Minnesota's Statement of Interest for the Pilot Project for the National Ground Water Monitoring Network

October 2009

This is the Statement of Interest from the Minnesota Department of Natural Resources and partnering organizations to participate in the Pilot Project to gather information about the future development of a comprehensive National Ground Water Monitoring Network. The ground water monitoring network in Minnesota is areally extensive and has a long period of record. Existing data systems can provide data about the ground water conditions throughout Minnesota and is accessible through a web-based data portal which allows dissemination of data to interested, outside parties.

Project Area

The proposed project area consists of the area of the Cambrian-Ordovician aquifer system found within the state of Minnesota. This aquifer system extends into Wisconsin, Iowa, Illinois and the Upper Peninsula of Michigan. The Cambrian-Ordovician aquifer system in Minnesota consists of four identified aquifers. From shallowest to deepest the aquifers are identified as the Upper Ordovician, (Galena Group, Glenwood, and St. Peter); the Prairie du Chien-Jordan; the Tunnel City/Wonewoc; and the Mt. Simon. These aquifers are separated by at least one aquitard which in places is also used as an aquifer for small scale water use. The aquitards are not being considered as a part of this Pilot Project.

The four aquifers cover an area of approximately 15,000 square miles in Minnesota alone. Figure 1 presents the extent of the aquifers in Minnesota. These aquifers are within the Holland Embayment, which includes the Twin Cities basin. The northern edge of the Holland Embayment is located in the project area.

These aquifers are the water supply for virtually all of the population within the project area. The most heavily used aquifers in terms of volume of water removed are the Prairie du Chien/Jordan followed by the Mt. Simon and then the Tunnel City/Wonewoc and the Upper Ordovician.

The project area in Minnesota is overlain by glacial deposits that are a principle aquifer (Glacial sand and gravel) as identified by the United States Geological Survey (USGS). These deposits range in thickness from zero to over 300 feet and consist of sand and gravel outwash plains or till moraines. This proposal does not address monitoring of the glacial sand and gravel aquifers, however they are currently monitored by the DNR and its partners for both water quantity and quality. Additional monitoring of the surficial sand and gravel aquifers will be included in any expansion of this proposal.

<u>Aquifer descriptions</u>

The Upper Ordovician aquifer is composed of the Platteville Formation, a dolomitic limestone; the Glenwood formation, a shale and argillaceous quartz sandstone; and the St. Peter Sandstone, a fine grained orthoquartize.

The Prairie de Chien Group consists of two dolomites, the Oneota Dolomite and the Shakopee Formation. The Jordan is a sandstone comprised of fine to medium quartzose sandstone. The Prairie du Chien and Jordan are considered one aquifer unit. In many locations they react

similarly to pumping and many wells are installed through both units. The Jordan Sandstone has a greater porosity but the Prairie du Chien Group has a greater yield.

The Tunnel City is a very-fine grained sandstone to siltstone. The Wonewoc Sandstone is a sandstone comprised of medium grained quartzose sandstone. The two formations are often used as one aquifer in the southern portion of the project area.

The Mt. Simon Sandstone is a sandstone comprised of medium grained quartzose sandstone and some thin shale beds.

Existing monitoring networks

Water Quantity

The existing water quantity monitoring network is a network operated by the Minnesota Department of Natural Resources (DNR). The network has approximately 750 monitoring wells throughout Minnesota, of which 142 are within the project area. Figure 2 presents the extent of the DNR's network throughout the state. Figure 3 presents the location of the wells in the project area. Figures 4, 5, 6, and 7 present the wells installed in each aquifer.

There are seven wells in the Upper Ordovician aquifer, 62 in the Prairie du Chien/Jordan aquifer, 22 in the Tunnel City/Wonewoc aquifer and 51 in the Mt. Simon aquifer. The wells are measured monthly from March through November by local Soil and Water Conservation District (SWCD) personnel. Less than 10 of the wells have automated water level measuring equipment.

The network has been in existence since the 1940s and has been expanded by the DNR and in cooperation with the USGS, other state agencies, local municipalities, and citizens.

The existing network includes a combination of stressed and unstressed wells. The stressed and unstressed wells can be divided into subnetworks, however they are not identified nor measured separately in the DNR's data system. However, the different types of ground water systems can be identified by using the well location and historical water level data. The DNR is also responsible for permitting and monitoring of large volume pumping systems. Using the location and pumping information for these systems allows us to differentiate stressed from unstressed portions of the aquifers.

The measurements collected from the wells in the DNR's network can be used to evaluate baseline and trend data. When there are special studies within the proposed project area, the frequency of water level and water quality testing in the existing network wells can be increased to meet the needs of the study.

Water Quality

Ambient (i.e. baseline) ground water quality monitoring has been conducted by the Minnesota Pollution Control Agency (MPCA) since 1978 to document the quality of the ground water resources statewide and identify trends. Site-specific investigations (i.e. special studies) also are conducted by the agency to determine the extent of non-agricultural point-source contamination to the ground water, such as from petroleum spills or landfills.

The MPCA's current ambient ground water quality monitoring network focuses on aquifers that are most susceptible to pollution from human activities, namely the surficial sand and gravel and Prairie du Chien-Jordan aquifers. The latter unit primarily is monitored where it is unconfined. For this study, only data from Prairie du Chien-Jordan aquifer wells will be used. These wells

are separate from the DNR's network.

The MPCA is in the process of enhancing the ambient network to discern the effects of urban land uses on ground water quality conditions. A total of 150 additional monitoring wells are needed to allow assessment of water-quality conditions in the surficial sand and gravel aquifers and trends by land-use setting. Figure 8 details the MPCA's ambient network and planned additions in the study area. The MPCA is working closely with its sister state agencies and local governments to site and install new wells to meet water quality monitoring and other monitoring needs. Funds have been appropriated to install at least 60 of the needed monitoring wells during fiscal years 2010-2011. The data from the ambient ground water quality network is stored in an internal Microsoft Access database and STORET and is presented in the MPCA's Environmental Data Access system (http://www.pca.state.mn.us/data).

The Minnesota Department of Agriculture (MDA) currently collects water quality samples from 15 domestic wells within the project area but outside of the Twin Cities metropolitan area. The MDA has conducted water quality sampling in the project area for over 20 years. Because the current MDA wells are domestic wells they are not being considered for this Pilot Project but the information will be incorporated into future work.

The USGS has monitoring wells in the project area that were installed to study ground water quantity, quality, and flow. The USGS water quantity and quality wells will be evaluated and used as a part of the Pilot Project.

Several counties are actively involved in assessment and monitoring of ground water resources as are watershed districts, conservation districts and others. Washington County, located in the northeast corner of the project area, has a county sponsored ground water monitoring network. A portion of this network is presented in Figure 9. The Washington County network is similar to other county networks in that it includes both DNR and county wells. This data is typically stored locally and is sometimes available via websites.

Ground Water Flow

Numerous ground water flow studies have been conducted in the project area. Within the Twin Cities metropolitan area, the Metropolitan Area Ground Water Model (Metro Model) has been developed. The Metro Model is a collaboration by various agencies and currently the Metropolitan Council is the lead agency in updating and improving the model. The Metropolitan Council is the regional planning agency serving the Twin Cities seven-county metropolitan area and provides essential services to the region. The Metropolitan Area Groundwater Model is used to assess the potential impacts of projected ground water withdrawals and evaluate alternatives to avoid adverse impacts to water resources and ensure water supplies are developed sustainably. The model provides a conceptual flow model for ground water flow. The model covers the greater Twin Cities metropolitan area but could be expanded to cover the project area.

