03	
4/11/01	-225	-5.9	-0.04	
4/11/01	-215	-5.903	-0.05	
4/11/01	-205	-5.9	-0.04	
4/11/01	-195	-5.897	-0.04	
4/11/01	-185	-5.894	-0.04	
4/11/01	-175	-5.916	-0.06	
4/11/01	-165	-5.919	-0.06	
4/11/01	-155	-5.913	-0.06	
4/11/01	-145	-5.909	-0.05	
4/11/01	-135	-5.913	-0.06	
4/11/01	-125	-5.913	-0.06	
4/11/01	-115	-5.919	-0.06	
4/11/01	-105	-5.913	-0.06	
4/11/01	-95	-5.932	-0.08	
4/11/01	-85	-5.929	-0.07	
4/11/01	-75	-5.932	-0.08	
4/11/01	-65	-5.925	-0.07	
4/11/01	-55	-5.932	-0.08	
4/11/01	-45	-5.929	-0.07	
4/11/01	-35	-5.916	-0.06	
4/11/01	-25	-5.916	-0.06	
4/11/01	-15	-5.85	0.01	

4/11/01	-5	-5.916	-0.06
4/11/01	0	NA	NA
4/11/01	5	-5.919	-0.06
4/11/01	15	-5.9	-0.04
4/11/01	25	-5.869	-0.01
4/11/01	35	-5.837	0.02
4/11/01	45	-5.821	0.04
4/11/01	55	-5.783	0.07
4/11/01	65	-5.752	0.10
4/11/01	75	-5.72	0.14
4/11/01	85	-5.676	0.18
4/11/01	95	-5.654	0.20
4/11/01	105	-5.606	0.25
4/11/01	115	-5.6	0.26
4/11/01	125	-5.53	0.33
4/11/01	135	-5.512	0.34
4/11/01	145	-5.489	0.37
4/11/01	155	-5.445	0.41
4/11/01	165	-5.417	0.44
4/11/01	175	-5.36	0.50
4/11/01	185	-5.351	0.51
4/11/01	195	-5.294	0.56
4/11/01	205	-5.25	0.61
4/11/01	215	-5.221	0.64
4/11/01	225	-5.193	0.66
4/11/01	235	-5.164	0.69
4/11/01	245	-5.107	0.75
4/11/01	255	-5.069	0.79
4/11/01	265	-5.019	0.84
4/11/01	275	-4.987	0.87
4/11/01	285	-4.956	0.90
4/11/01	295	-4.934	0.92
4/11/01	305	-4.915	0.94
4/11/01	315	-4.874	0.98
4/11/01	325	-4.836	1.02
4/11/01	335	-4.801	1.06
4/11/01	345	-4.757	1.10
4/11/01	355	-4.725	1.13
4/11/01	365	-4.691	1.17
4/11/01	375	-4.656	1.20
4/11/01	385	-4.618	1.24
4/11/01	395	-4.583	1.27
4/11/01	405	-4.545	1.31
4/11/01	415	-4.514	1.34
4/11/01	425	-4.476	1.38
4/11/01	435	-4.444	1.41
4/11/01	445	-4.41	1.45
4/11/01	455	-4.378	1.48
4/11/01	465	-4.346	1.51
4/11/01	475	-4.312	1.54
4/11/01	485	-4.28	1.58
4/11/01	495	-4.252	1.60

Production Well 8 Started

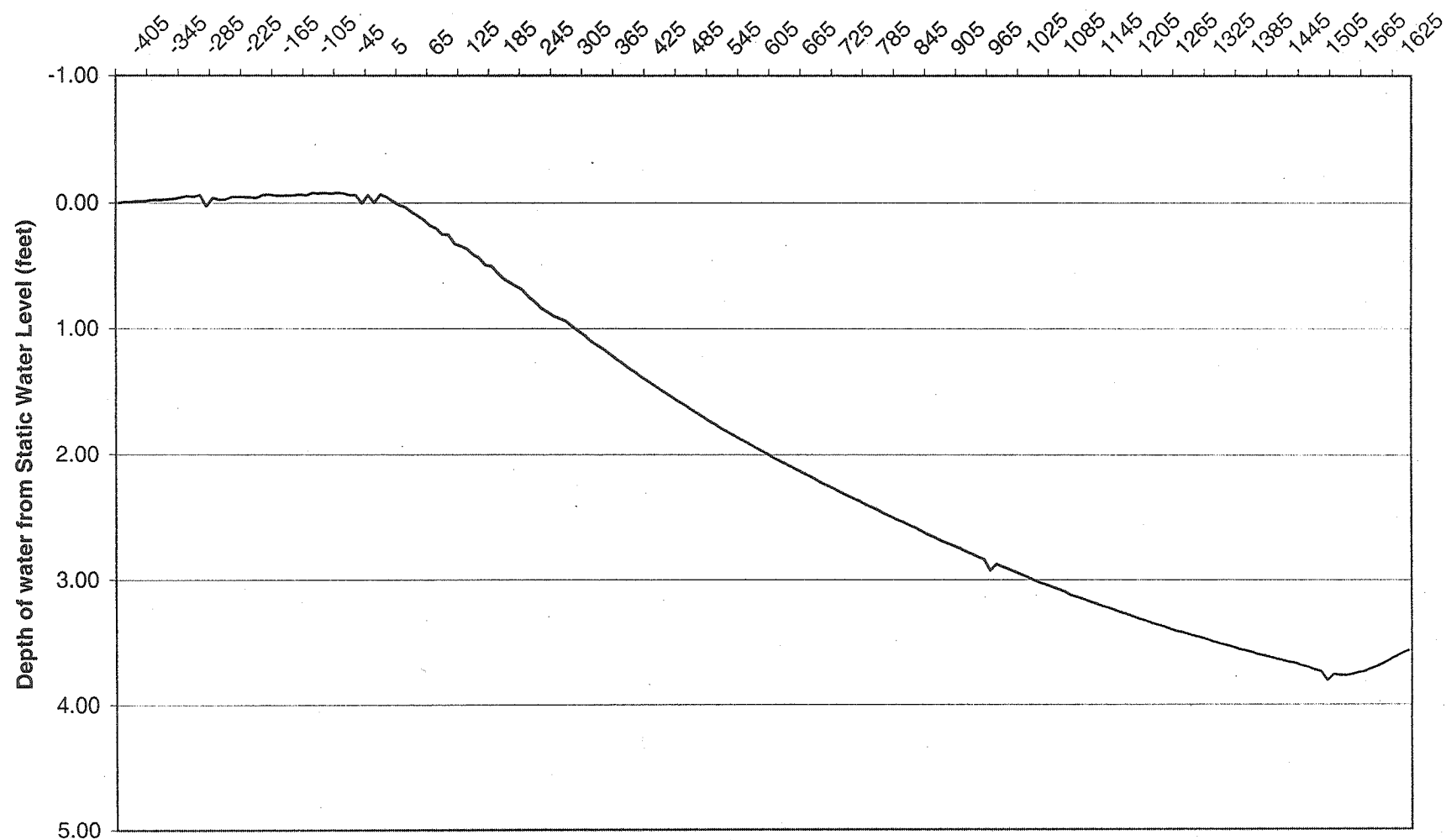
4/11/01	505	-4.217	1.64
4/11/01	515	-4.185	1.67
4/11/01	525	-4.154	1.70
4/11/01	535	-4.122	1.73
4/11/01	545	-4.094	1.76
4/11/01	555	-4.062	1.79
4/11/01	565	-4.034	1.82
4/11/01	575	-4.006	1.85
4/12/01	585	-3.977	1.88
4/12/01	595	-3.952	1.90
4/12/01	605	-3.923	1.93
4/12/01	615	-3.895	1.96
4/12/01	625	-3.867	1.99
4/12/01	635	-3.835	2.02
4/12/01	645	-3.81	2.05
4/12/01	655	-3.785	2.07
4/12/01	665	-3.759	2.10
4/12/01	675	-3.734	2.12
4/12/01	685	-3.709	2.15
4/12/01	695	-3.684	2.17
4/12/01	705	-3.658	2.20
4/12/01	715	-3.627	2.23
4/12/01	725	-3.605	2.25
4/12/01	735	-3.583	2.27
4/12/01	745	-3.554	2.30
4/12/01	755	-3.532	2.32
4/12/01	765	-3.507	2.35
4/12/01	775	-3.485	2.37
4/12/01	785	-3.456	2.40
4/12/01	795	-3.434	2.42
4/12/01	805	-3.412	2.44
4/12/01	815	-3.384	2.47
4/12/01	825	-3.362	2.49
4/12/01	835	-3.336	2.52
4/12/01	845	-3.317	2.54
4/12/01	855	-3.292	2.56
4/12/01	865	-3.27	2.59
4/12/01	875	-3.242	2.61
4/12/01	885	-3.217	2.64
4/12/01	895	-3.198	2.66
4/12/01	905	-3.169	2.69
4/12/01	915	-3.15	2.71
4/12/01	925	-3.128	2.73
4/12/01	935	-3.109	2.75
4/12/01	945	-3.084	2.77
4/12/01	955	-3.062	2.79
4/12/01	965	-3.04	2.82
4/12/01	975	-3.021	2.84
4/12/01	985	-2.929	2.93
4/12/01	995	-2.98	2.88
4/12/01	1005	-2.958	2.90
4/12/01	1015	-2.939	2.92