The Metro Model will be evaluated to determine the ability to provide data to this Pilot Project.

Network Goals

The goal of Minnesota's ground water monitoring network is to provide information about the quantity and quality of the State's ground water. This information is used to insure the current and future citizens of Minnesota have a clean and abundant source of water for domestic, environmental, and industrial needs.

Minnesota's ground water monitoring network is and will continue to be comprised of a collection of networks. To reach the goal of clean and abundant ground water for generations to come, we need to be able to answer the following questions:

- How does this aquifer system work and how might we use the network to test conceptual models of the hydrogeologic setting?
- What are the ground water level trends?
- How much ground water moves through the system?
- How can we use the network to define the direction and gradient of ground water flow?
- How much ground water contribution is needed by critical ecosystems to maintain minimum (non-lethal) and maximum (successful reproduction of sustainable populations) suitable conditions?
- What is the unstressed condition of the monitored aquifer?
- How is ground water chemistry changing over time?
- What are the sources/causes of these changes?
- How might we use the network to establish background levels of water quality indicators?
- What are the long-term and annual changes in ground water storage due to effects of climate and of withdrawals?
- What are the effects of ground water withdrawals?
- What are the effects of periods of drought and above average rainfall?
- What are the long-term effects of climate change?
- What is the relationship between climate, ground water storage, ground water appropriations, and ground water contribution to critical ecosystems?
- How do ground water management efforts impact chemistry, recharge, discharge, ecosystems, etc.?

While the existing networks can provide some of the necessary information, there is agreement that the current network is insufficient to answer all of these questions. We are working to increase the amount and quality of ground water monitoring to be able to answer these questions.

Description of collaboration between project partners

Minnesota employs a multi-agency approach to ground water monitoring and protection. It takes the concerted effort of all agencies, along with local and federal partners, to build a comprehensive picture of the status of the state's ground water resources. These ground water quality and quantity data are needed for water supply planning, permitting and other regulatory actions, best management practice implementation and better understanding of surface water and ground water interactions that have the potential to affect water quality and availability.

A 2004 Memorandum of Agreement (MOA) between the MPCA, the MDA, and the MDH clarified the agencies' respective roles (as specified by state statute) in ambient ground water quality monitoring, and these agencies operate a statewide integrated ground water-quality monitoring system. Figure 10 is a graphical depiction of agency roles, including the water quantity management responsibility of the DNR.

The DNR and MPCA currently have a joint stream flow project where personnel from either agency can enter, manage and retrieve stream flow data from any of the 60 state wide sites measured by the two agencies. These data are accessible to the public by an interactive website.

The DNR has an additional 90 stream flow sites that are measured throughout the state. Many of these sites are automated and provide near real time data via the interactive website as mentioned above.

The DNR and USGS have successfully partnered on a number of studies, most recently in 2008 when the DNR assisted the USGS in the synoptic measurement of wells in the Twin Cities Metropolitan Area. Various agencies have also been cooperators in many of the USGS studies conducted within the project area and this cooperative effort will be a part of this Pilot Project.

The MDH and Minnesota Geological Survey (MGS) are responsible to maintain a repository of well logs for all wells installed in Minnesota. This repository, the County Well Index (CWI), contains such well data as location, construction information, and the geologic information as collected by the driller. These logs are located in a database and are accessible via the CWI website. The geologic information available through the CWI allows for detailed and valuable information about the geology and hydrology of the state.

The DNR, MPCA, USGS, and MGS have worked with the Metropolitan Council on the Metropolitan Area Ground Water Model. This cooperative work is ongoing and will be considered as a part of this proposal.

The DNR partners with SWCDs throughout the state to provide water level measurements from the DNR's observation wells. The SWCDs measure all of the DNR's monitoring wells in their area (usually defined by county boundaries). The SWCDs provide the DNR the ability to continue long-term monitoring of the wells in the network. They also assist in locating new monitoring wells to add to the network.

Primary Contact

Michael MacDonald of the DNR will be the primary contact person for the Pilot Project. Mr. MacDonald is responsible for coordinating and managing the data collected from the DNR's monitoring network. He is also responsible for evaluating the condition of the existing wells and for adding and removing wells to the network.

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<u>Key Partners for the Pilot Project</u>
Minnesota Pollution Control Agency
Metropolitan Council
USGS Water Science Center
Minnesota Department of Agriculture
Minnesota Department of Health
Various counties
Various Soil and Water Conservation Districts

Draft Field Practices for Ground-Water Data Collection

These field practices are based on Appendix 5, Field Practices for Ground-Water Data Collection, A National Framework for Ground Water Monitoring in the United States, June 2009, Advisory Committee on Water Information, Subcommittee on Ground Water and on Standard Practices Established for DNR and MPCA hydrologists.

The MPCA has developed additional Standard Operating Procedures (SOP) for water quality sampling. These SOPs (Field Guidance Manual for Ambient Ground Water Monitoring Network, November 2008, MPCA) are the procedures to be used for any water quality sampling conducted for this study.

The following sections outline some of the basic field practices consistent between the different agencies and cooperators.

Standards for Field Data Collection

Quality data depend on good, consistent field data collection procedures. Important elements to ensure data quality includes:

- Training of all staff who are involved in data collection
- Pre-visit field site review and preparation procedure
- Standard listing of data elements that must be recorded
- Standard procedure to prepare for water level measurements at the field site
- Water-level collection and data recording procedures

Field-sampling procedures must take these elements into account in order to ensure that:

- Water levels are being taken at the correct location, from the correct well at that location, and at the proper time
- Water-level data are recorded and transmitted accurately
- Information recorded during measurements contains all of the information needed to normalize and compare analysis results
- Measures are taken to ensure the accuracy of the result

Training

Staff training prior to collection of ground-water levels is important to ensure consistent data quality. All staff is required to have appropriate training which includes formal training and hands-on field experience.

Pre-visit Field Site Review and Preparation Procedure

Preparations for water-level measurements include the gathering of equipment and supplies. A checklist of the equipment and supplies needed for each measurement trip will help the measurer avoid delays and prevent the collection of invalid measurements. Equipment that will be used to collect continuous water levels should be calibrated and tested before deployment to ensure accuracy.

Decontamination and calibration of steel and electric tapes should be conducted as near in time as practical to field measurement. A record of decontamination and calibration should be maintained for all equipment.

Standard data sheets for recording water-level measurements will include all appropriate data fields such as well unique number, site name, date, time, water level below measurement point, land surface correction, elevation of measurement point, etc. Copies of data sheets from prior site visits are very useful when determining the approximate depth to water to determine length of steel tape to be chalked.

Minimum Data Elements

Each water-level measurement site has inherent data elements that need to be verified and recorded, preferably prior to water-level measurements. The person making the water-level measurement should check to ensure minimum data elements are available prior to conducting measurements to ensure that it is accurate and up to date when in the field. Corrections and updates to the information should be made prior to measurement. Data elements include but are not limited to:

- Date and time of water level measurement
- Well ID number
- Tape held length value
- Cut (or level of water) value
- Depth to water (if using an electronic measuring device)
- Condition of the well (if necessary)
- Name of the person collecting the measurement

The following activities are carried out in preparation for a water level measurement:

- Site verification. This can be accomplished in several ways including having made a previous visit to the site, comparing the site to a known grid reference using GPS equipment, comparing photographs of the listed site to the actual site, or identifying the site by a physical label on the wellhead or identifying sign.
- Equipment decontamination. Equipment must be decontaminated between water-level collections to prevent cross contamination between wells. The decontamination type will depend on expected compounds of concern but at a minimum should include a bleach wash and clean water rinse of the equipment. The MPCA's Field Guidance manual provides additional information about decontaminating equipment.
- Site condition notations. These include the date and time of day, weather conditions (rain, snow, etc.), measurement-point condition, damage, deterioration and any other factors that could affect the results of the current water-level measurement or future measurements.
- Site access. This may include access to the property (gate opening, etc.) and opening the cap or shelter that encloses the well.
- Use site reference materials to verify the measuring point for each measurement.