4/12/01	1025	-2.92	2.94
4/12/01	1035	-2.898	2.96
4/12/01	1045	-2.879	2.98
4/12/01	1055	-2.854	3.00
4/12/01	1065	-2.832	3.02
4/12/01	1075	-2.816	3.04
4/12/01	1085	-2.797	3.06
4/12/01	1095	-2.781	3.08
4/12/01	1105	-2.762	3.09
4/12/01	1115	-2.734	3.12
4/12/01	1125	-2.718	3.14
4/12/01	1135	-2.702	3.15
4/12/01	1145	-2.683	3.17
4/12/01	1155	-2.664	3.19
4/12/01	1165	-2.645	3.21
4/12/01	1175	-2.63	3.23
4/12/01	1185	-2.614	3.24
4/12/01	1195	-2.595	3.26
4/12/01	1205	-2.579	3.28
4/12/01	1215	-2.56	3.30
4/12/01	1225	-2.541	3.32
4/12/01	1235	-2.526	3.33
4/12/01	1245	-2.507	3.35
4/12/01	1255	-2.491	3.37
4/12/01	1265	-2.478	3.38
4/12/01	1275	-2.459	3.40
4/12/01	1285	-2.443	3.41
4/12/01	1295	-2.431	3.43
4/12/01	1305	-2.418	3.44
4/12/01	1315	-2.402	3.45
4/12/01	1325	-2.39	3.47
4/12/01	1335	-2.374	3.48
4/12/01	1345	-2.355	3.50
4/12/01	1355	-2.343	3.51
4/12/01	1365	-2.33	3.53
4/12/01	1375	-2.314	3.54
4/12/01	1385	-2.298	3.56
4/12/01	1395	-2.286	3.57
4/12/01	1405	-2.273	3.58
4/12/01	1415	-2.257	3.60
4/12/01	1425	-2.245	3.61
4/12/01	1435	-2.232	3.62
4/12/01	1445	-2.22	3.64
4/12/01	1455	-2.207	3.65
4/12/01	1465	-2.194	3.66
4/12/01	1475	-2.185	3.67
4/12/01	1485	-2.166	3.69
4/12/01	1495	-2.153	3.70
4/12/01	1505	-2.134	3.72
4/12/01	1515	-2.119	3.74
4/12/01	1525	-2.046	3.81
4/12/01	1535	-2.096	3.76

4/12/01	1545	-2.09	3.77	Production Well 8 off
4/12/01	1555	-2.087	3.77	
4/12/01	1565	-2.096	3.76	
4/12/01	1575	-2.112	3.74	
4/12/01	1585	-2.119	3.74	
4/12/01	1595	-2.144	3.71	
4/12/01	1605	-2.163	3.69	
4/12/01	1615	-2.185	3.67	
4/12/01	1625	-2.213	3.64	
4/12/01	1635	-2.242	3.61	
4/12/01	1645	-2.267	3.59	
4/12/01	1655	-2.289	3.57	

# Delano Well (Depth to Water From Top of Casing)

Elapsed time in minutes from start of Production Well 8





# City of Hudson Production Well 8 Pumping Test

City of Hudson Farmhouse well's drawdown  
4-11-01 to 4-12-01

Date	Elapsed Time since starting pump	Depth to Water	Remarks
11-Apr-01	-226	107.45	
11-Apr-01	-163	107.48	
11-Apr-01	-109	107.50	
11-Apr-01	-76	107.51	
11-Apr-01	-7	107.48	
11-Apr-01	4.5	107.57	Production Well-8 on at 4-11-01 2:15pm
11-Apr-01	24	107.73	
11-Apr-01	45	107.81	
11-Apr-01	90	108.12	
11-Apr-01	121	108.22	
11-Apr-01	153.5	108.45	
11-Apr-01	179	108.57	
11-Apr-01	209	108.78	
11-Apr-01	239	108.93	
11-Apr-01	270	109.07	
11-Apr-01	310	109.28	
11-Apr-01	331	109.41	
11-Apr-01	361	109.56	
11-Apr-01	393	109.75	
11-Apr-01	418	109.93	
11-Apr-01	481	110.22	
11-Apr-01	513	110.43	
11-Apr-01	540	110.54	
11-Apr-01	572	110.70	
12-Apr-01	599	110.85	
12-Apr-01	665	111.14	
12-Apr-01	722	111.43	
12-Apr-01	789	111.70	
12-Apr-01	842	111.95	
12-Apr-01	906	112.22	
12-Apr-01	942	112.37	
12-Apr-01	1051	112.82	
12-Apr-01	1080	112.92	
12-Apr-01	1142	113.12	
12-Apr-01	1227	113.40	
12-Apr-01	1281	113.58	
12-Apr-01	1319	113.65	
12-Apr-01	1351	113.78	
12-Apr-01	1371	113.80	
12-Apr-01	1372	113.80	Start house pump (11gal/min)
12-Apr-01	1373	115.53	
12-Apr-01	1374	115.53	
12-Apr-01	1375	115.51	

12-Apr-01	1380	115.54
12-Apr-01	1385	115.50
12-Apr-01	1405	115.64
12-Apr-01	1455	115.92
12-Apr-01	1460	115.63
12-Apr-01	1461	115.54
12-Apr-01	1463	115.54
12-Apr-01	1498	114.44
12-Apr-01	1534	114.42
12-Apr-01	1543	114.40
12-Apr-01	1578	114.15
12-Apr-01	1594	114.02
12-Apr-01	1715	113.41