Water-Level Measurements

Numerous technical guidance documents have been written to describe the procedures to use when measuring water levels, either manually or with recorders designed to automatically measure water levels on a continuous basis. Procedures from USEPA, USGS, ASTM, WMO exist. Because these technical procedures do not appreciably vary in terms of the quality of data

that would result, the following sections refer to the technical procedures already documented by these organizations.

All measurements should be recorded either on a field computing device or on network standard paper forms. If electronic recording of measurements is chosen, all information required on the paper form also should be enterable electronically. Electronic files should be downloaded when returning from the field and archived as a method for retaining original field measurements. Field measurements recorded on paper should be electronically entered into available databases shortly after returning from the field. Paper forms should be scanned and archived appropriately. No original documents are to be returned to the field.

Manual Water-Level Measurements

All manual water-level measurements should be designed to have repeatable and accurate methods of determining the elevation of the water-level surface. Manual water-level measurements can be made by use of several methods; the most common are the graduated steel or wetted tape method and the electric-tape method. The method chosen at a given site will depend on site conditions and well construction.

Several manual water-level measurements should be made in short succession to ensure the measurement is accurate to within at least 0.02 ft between consecutive measurements. For electric-tape measurements, the USGS (Wilde and others, 1999; Drost, 2005) recommends that at least three measurements be made, with two consecutive measurements within 0.02 ft. Some methods of manual measurement (at flowing wells, for example) will not have that level of repeatability. Regardless of the method of measurement, all measurements should be recorded for the record. The accuracy of the water-level measurements (based on the repeatability of the measurements) should be documented.

Automated Water-Level Measurements

Automated water-level measurements are made so that a continuous (or near-continuous) record of water levels can be made with minimal human intervention. Automated (continuous or near-continuous) water-level measurements can be made with pressure transducers. Care should be taken to ensure that the entire expected range of water levels can be measured with the device at the expected accuracy. After the water-level recorder is placed in a well, the resulting measurements are compared to manual water-level measurements to create a calibrated record of water levels. Documentation should be maintained to ensure accurate measurements, including date/time of calibration; the type, serial number, and range of measurement device; and what units are being measured (ft, psi). A field copy of the necessary calibration and equipment information should be taken to the field each visit.

The accuracy of automated (continuous) water-level measurements should be at least 0.02 ft. Instrument drift and faulty instrumentation can affect the accuracy of the data collected.

The frequency at which the water-level recorder should be visited should be based on the stability of the transducer, the storage limitations of the recording device, and knowledge of the expected hydrograph of the aquifer. Field visits at intervals of 2-6 weeks should be sufficient until the requirements of the individual site are determined. Instrument drift corrections, calibration corrections, and datum corrections all can affect the accuracy of measurements and should be applied after downloading the data. All corrections should be noted and archived.

Data Management System

Extreme importance must be placed on documentation of field and office procedures to ensure that the quality of the data is maintained. This section covers some specific data handling and management procedures.

Electronic Entry of Data

The first step in processing water-level data is entry of the measured data, field data, and related information into the database.

Verification and Editing of Water-Level Values

Data must be checked carefully and verified against field notes or records before being used in further analysis. Data outliers (data outside of the expected range of values) will require investigation. Individual values that might be incorrect are compared to field measurements or to known extremes of record. Prior to editing, original unit values should be archived; a copy of the original data file should be edited, and finally this copy should also be archived. Various issues can arise in water level data sets, including errors with times and dates and instrument drift or datum errors.

Original paper records should not be modified, deleted or erased, or returned to the field because this increases the chance they will get damaged or lost. Scanning and archiving of notes recorded on paper notes should be done so that all editing of errors, instrument or time drift corrections, and such can be recreated if necessary

Current Data Entry, Storage, and Web Accessibility for DNR data

Information about the DNR's wells and ground water level measurements are stored in a PostgreSQL database housed at the DNR. Security protocols only allow the monitoring well coordinator and database administrator to modify data within the database. The metadata elements for the database are presented in Table 1. Additional information about each well is stored in paper files in the DNR's Central Office. Many of these files have been scanned and are available electronically.

The ground water level measurements are collected by DNR staff or by the DNR's partners and are submitted via a secure webpage. The webpage allows the partners to enter the water level measurement data as well as any comments about the well. The webpage also provides a hydrograph of the measurements from the past six months to assist the partners in understanding the ground water levels in the well. The system further allows the uploading of time-series data. The entered data is reviewed by the monitoring well coordinator for errors and to evaluate the accuracy of the data. If the data appears correct, it is approved and placed into the database. If the data appears incorrect, the data is not entered into the database and the data collector is contacted and the data is verified with them. The data, either as it was provided or revised, is then entered into the database. The partners can also submit water level data via paper to the monitoring well coordinator, who then inputs the data into the database.

The data is accessible through a web based map which allows users to obtain the ground water data by either entering a well number (the DNR's well number or the Minnesota Department of Health (MDH) statewide Unique number) or by using a Google map to zoom into an area and selecting the well of interest (http://climate.umn.edu/ground_water_level/). The system provides

a hydrograph of the ground water levels from the well plus a graph of precipitation from a weather station close to the well. All of the well information (location, depth, and construction) and the ground water level observations can be accessed (and downloaded) from this page. Data requests can also be made directly to the ground water coordinator.

Current Data Entry, Storage, and Web Accessibility for MPCA data

Data management systems are in place at the MPCA to ensure accurate groundwater quality information is collected. Procedures also are in place to track receipt of analytical results from the laboratory. Ambient network personnel keep a record of all samples collected and shipped to the laboratory to ensure the complete receipt of all analytical results.

Field data collection is facilitated through the use of a computer program which inputs the information directly into a Microsoft Access database. The field information database contains a record of the: 1) field parameter values collected during well purging, 2) procedure(s) used to collect the samples, 3) personnel collecting the samples, and 4) weather conditions during sampling.

Laboratory analytical data are provided to the MPCA in paper reports and in an electronic format. The analytical data is imported into a Microsoft Access database, which is separate from the Access database listed in the preceding paragraph. After the Access database is reviewed and finalized by MPCA staff, these data are subsequently imported into STORET. Groundwater quality data in STORET are made available to the public via the agency's Environmental Data Access system (http://www.pca.state.mn.us/data) or by contacting the coordinator of the ambient groundwater quality monitoring network.

These systems and the County Well Index (detailed below) are data portals that provide data sharing among data providers and the public. These systems can be expanded to provide a central data portal to assist the NGWMN in providing data to a larger audience.

Approach to accomplishing the tasks

To begin the process we would work with other state agencies to evaluate how we can coordinate ground water measurements and water quality sampling throughout the state. We would also begin identifying possible monitoring points from all available networks within the project area.