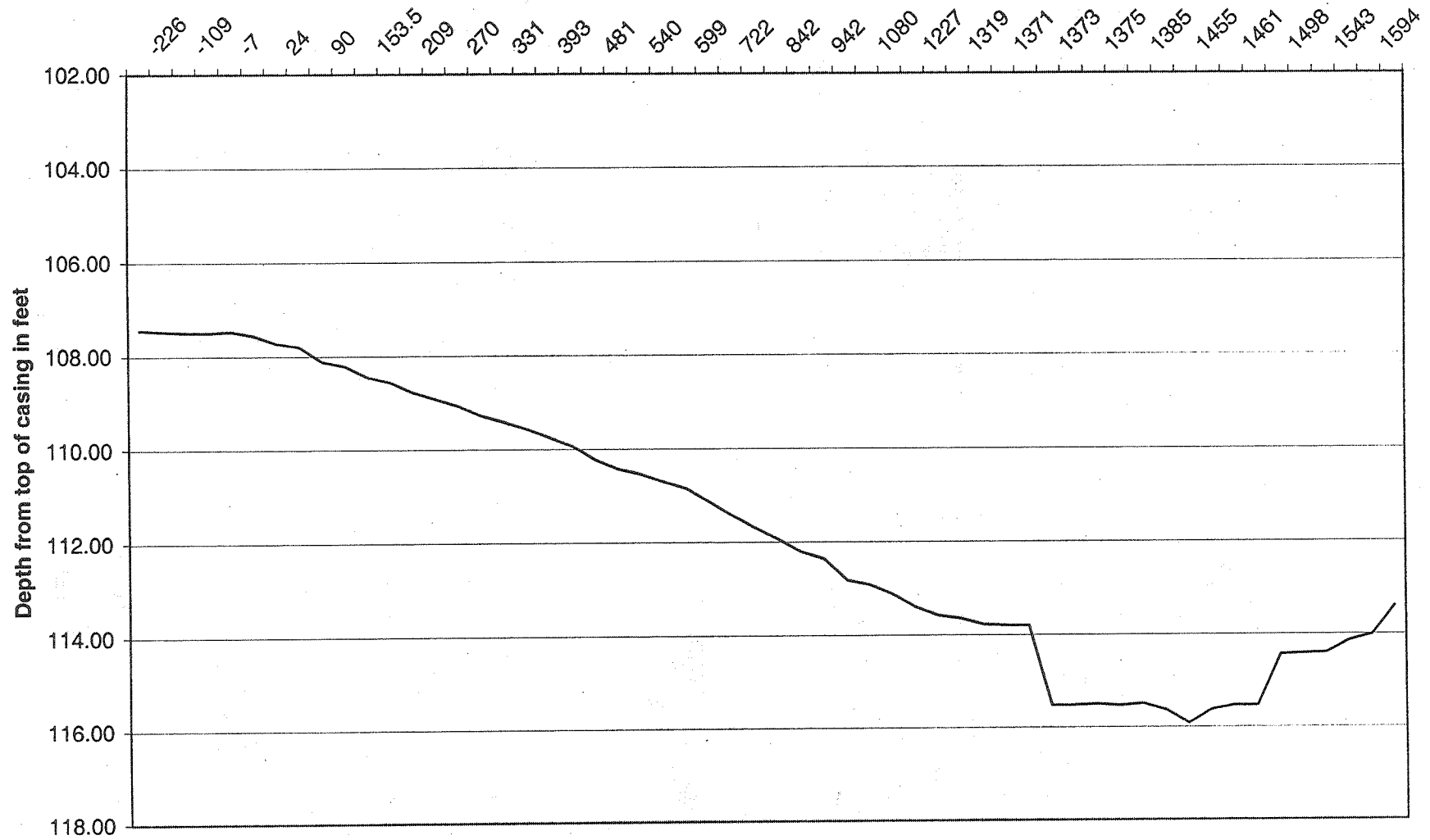
House pump off at 1459.33 min

House pump back on at 1463.5 min

Production Well 8 off at 1540.5 min

# City Farmhouse Well (Depth to Water From Top of Casing)

Elapsed Time from Start of Production Well 8



State of Wisconsin  
Department of Natural Resources  
Private Water Supply  
Box 7921  
Madison, Wisconsin 53707

NOTE:

White Copy - Division's Copy  
Green Copy - Driller's Copy  
Yellow Copy - Owner's Copy

WELL CONSTRUCTOR'S REPORT  
Form 3300-15 Rev. 5-85

SEP 7 5 1985

Clymer

1. COUNTY <b>St. Croix</b>		CHECK (✓) ONE: <input checked="" type="checkbox"/> Town <input type="checkbox"/> Village <input type="checkbox"/> City		Name <b>Hudson</b>	
2. LOCATION OR - Grid or Street No. <b>NW 1/4</b> AND - If available subdivision name, lot & block No. <b>H.O. Mike Kranz</b>		Section <b>32</b> Township <b>29N</b> Range <b>19W</b>		3. NAME <input checked="" type="checkbox"/> OWNER <input checked="" type="checkbox"/> AGENT AT TIME OF DRILLING CHECK (✓) ONE <b>Valley Earth Shelter</b>	
Street or Road Name <b>O-Neal Rd</b>		ADDRESS <b>Box 686 Highway 8E</b>		POST OFFICE <b>St. Croix Falls WI</b>	
ZIP CODE <b>54024</b>		4. Distance in feet from well to nearest: (Record answer in appropriate block) <b>12</b>		Building <b>Sanitary Bldg. Drain</b> C.I. Other C.I. Other	
Sanitary Bldg. Drain C.I. Other		Sanitary Bldg. Sewer C.I. Other		Floor Drain Connected To: C.I. Sewer Other Sewer	
Storm Bldg. Drain C.I. Other		Storm Bldg. Sewer C.I. Other		Storm Bldg. Drain C.I. Other	
Street Sewer San. Storm C.I. Other		Foundation Drain Connected to: Sewer Sewage Sump C.I. Other		Sewage Sump Clearwater Sump Septic Tank Holding Tank	
Sewage Absorption Unit Seepage Pit Seepage Bed Seepage Trench		Manure Hopper or Retention or Pneumatic Tank		5. Well is intended to supply water for: <b>Home use</b>	
6. DRILLHOLE Dia. (in.) From (ft.) To (ft.) Dia. (in.) From (ft.) To (ft.)		7. CASING, LINER, CURBING AND SCREEN Material, Weight, Specification Mfg. & Method of Assembly Dia. (in.) From (ft.) To (ft.)		9. FORMATIONS Kind From (ft.) To (ft.)	
10 1/2 Surface 40 130 13		6" 40 130 13		Sand & gravel Surface 38	
				Clay 0 18	
				Sand & gravel 18 38	
				Lime rock 38 130	
				Warning Letter in Well Driller File	
8. GROUT OR OTHER SEALING MATERIAL Kind From (ft.) To (ft.)		10. TYPE OF DRILLING MACHINE USED <input type="checkbox"/> Cable Tool <input checked="" type="checkbox"/> Rotary-hammer w/drilling mud & air <input type="checkbox"/> Jetting with <input type="checkbox"/> Air <input type="checkbox"/> Water			
Grouted Surface 40		<input type="checkbox"/> Rotary-air w/drilling mud <input type="checkbox"/> Rotary-hammer & air <input type="checkbox"/> Reverse Rotary			
11. MISCELLANEOUS DATA Yield Test: <b>2</b> Hrs. at <b>25</b> GPM		Well construction completed on <b>8/20/86</b> 19			
Depth from surface to normal water level <b>110</b> Ft.		Well is terminated <b>12</b> inches <input type="checkbox"/> above final grade <input type="checkbox"/> below			
Depth of water level when pumping <b>112</b> Ft. Stabilized <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Well disinfected upon completion <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
Water sample sent to <b>Field Engineering</b> laboratory on <b>8/20/86</b> 19		Well sealed watertight upon completion <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
Your opinion concerning other pollution hazards, information concerning difficulties encountered, and data relating to nearby wells, screens, seals, method of finishing the well, amount of cement used in grouting, blasting, etc., should be given on reverse side.					
Signature <b>David McCullough</b> Registered Well Driller		Business Name and Complete Mailing Address <b>McCullough &amp; Sons</b> <b>20335 Forest Lake MN 55025</b>			

Construction Report For  
NSIN UNIQUE WELL NUMBER

OJ 511

Telephone  
Number ( )State of Wisconsin  
Private Water Systems-DG/2  
Department of Natural Resources  
Box 7921Madison, WI 53707 (Please type or print  
using a black pen.)ing  
Address

City

County of Well Location

Co. Well Permit  
No. W

Well Completion Date (mm-dd-yy)

Well Constructor (Business Name)

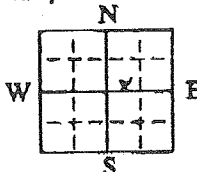
License #

Address

City

State

Zip Code

2. Mark well location  
with a dot in correct  
40-acre parcel of section.

1. Well Location Please use decimals instead of fractions.

☒ Town ☐ City ☐ Village Fire # (if avail.)

of HUDSON

Grid or Street Address or Road Name and Number

Subdivision Name

Lot #

Block #

Gov't Lot # or SLU 1/4 of A/E 1/4 of

Section 32 T. 29 N; R. 19 ☐ E ☒ W

3. Well Type

☒ New☒ Replacement (see item 13 below)☐ Reconstruction

of previous unique well # constructed in 19

Reason for replaced or reconstructed well?

DRY HOLE

Well serves # of homes and or

(Eg: barn, restaurant, church, school, industry, etc.)

High Capacity:

Well? ☐ Yes ☒ NoProperty? ☐ Yes ☒ No☒ Drilled ☐ Driven Point ☐ Jetted ☐ OtherIs the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? ☒ Yes ☐ No If no, explain on back side.Well located in floodplain? ☐ Yes ☒ No

Distance in Feet from Well To Nearest: (include proposed)

9. Downspout/Yard Hydrant

10. Privy

11. Foundation Drain to Clearwater

12. Foundation Drain to Sewer

13. Building Drain

☐ Cast Iron or Plastic ☐ Other14. Building Sewer ☐ Gravity ☐ Pressure☐ Cast Iron or Plastic ☐ Other

15. Collector Sewer: units in. diameter

16. Clearwater Sump

17. Wastewater Sump

18. Paved Animal Barn Pen

19. Animal Yard or Shelter

20. Silo

21. Barn Guiter

22. Manure Pipe ☐ Gravity ☐ Pressure☐ Cast Iron or Plastic ☐ Other

23. Other Manure Storage

24. Ditch

25. Other NR 812 Waste Source

## 5. Drillhole Dimensions

From To  
Dia. (in.) (ft.) (ft.)

10 surface 411

10 411 189

## Upper Enlarged Drillhole:

Method of Construction

☐ 1. Rotary - Mud Circulation☒ 2. Rotary - Air☐ 3. Rotary - Foam☐ 4. Reverse Rotary☐ 5. Cable-tool Bit in. dia.☒ 6. Temp. Outer Casing 10 in. dia. 3/depthRemoved? ☐ Yes ☒ No

If no, explain why not

☐ 7. OtherCasing, Liner, Screen  
Material, Weight, Specification  
Manufacturer & Method of AssemblyDia. (in.) From To  
(ft.) (ft.)