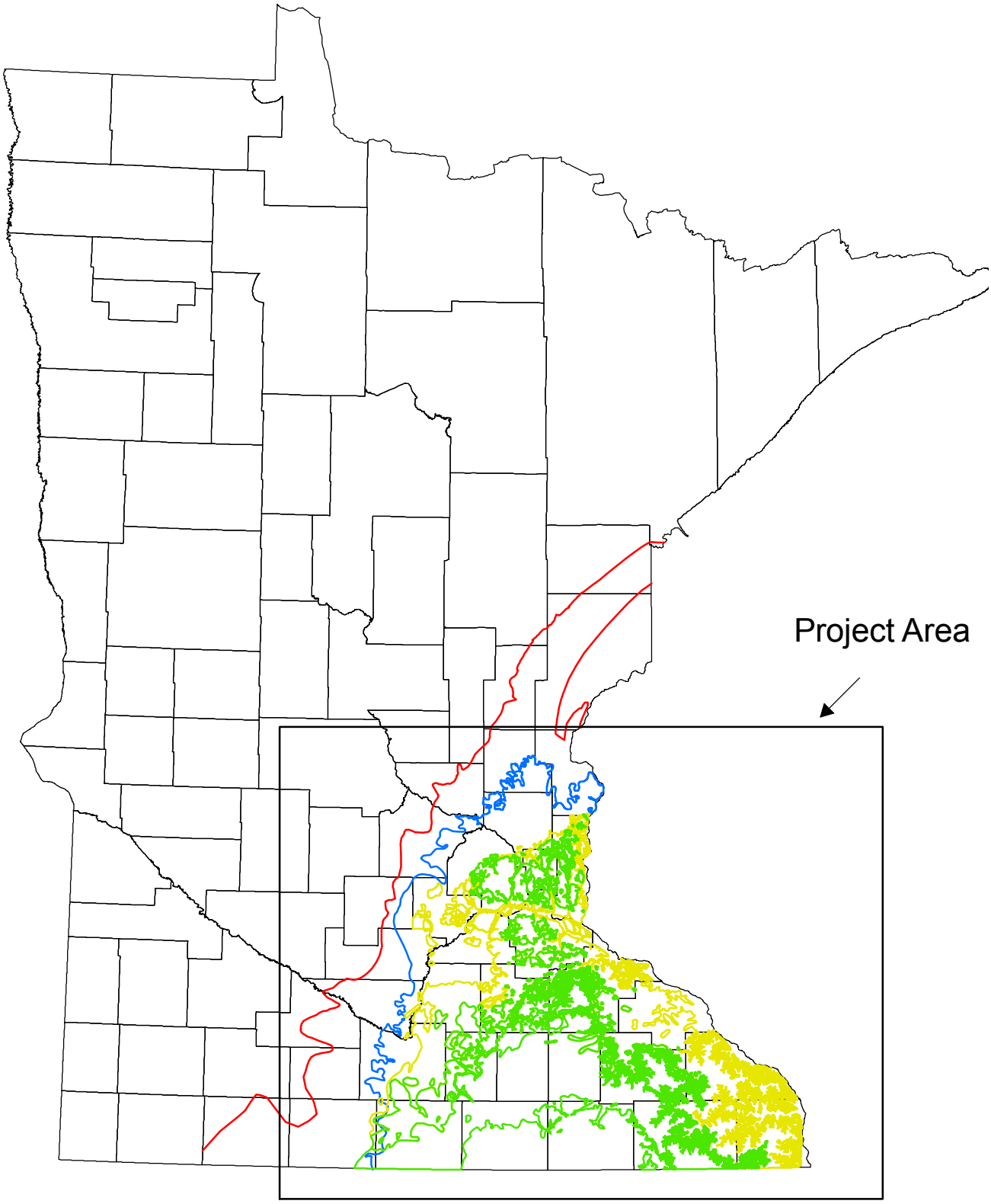
By March 2010, determine if our field practices meet the National Ground Water Monitoring Network (NGWMN) criteria and what changes maybe required to meet the criteria. We also have identified gaps in the current monitoring network.

By July 2010, develop a cost-estimate to participating in the Pilot Project. We will have determined what other Federal and non-federal monitoring networks are present and available in the Project area.

By September 2010, evaluate whether our data management standards meet the NGWMN criteria and if our data management system will interface with the proposed NGWMN data portal.

By November a final report will be presented to the Subcommittee on Ground Water (SOGW) detailing the work that had been conducted and detail the items as outlined in the Announcement of Pilot Studies and request for Statement of Interest in the National Ground Water Monitoring network.

Figure 1
Cambrian - Ordovician Aquifer system in Minnesota
Minnesota Department of Natural Resources
October 2009

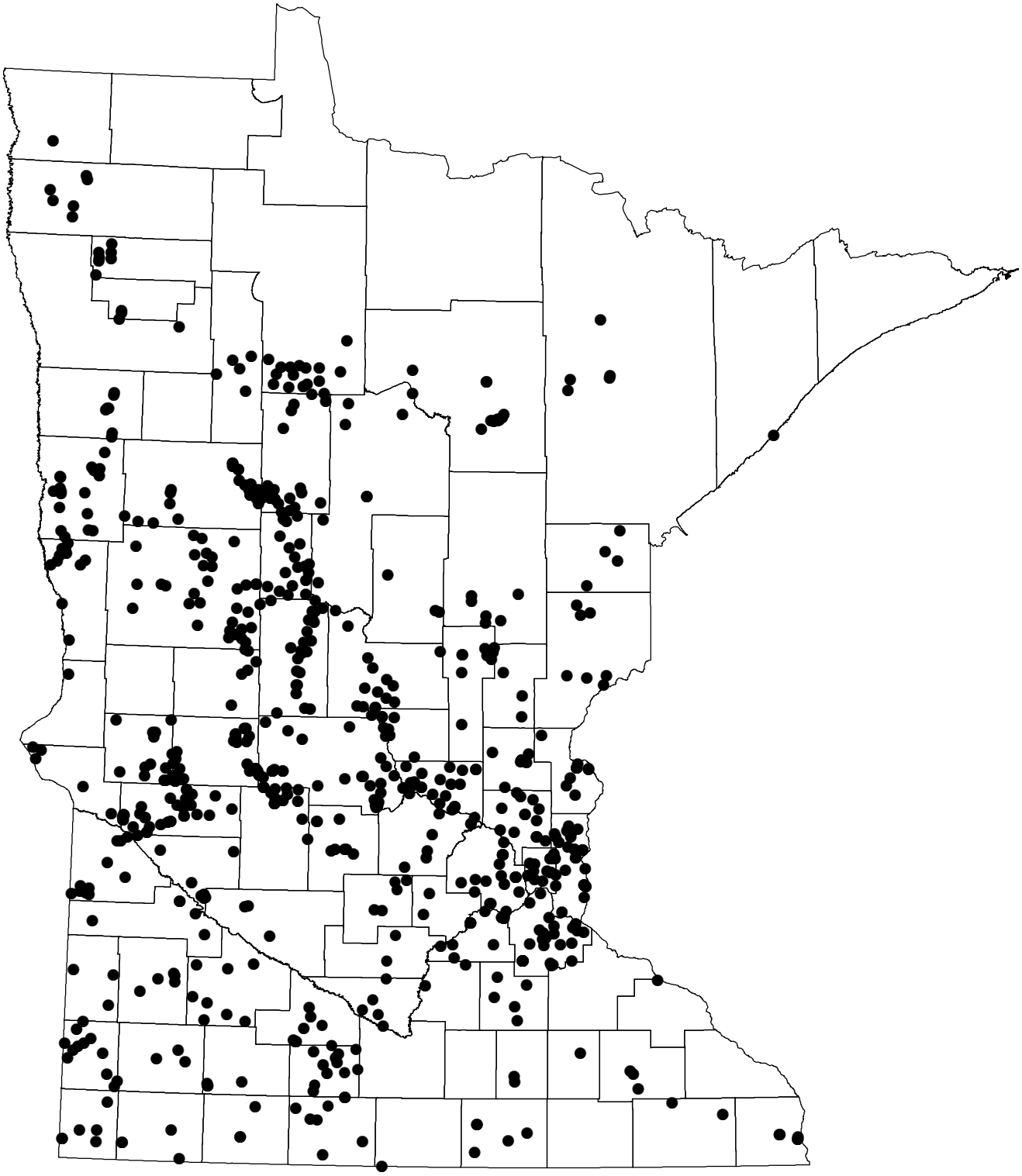


Legend

- Upper Ord Aquifer
- PDC-JDN Aquifer
- Tunnel City/Wonewoc Aquifer
- Mt. Simon Aquifer

N

Figure 2
DNR Monitoring Wells
Minnesota Department of Natural Resources
October 2009

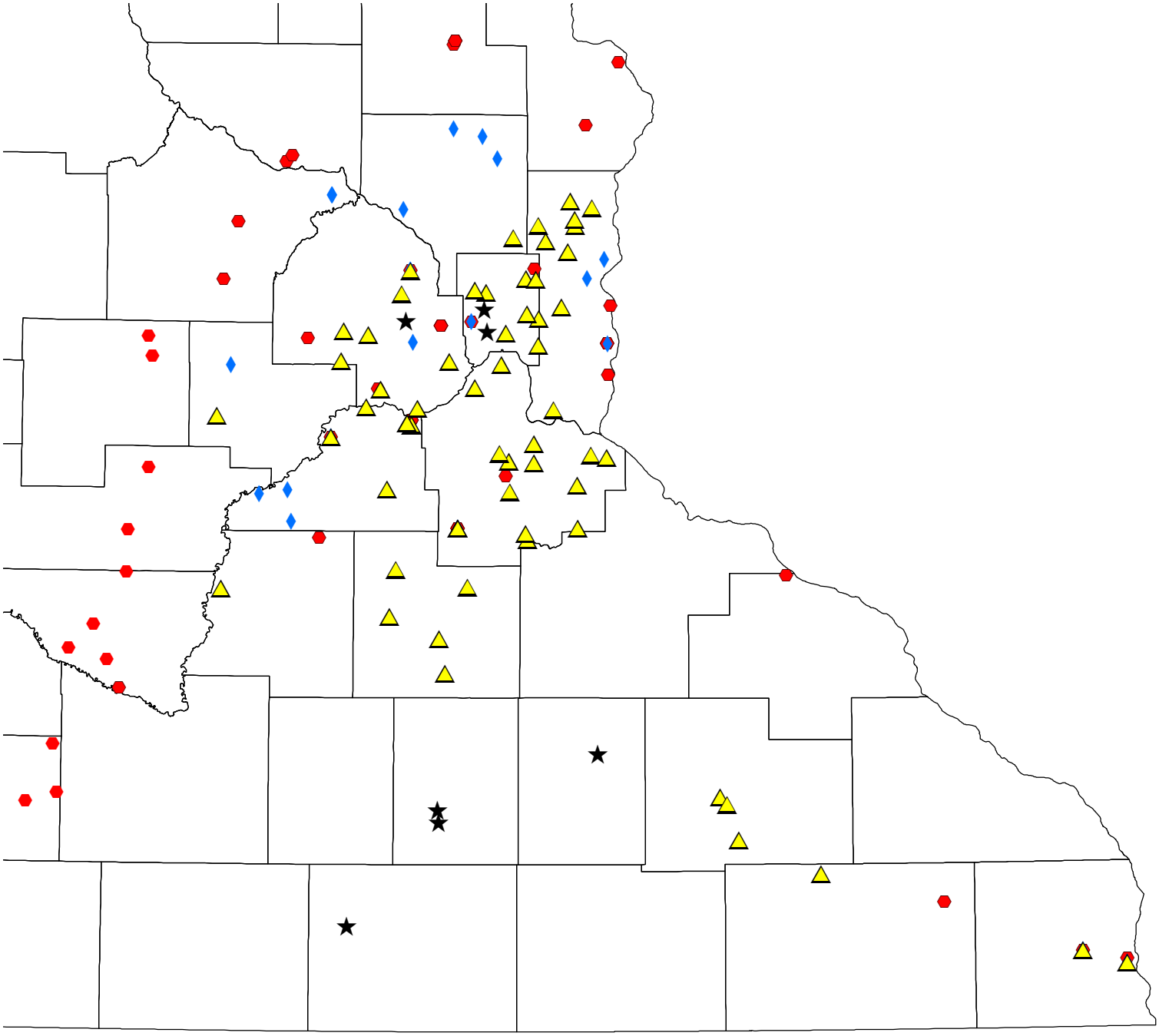


Legend

- Actively measured wells

N

Figure 3
Monitoring Wells within the Project Area
Minnesota Department of Natural Resources
October 2009



Legend

- Upper Ordovician
- Prairie du Chien/Jordan
- Tunnel City/Wonewoc
- Mt. Simon

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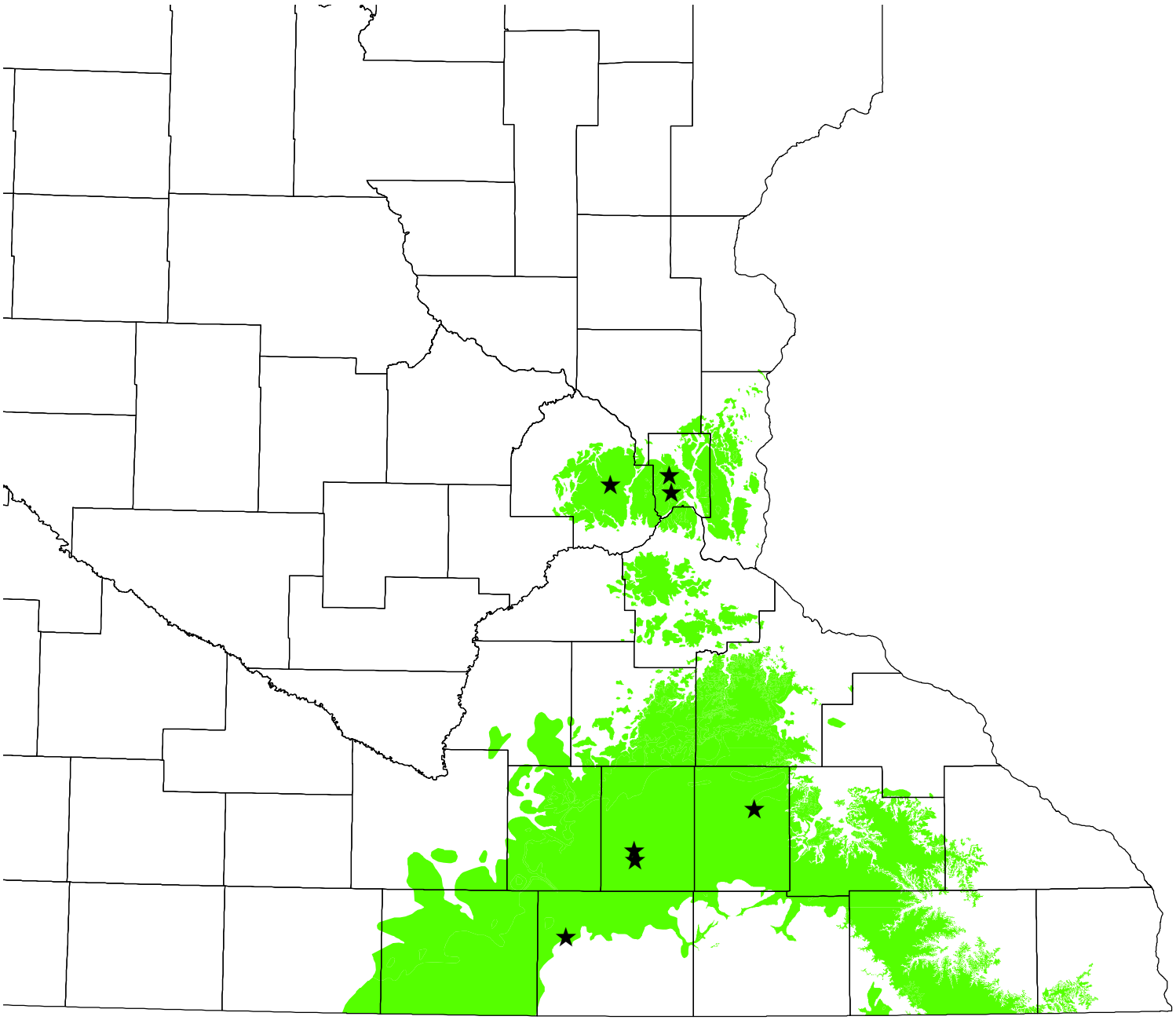
Figure 4
Monitoring Wells within the Upper Ordovician Aquifer
Minnesota Department of Natural Resources
October 2009