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

10 571 HKK 18.92 surface

DNR  
USE  
ONLY9. Geology  
Type, Caving/Noncaving, Color, Hardness, Etc.From To  
(ft.) (ft.)

SAND B R S surface 31

LIME Y S 31 189

## 6. Grout or Other Sealing Material

Method 2:1:5 S 1:2:1:1

Kind of Sealing Material

From To  
(ft.) (ft.)

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

surface 411 15

## 13. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?

☒ Yes ☐ No If no, explain

## 14. Signature of Point Driver or Licensed Supervisory Driller

Date Signed

Signature of Drill Rig Operator (Mandatory unless same as above)

Date Signed

GARY SMOCKS

28 APR 01

Make additional comments on reverse side about geology, additional screens, water quality, etc.

Comments on reverse side (CHECK ☒, IF YES)

WELL CONSTRUCTION REPORT

Form 3300-77A

Rev. 8-98

WELL CONSTRUCTION

# WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

Vol 6

1. County St. Croix Town ☒ Village ☐ City ☐ Hudson  
 2. Location N 8 1/2 of NW 1/4 of Sect 32, T 29N, R 19W  
 Name of street and number, or premise or Section, Town and Range numbers  
 3. Owner ☒ or Agent ☐ W. H. Nelson / GUS NELSON  
 Name of individual, partnership or firm  
 4. Mail Address Rt 1 Hudson, Wis.  
 Complete address required

5. From well to nearest: Building 6 ft; sewer 6 ft; drain 6 ft; septic tank 100 ft;  
 dry well or filter bed 125 ft; abandoned well 6 ft.  
 6. Well is intended to supply water for: Home

## 7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
10	0	40	6	91	235
6	41	90			

## 8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
6	Rep. 100	0	414
4	Rep. 80	12	186

## 9. GROUT:

Kind	From (ft.)	To (ft.)
Cement	0	40

## 11. MISCELLANEOUS DATA:

Yield test: 3 Hrs. at 12 GPM.Depth from surface to water-level: 204 ft.Water-level when pumping: 204 ft.

Water sample was sent to the state laboratory at:

Madison City on 29 June 1965

## 10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Clay	0	9
Shale	10	90
Soft sand rock	91	164
Hard sand rock	165	230
Lime rock	231	235

Construction of the well was completed on:

19 June 1965The well is terminated 12 inches  
☐ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion?

Yes ☒ No ☐

Was the well sealed watertight upon completion?

Yes ☒ No ☐

Signature

Registered Well Driller

Edward A. Monty

Please do not write in space below

Rt 5

Complete Mail Address

Stillwater, Minn.

Rec'd \_\_\_\_\_ No \_\_\_\_\_

Ans'd \_\_\_\_\_

Interpretation \_\_\_\_\_

Gas—24 hrs. \_\_\_\_\_

48 hrs. \_\_\_\_\_

Confirm \_\_\_\_\_

B. Coll. \_\_\_\_\_

10 ml 10 ml 10 ml 10 ml 10 ml

Water 190'

Pump 220'

WISCONSIN UNIQUE WELL NUMBER

NE

558

Department of Natural Resources

Box 7921

Madison, WI 53707

(Please type or print using a black pen.)

Property Owner **AL SCHULTZ**

Telephone Number ( )

Mailing Address **500 CARRIAGE LN**

City **HUDSON**

State **WI**

Zip Code **54016**

County of Well Location **ST CRAW**

Co. Well Permit No. **W**

Well Completion Date (mm-dd-yy) **01-06-00**

Well Constructor (Business Name) **MONYLA WELL**

License # **62**

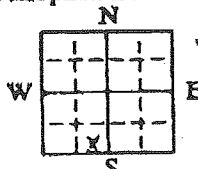
Address **PO BOX 797**

City **LAKELAND**

State **WI**

Zip Code **53043**

2. Mark well location with a dot in correct 40-acre parcel of section.



1. Well Location Please use decimals instead of fractions.

☒ Town ☐ City ☐ Village Fire # (if avail.)

of **HUDSON**  
Ordn or Street Address or Road Name and Number

Subdivision Name Lot # Block #

Gov't Lot # or **SE** 1/4 of **SW** 1/4 of

Section **32**, T **29** N: R **19** ☐ E ☒ W

3. Well Type ☒ New

☐ Replacement ☐ Reconstruction

(see item 13 below) of previous unique well # constructed in 19

Reason for replaced or reconstructed well?

4. Well serves / # of homes and or (Fig: barn, restaurant, church, school, industry, etc.)

High Capacity:

Well? ☐ Yes ☒ No

Property? ☐ Yes ☒ No

5. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? ☒ Yes ☐ No If no, explain on back side.

Well located in floodplain? ☐ Yes ☒ No

Distance in Feet From Well To Nearest: (includes proposed)

- 1. Landfill
- 2. Building Overhang
- 3. Septic or Holding Tank (circle one)
- 4. Sewage Absorption Unit
- 5. Nonconforming Pit
- 6. Buried Home Heating Oil Tank
- 7. Buried Petroleum Tank
- 8. Shoreline/Swimming Pool (circle one)

- 9. Downspout/Yard Hydrant
- 10. Privy
- 11. Foundation Drain to Clearwater
- 12. Foundation Drain to Sewer
- 13. Building Drain
- 14. Building Sewer ☐ Cast Iron or Plastic ☐ Other ☐ Gravity ☐ Pressure
- 15. Collector Sewer: units in. diameter
- 16. Clearwater Sump

- 17. Wastewater Sump
- 18. Paved Animal Barn Pen
- 19. Animal Yard or Shelter
- 20. Silo
- 21. Barn Gutter
- 22. Manure Pipe ☐ Gravity ☐ Pressure ☐ Cast Iron or Plastic ☐ Other
- 23. Other Manure Storage
- 24. Ditch
- 25. Other NR 812 Waste Source

6. Drillhole Dimensions

Dia. (in.)	From (ft.)	To (ft.)
10	surface	41
6	41	270
4	270	320

Upper Enlarged Drillhole: Method of Construction

- ☐ 1. Rotary - Mud Circulation
- ☒ 2. Rotary - Air
- ☐ 3. Rotary - Foam
- ☐ 4. Reverse Rotary
- ☐ 5. Cable-tool Bit in. dia.
- ☐ 6. Temp. Over Casing in. dia. depth Removed? ☐ Yes ☐ No If no, explain why not
- ☐ 7. Other

7. Casing, Liner, Screen Material, Weight, Specification Manufacturer & Method of Assembly

Dia. (in.)	From (ft.)	To (ft.)
6	surface	41
4	41	270
4	270	320

8. Grout or Other Sealing Material

Method	From (ft.)	To (ft.)	# Sacks Cement
<b>PRESSURE</b>	surface	41	16

9. Geology

Type, Caving/Noncaving, Color, Hardness, Etc.	From (ft.)	To (ft.)
<b>CLAY</b>	surface	23
<b>LIME</b>	23	27
<b>SANDROCK</b>	27	32
<b>SANDROCK</b>	32	32

10. Static Water Level

**23** ft. above ground surface  
**23** ft. below ground surface

12. Well Is:

☐ Above Grad  
☒ Below Grad  
Developed? ☐ Yes ☒ No  
Disinfected? ☐ Yes ☒ No  
Capped? ☐ Yes ☒ No

11. Pump Test

Pumping Level **262** ft. below surface  
Pumping at **15** GPM for **1** hour

13. Did you permanently abandon (fill) all unused, noncomplying, or unsafe wells?

☐ Yes ☒ No If no, explain **N/A**

14. Signature of Point Driver of Licensed Supervisory Driller

Signature of Drill Rig Operator (Mandatory unless same as above)

**GRAY SANDERS** 11 JAN 01

Make additional comments on reverse side about geology, additional screens, water quality, etc.  
Comments on reverse side (CHECK /, IF YES)

WELL CONSTRUCTION REPORT  
Form 3300-71A Rev. 9-96

WELL CONSTRUCTOR



## TECHNICAL MEMORANDUM


3535 Vadnais Center Drive, St. Paul, MN 55110-5196

651.490.2000

800.325.2055

651.490.2150 FAX

TO: Dennis Christophersen, City of Hudson; Greg Johnson PE, SEH Inc.

FROM: Craig Kurtz 

DATE: June 27, 2003

RE: Addendum to Hudson Wellhead Protection Plan  
SEH No. A-HUDSO0104.00 SP

This Technical Memorandum is an Addendum to the October 1994 Wellhead Protection Plan for the City of Hudson, Wisconsin, titled *Wellhead Protection Area Delineation Report*. The 1994 Wellhead Protection Plan was completed for Municipal Wells 3, 4, 5, 6, and 7. The purpose of this Addendum is to update the City's Wellhead Protection Plan to incorporate Municipal Wells 8 and 9. The scope of this Addendum is in accordance with, and addresses the requirements of the Wisconsin Administrative Code (WAC) - ch. NR 811.16, Subpart 5, WAC.