Legend

★ Upper Ordovician

Upper Ordovician Aquifer Extent

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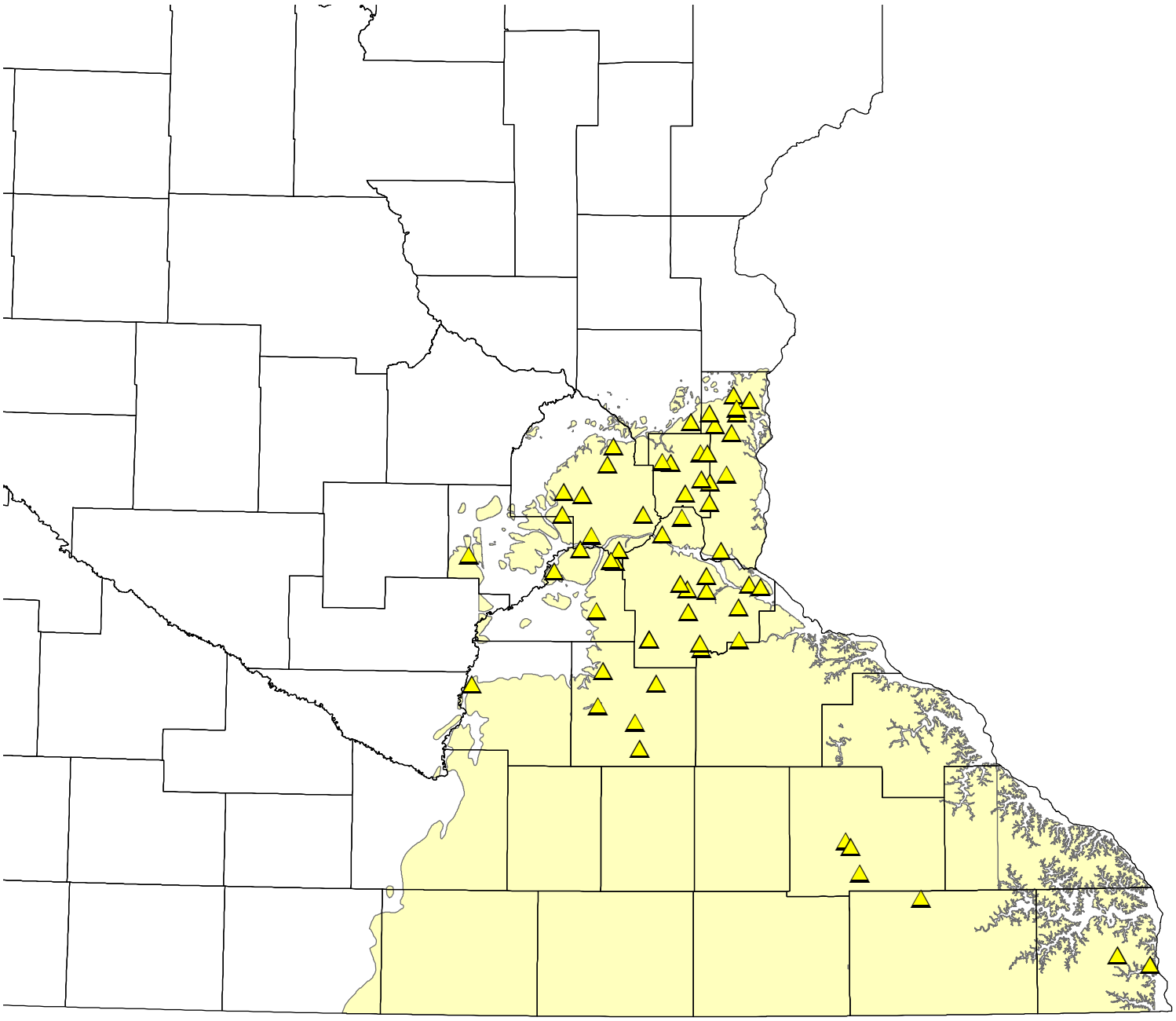
Figure 5
Monitoring Wells within the Prairie du Chien/Jordan Aquifer
Minnesota Department of Natural Resources
October 2009