### Background

Municipal Wells 8 and 9 were constructed in 2000 and 2002 respectively. Copies of the logs for the municipal wells included as Attachment A. Both wells are designed with a pumping capacity of 1,000 gallons per minute. The two wells and the adjacent water treatment plant are designed to pump and process a total of 1,440,000 gallons per day (720,000 gallons per day from each well). The wells are scheduled to be online with the Hudson public water supply system in June 2003.

Municipal Wells 8 and 9 are 375 and 387 feet deep respectively. Both wells are open to a 65 to 90 feet thick sandstone formation present at an approximate depth of 300 feet below grade. For a complete discussion regarding the geologic and hydrogeologic conditions in Hudson, please refer to the October 1994 Wellhead Protection Area Delineation Report.

Three formal pumping tests have been conducted using Municipal Wells 8 and 9. Additional pumping tests were conducted on each well to satisfy the specifications of their construction. Based on the results of the three formal pumping tests, representative transmissivity and storativity values for the aquifer were calculated (10,080 ft<sup>2</sup>/day and 0.00054 respectively). It was also determined that the sandstone aquifer was under leaky (semi-confined) hydraulic conditions in the vicinity of the two new municipal wells.



## **Wellhead Protection Area Delineation**

### ***Groundwater Flow Direction***

Based on the information presented in the October 1994 Wellhead Protection Area Delineation Report, groundwater flow direction in the vicinity of Municipal Wells 8 and 9 is generally westward toward the St. Croix River (please refer to Figure 8).

### ***Zone of Influence***

The calculation for the zone of influence for Municipal Wells 8 and 9 combined is provided as Attachment B. Based on a 30-day continuous pumping scenario, and using the Theis Equation with the results of the formal pumping tests, the zone of influence (1.0 foot of drawdown or more) is calculated to be 31,072 feet (5.9 miles).

### ***Recharge Area***

Using the Uniform Flow Equation method, the recharge area for Municipal Wells 8 and 9 combined was calculated. The downgradient null point of the recharge area was calculated to be 675 feet, and the sidgradient width of the recharge area was calculated to be 2,122 feet. The calculations are provided in Attachment C. Figure 13 depicts the recharge area for the two municipal wells.

### ***Wellhead Protection Area***

The one, five and ten year wellhead protection areas were delineated using the fixed radius method without any recharge. This conservative approach resulted in radii of 1,092 feet, 2,442 feet, and 3,454 feet for the one, five and ten year wellhead protection areas respectively. The calculations are provided in Attachment D. The wellhead protection areas are depicted in Figure 14.

## **Risk Assessment**

### ***Potential Contaminant Source Inventory***

A Public Water Supply Potential Contaminant Use Inventory has been completed for a ½-mile radius around Municipal Wells 8 and 9. A copy of Wisconsin Department of Natural Resources Form 3300-215 and related documents is provided as Appendix E. Figures in Attachment E depict the potential contaminant sources within ½-mile of Municipal Wells 8 and 9.

Based on the inventory, one petroleum storage tank, seven municipal sewer lines, 24 sewage tanks, one mining operation/quarry, and one water well (active production) were identified within ½-mile of the two municipal wells. The active production well was abandoned and properly sealed on May 22, 2002. Twenty-four (24) privately owned, domestic-supply wells, not included in the inventory, are known to exist within ½-mile of the municipal wells.

### ***Potential Well Interference Evaluation***

The City has conducted formal pumping tests to evaluate the potential adverse hydrologic effects the municipal wells could have on nearby domestic-supply wells. The pump tests and evaluation determined that the use of the two new municipal wells would not likely affect the operation or functionality of the domestic water supply wells in the vicinity of Municipal Wells 8 and 9.

June 27, 2003

Page 3

### **Wellhead Protection Plan Implementation**

The City intends to incorporate Municipal Wells 8 and 9 into the existing Wellhead Protection Plan implementation strategy as outlined and discussed in detail in the October 1994 *Wellhead Protection Area Delineation Report* (please refer to Sections 9.2 and 9.5 in the report).

### **Wellhead Protection Plan Revision**

In 2004, the City intends to update and revise the October 1994 Wellhead Protection Plan. The updated Wellhead Protection Plan will include development of a new groundwater flow model to be used to delineate the zones of influence, recharge areas, and wellhead protection areas for all of the City's municipal wells. In addition, the updated Plan will reassess and revise if necessary the implementation strategies (public education program, water conservation program, contingency plan, and management plan) for protecting the City's wells and public water supply from accidental contamination.

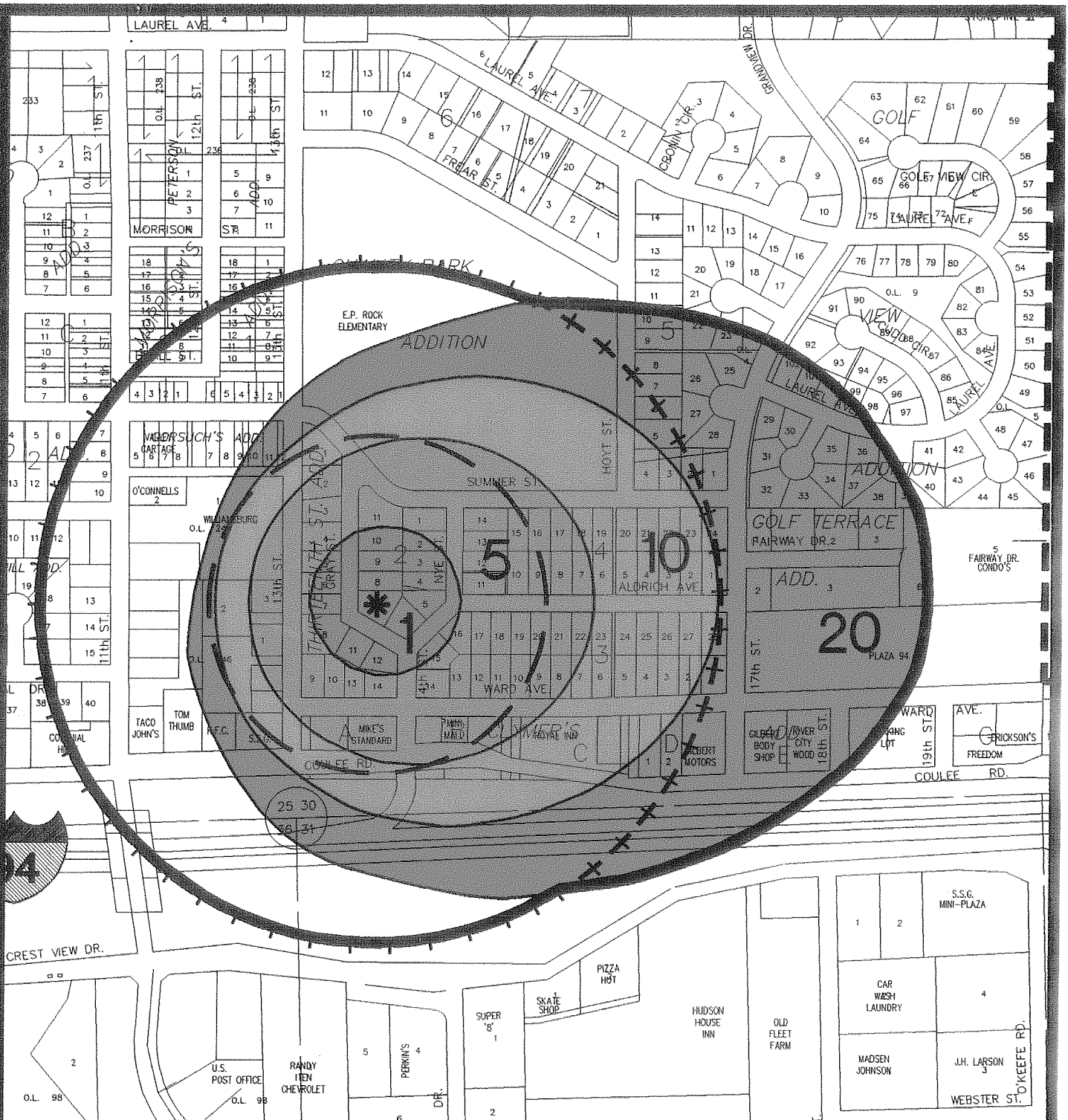
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Attachments:      Figure 13  
                         Figure 14  
                         A – Logs of Municipal Wells 8 and 9  
                         B – Zone of Influence Calculations  
                         C – Recharge Area Calculations  
                         D – Wellhead Protection Area Calculations  
                         E – Potential Contaminant Source Inventory (WDNR Form 3300-215)

c: Steve Heth PE, City Engineer, SEH Inc. St. Paul, MN  
    Al Sunderman PG, SEH Inc. St. Paul, MN

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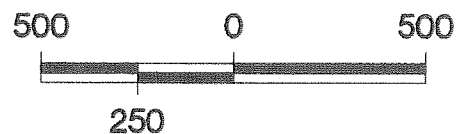
## Wellhead Protection Zones

### Legend

- Municipal Wells
- 600' Radius From Center Of Municipal Wells
- 1200' Radius From Center Of Municipal Wells
- Outer Boundary Of Wellhead Protection Zone (WHPZ)
- Groundwater Protection Area 1 - 1-Year Time of Travel
- Groundwater Protection Area 5 - 5-Year Time of Travel
- Groundwater Protection Area 10 - 10-Year Time of Travel
- Groundwater Protection Area 20 - 20-Year Time of Travel

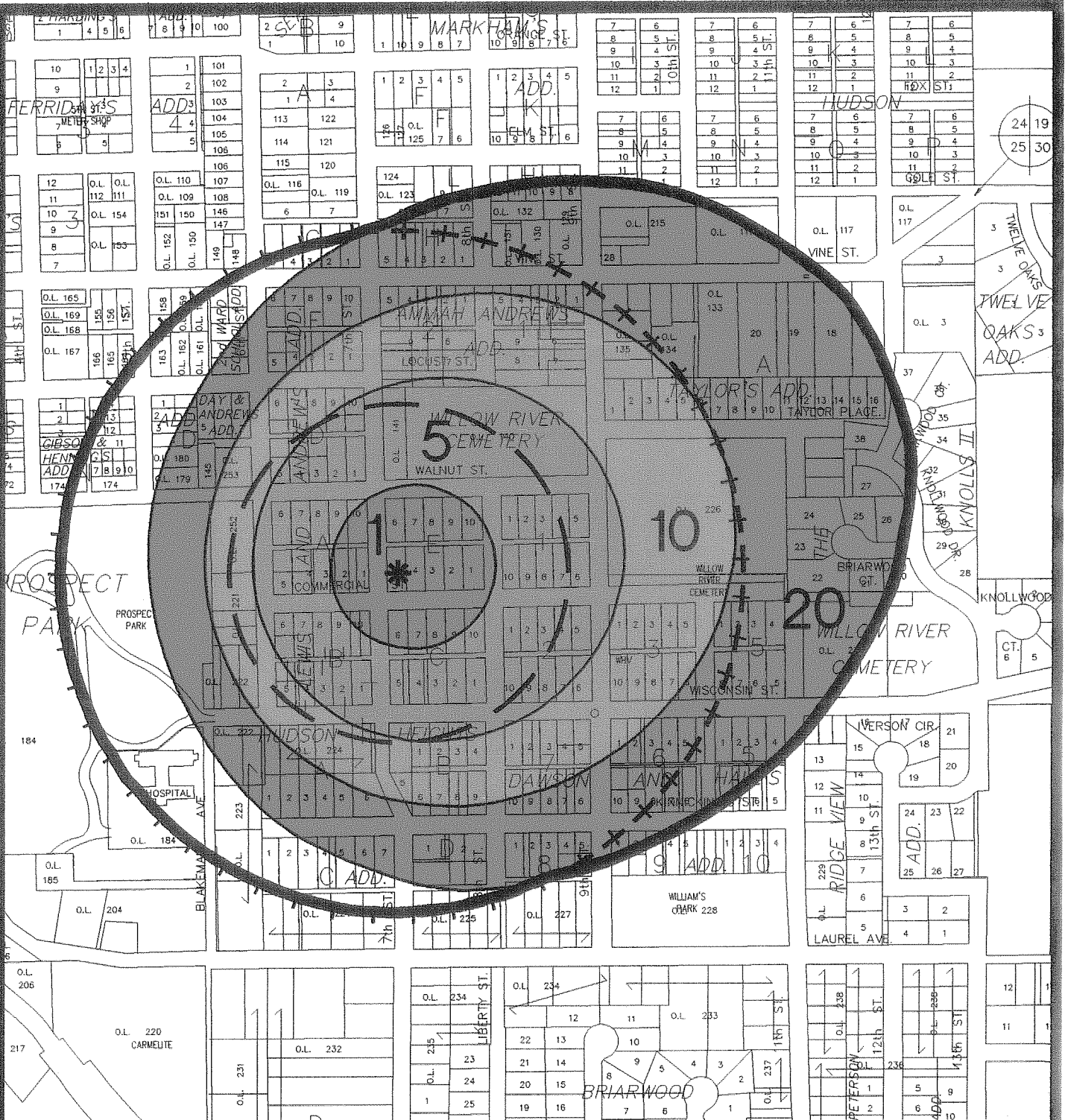
City of Hudson, Wisconsin

# Well #3



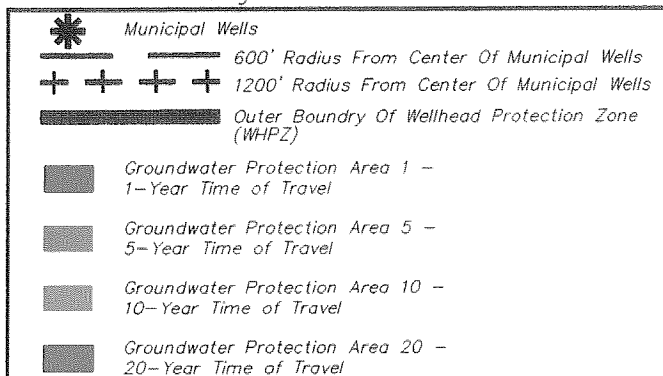