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Prairie du Chien/Jordan

Prairie du Chien/Jordan Aquifer Extent

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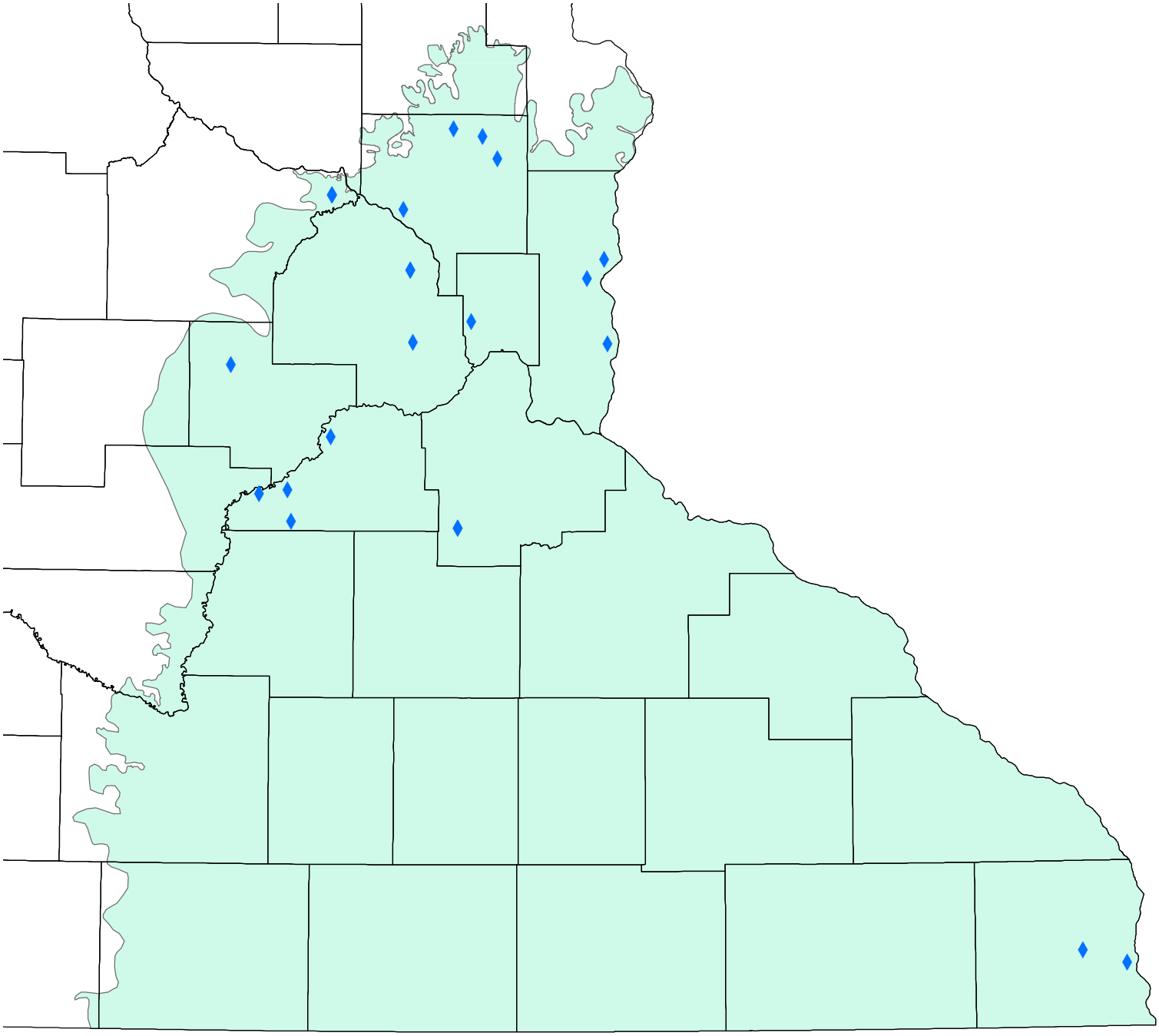
Figure 6
Monitoring Wells within the Tunnel City/Wonewoc Aquifer
Minnesota Department of Natural Resources
October 2009

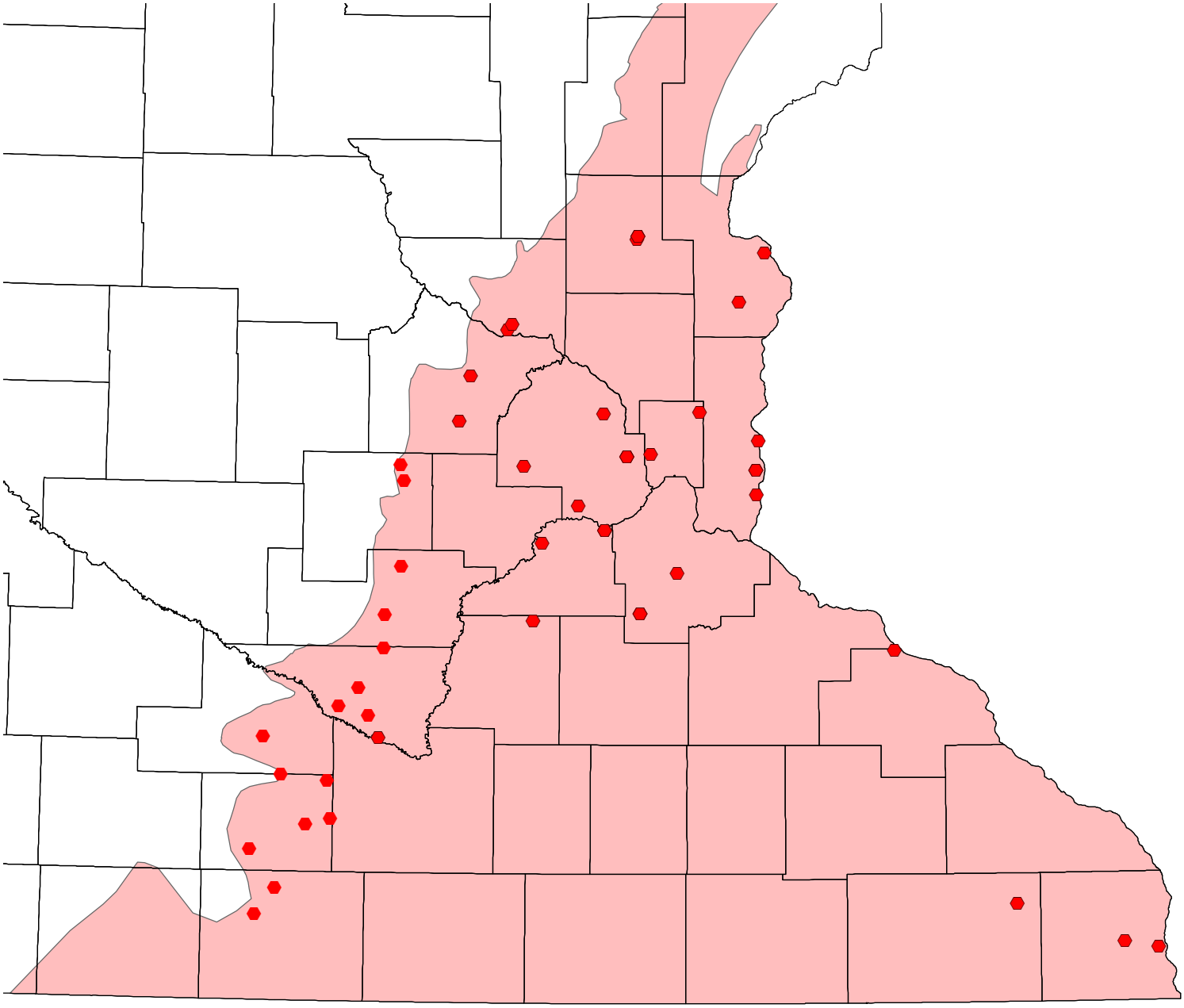


Legend

- Tunnel City/Wonewoc
- Tunnel City/Wonewoc Aquifer Extent

N

Figure 7
Monitoring Wells within the Mt. Simon Aquifer
Minnesota Department of Natural Resources
October 2009



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- Mt. Simon
- Mt Simon Aquifer Extent