**SEH**

June 1998



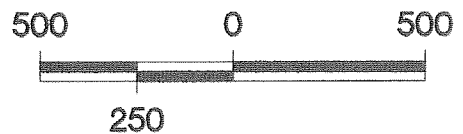
## Wellhead Protection Zones

### Legend



City of Hudson, Wisconsin

# Well #4

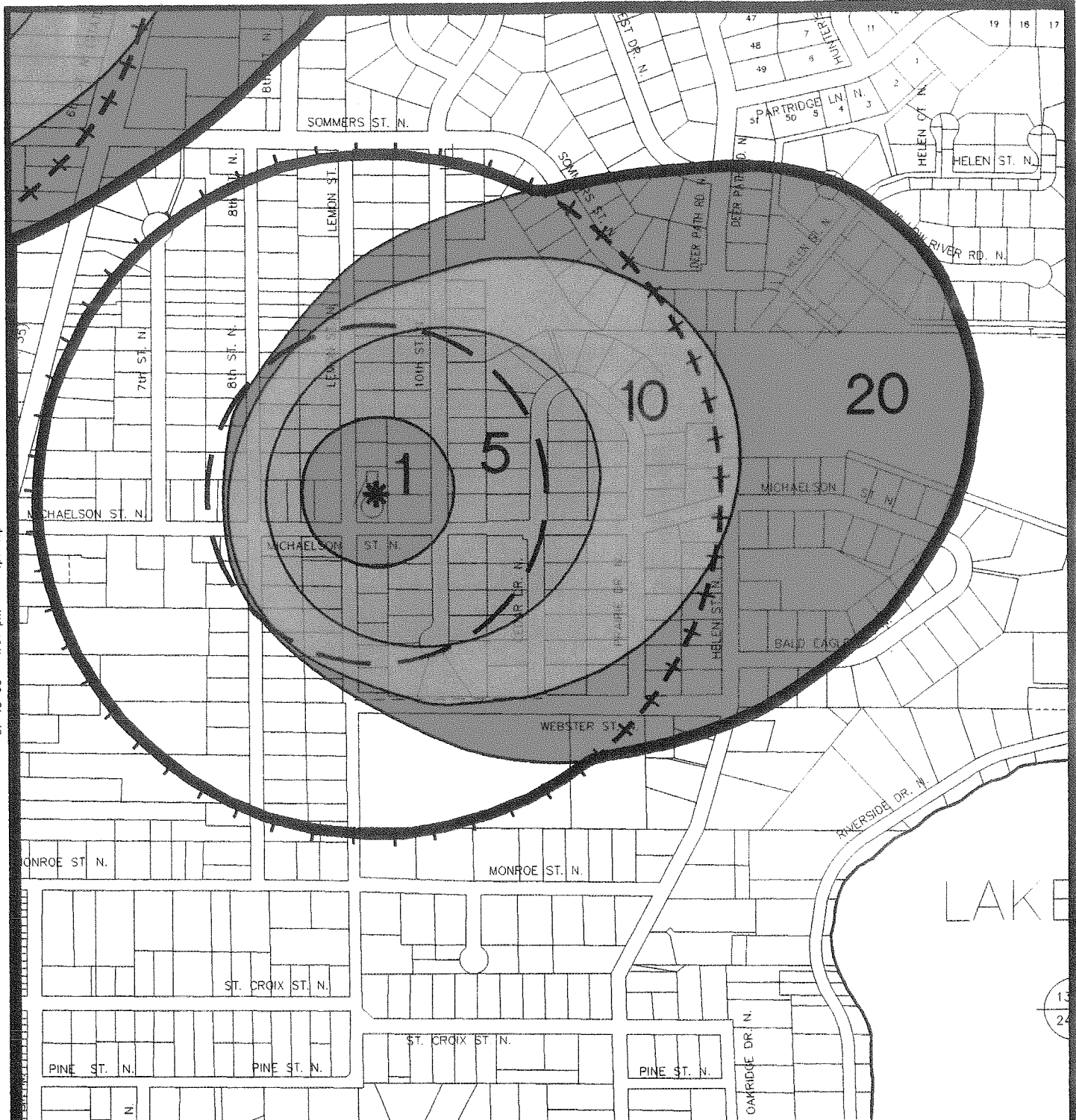


**SEH**

June 1998

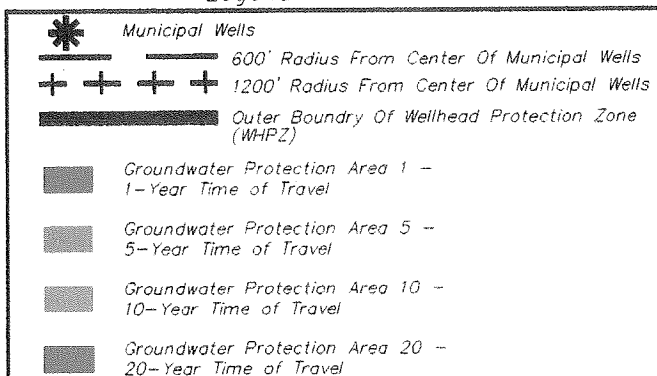


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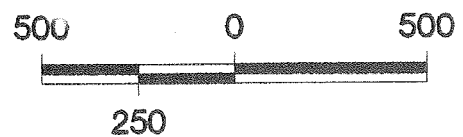
### Wellhead Protection Zones

#### Legend



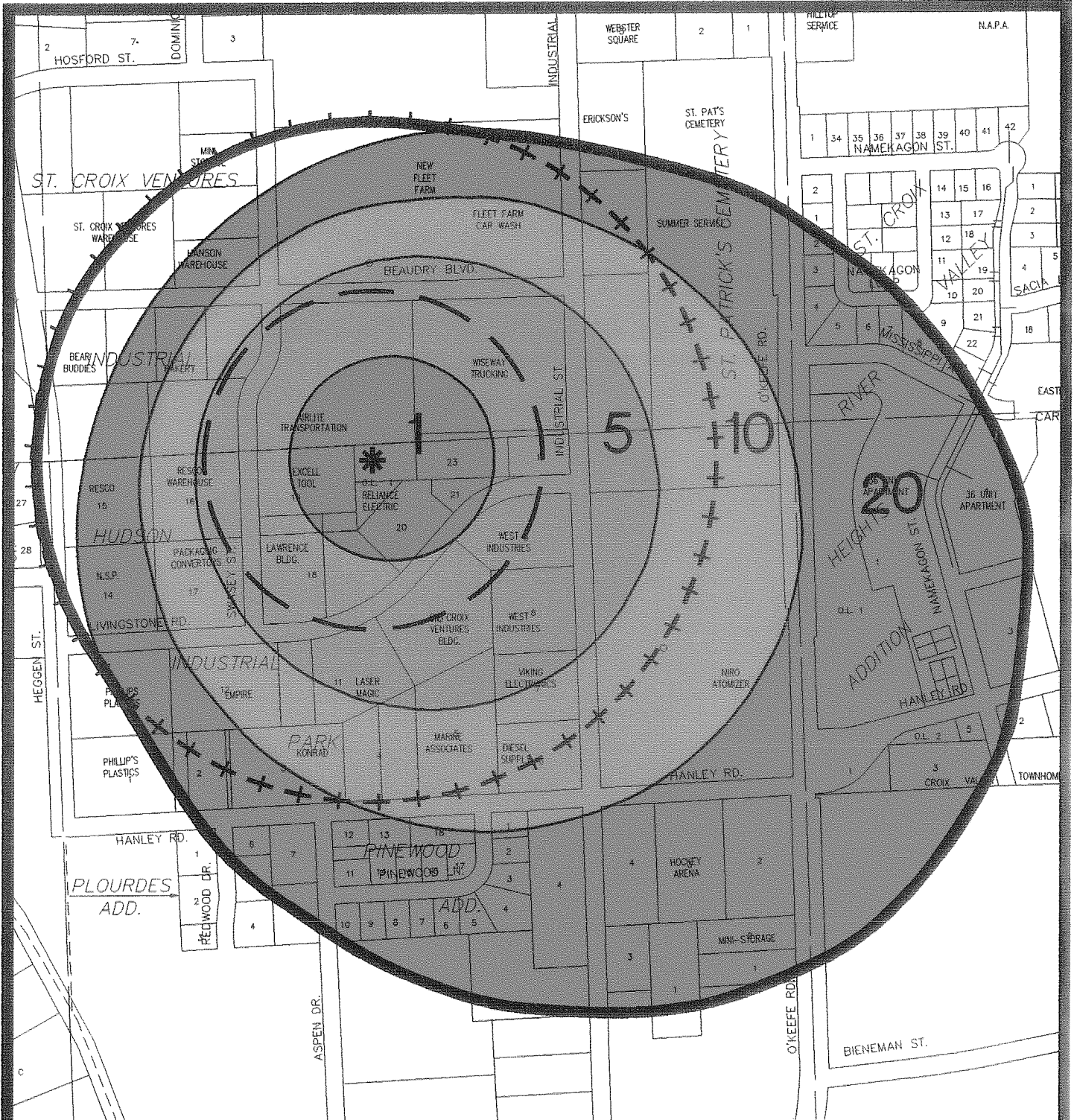
City of Hudson, Wisconsin

## Well #5



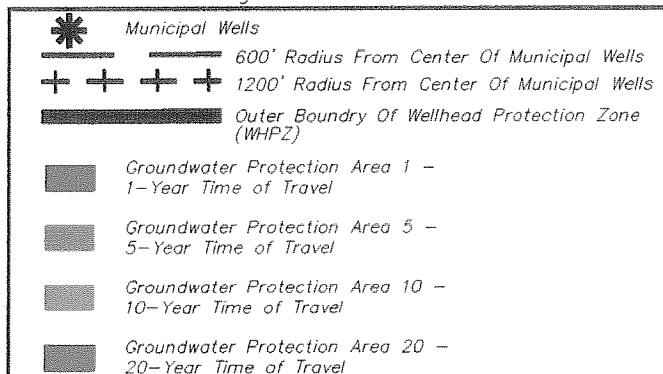
June 1998

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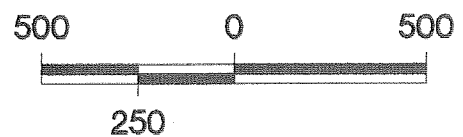
## Wellhead Protection Zones

Legend



City of Hudson, Wisconsin

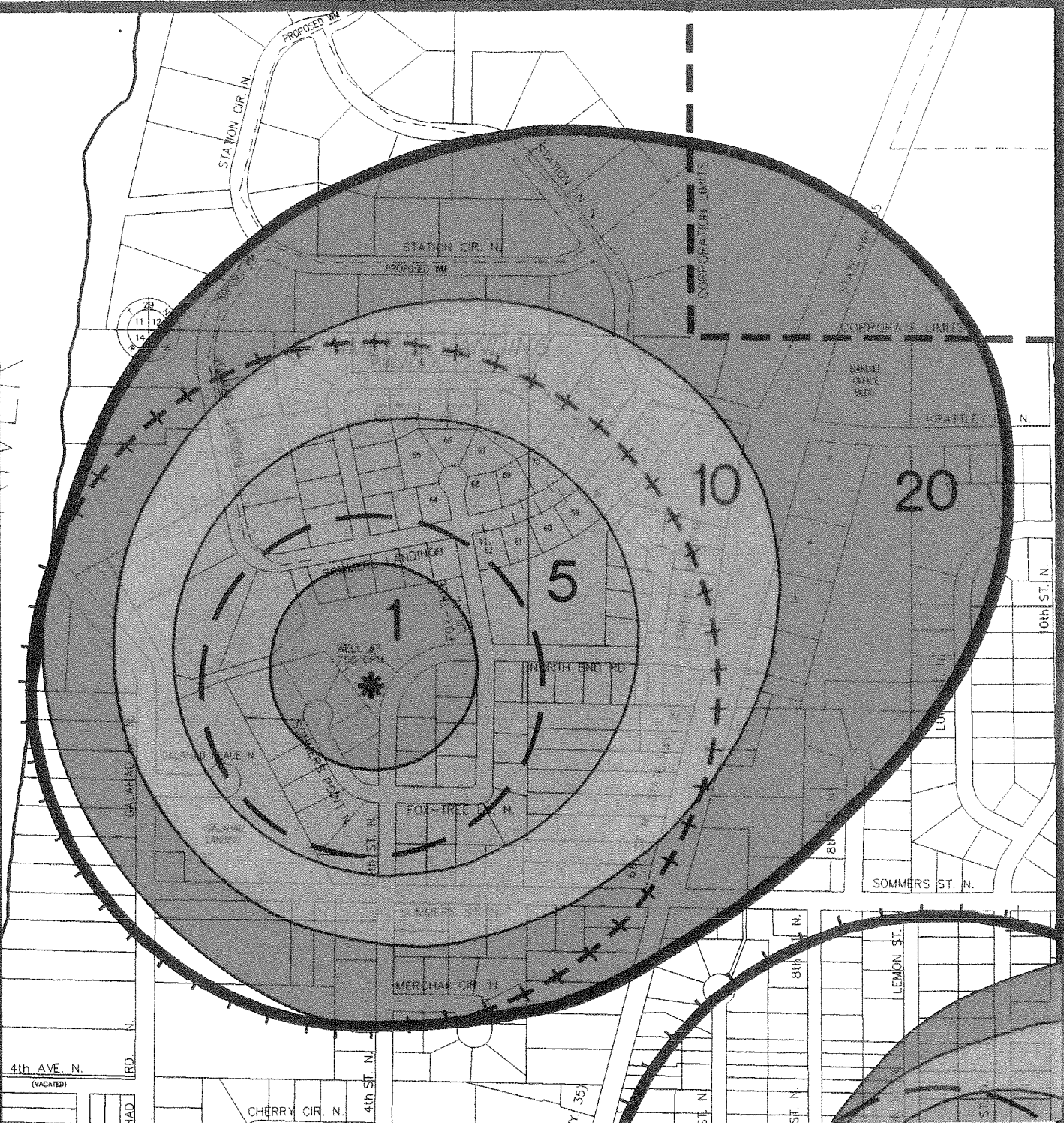
Well #6



**SEH**

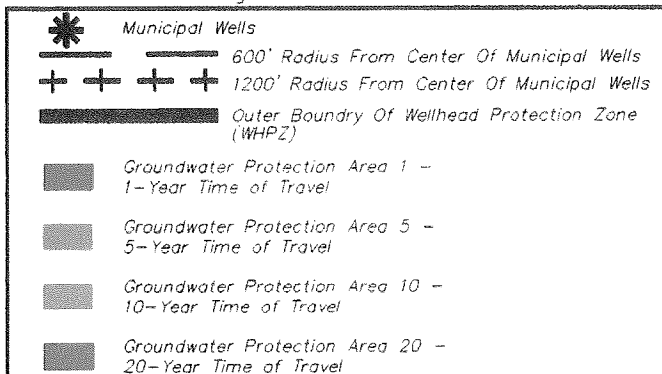
June 1998





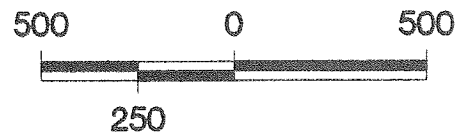
# Wellhead Protection Zones

## Legend











City of Hudson, Wisconsin

Well #7



June 1998

# LEGEND

-  Municipal Well
-  600' Radius From Municipal Wells
-  1200' Radius From Municipal Wells
-  Outer Boundary Of Wellhead Protection Zone (WHPZ)
-  Groundwater Protection Area 1-Year Time of Travel
-  Groundwater Protection Area 5-Year Time of Travel
-  Groundwater Protection Area 10-Year Time of Travel
-  Groundwater Protection Area 20-Year Time of Travel

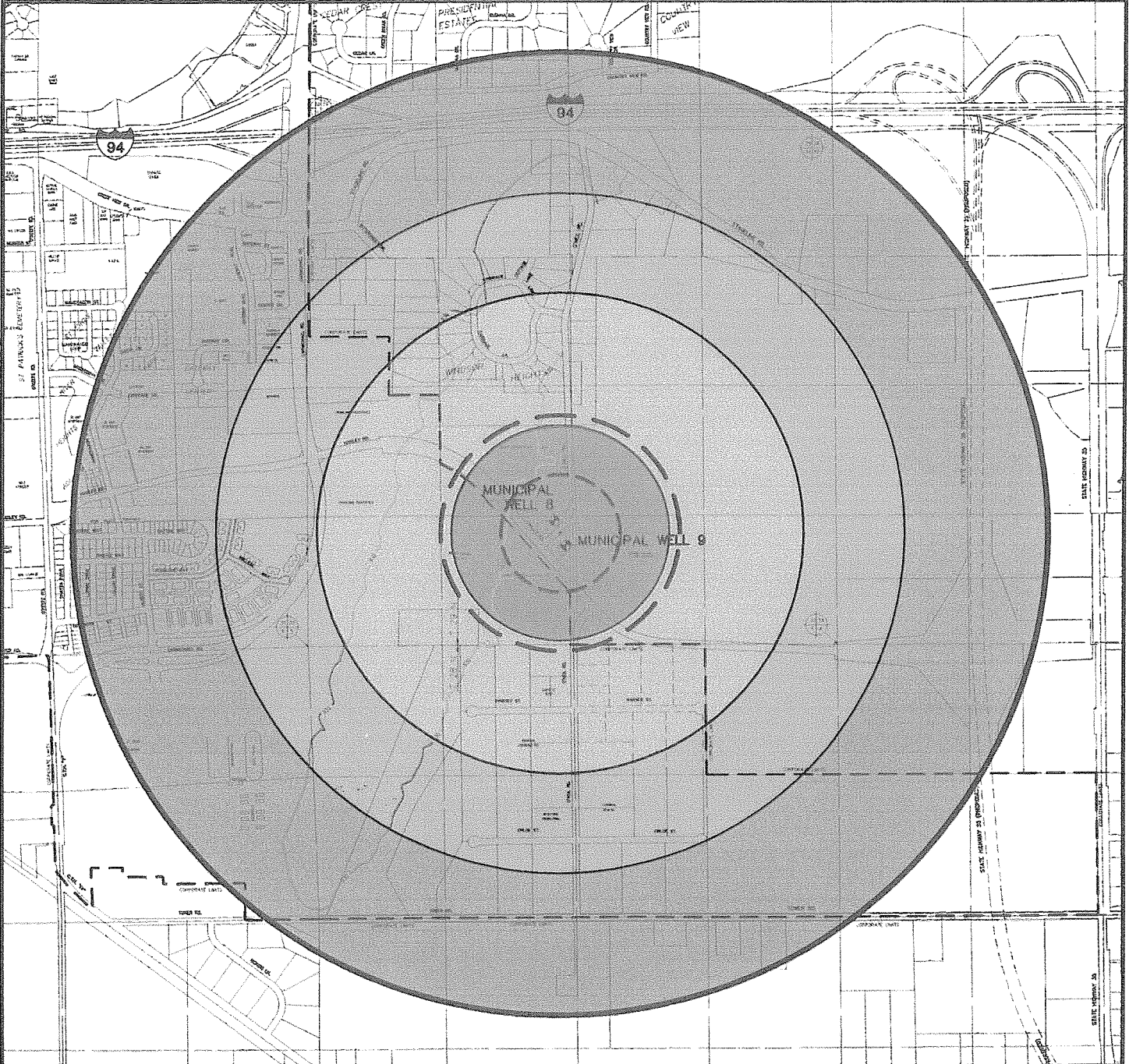



0 375 750 1500  
SCALE IN FEET

NOTE: WELL LOCATIONS ARE APPROXIMATE.

DATE: 07-07-03 3:28 pm USER: BHEINRICH

C:\F\HUDSON\010400\ACAD-ENV\HUDSON-WPA.DWG



1	07/07/03	ORIGINAL ISSUE	SRH	07/03	CLK	07/03
NO.	DATE	ISSUE/REVISIONS	DRAWN BY	QC REVIEW	QC CHECK	
			MUNICIPAL WELLS 8 AND 9 HUDSON, WISCONSIN			PROJ. NO. HUDS00104 DATE 07/07/03
WELLHEAD PROTECTION ZONES					FIGURE	14