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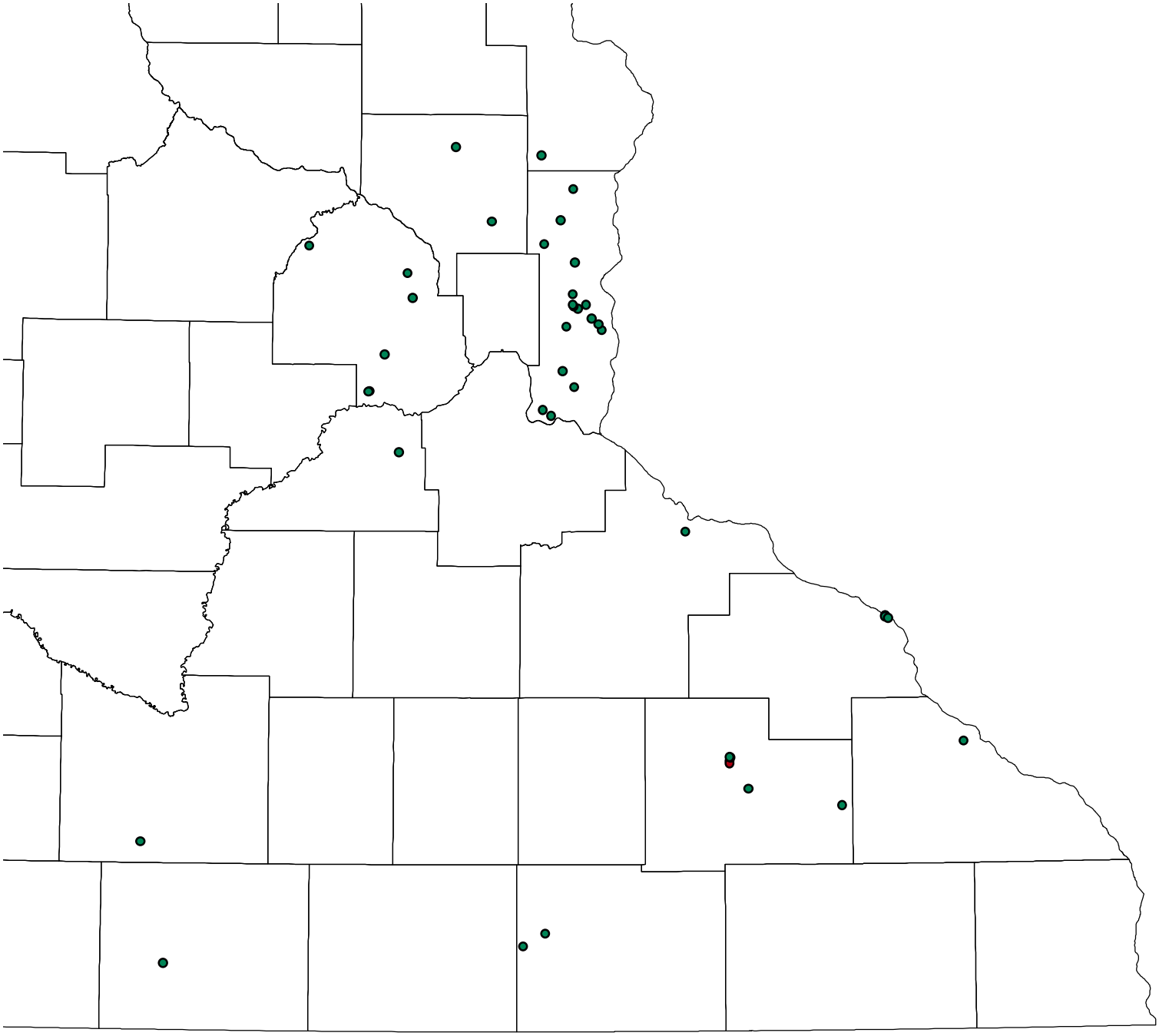
Figure 8
MPCA Ambient Monitoring Wells within the Project Area
Minnesota Department of Natural Resources
October 2009



Legend

- MPCA Domestic Wells
- MPCA Montoring Wells

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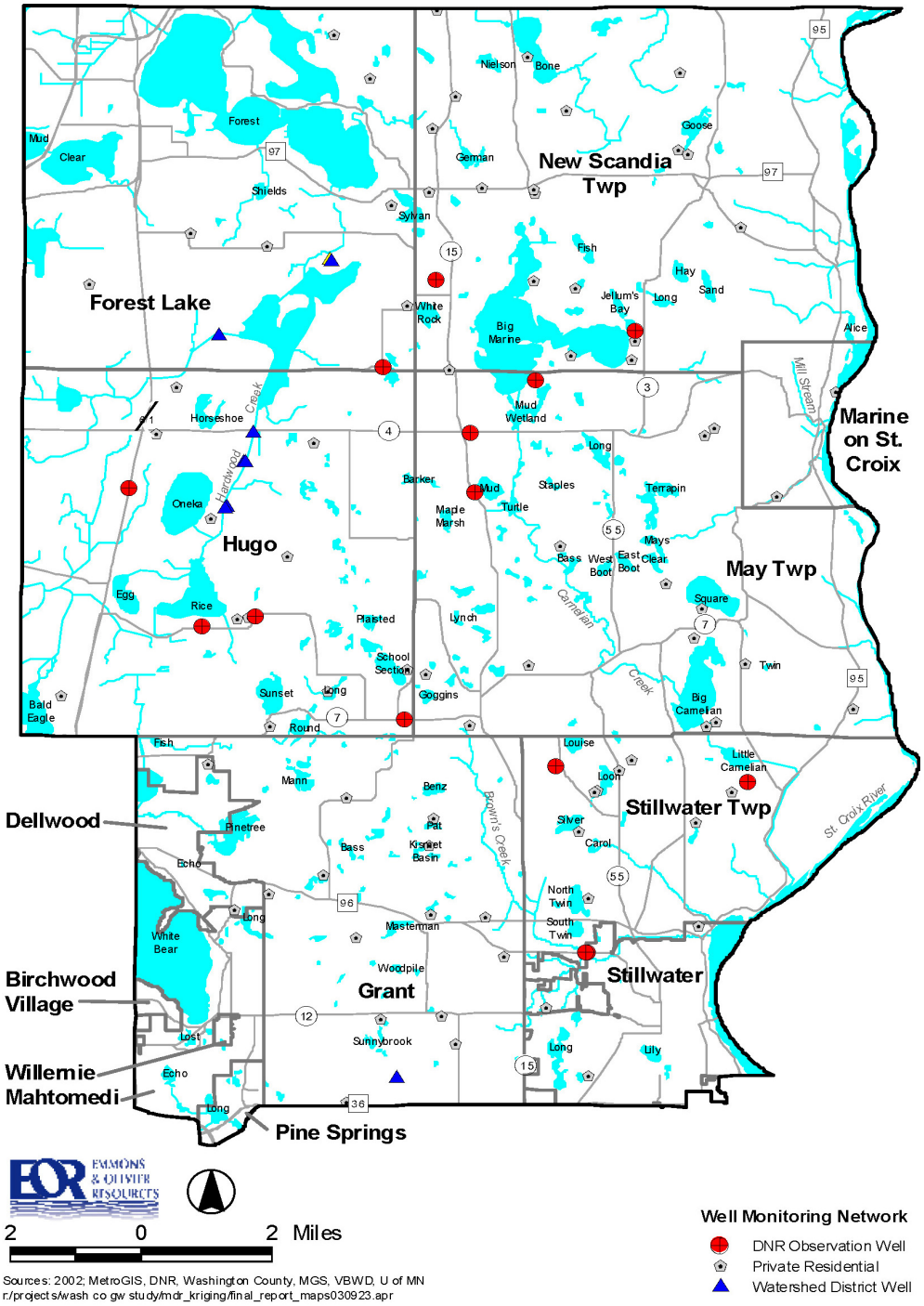
Figure 9

Location of Washington County's monitoring wells.



EMMONS & OLIVIER RESOURCES

2 0 2 Miles

Sources: 2002; MetroGIS, DNR, Washington County, MGS, VBWD, U of MN
r:/projects/wash co gw study/mdr_kriging/final_report_maps030923.apr

Well Monitoring Network

- DNR Observation Well
- Private Residential
- Watershed District Well

Figure 10

Minnesota State Agency's Roles in Ground Water Monitoring

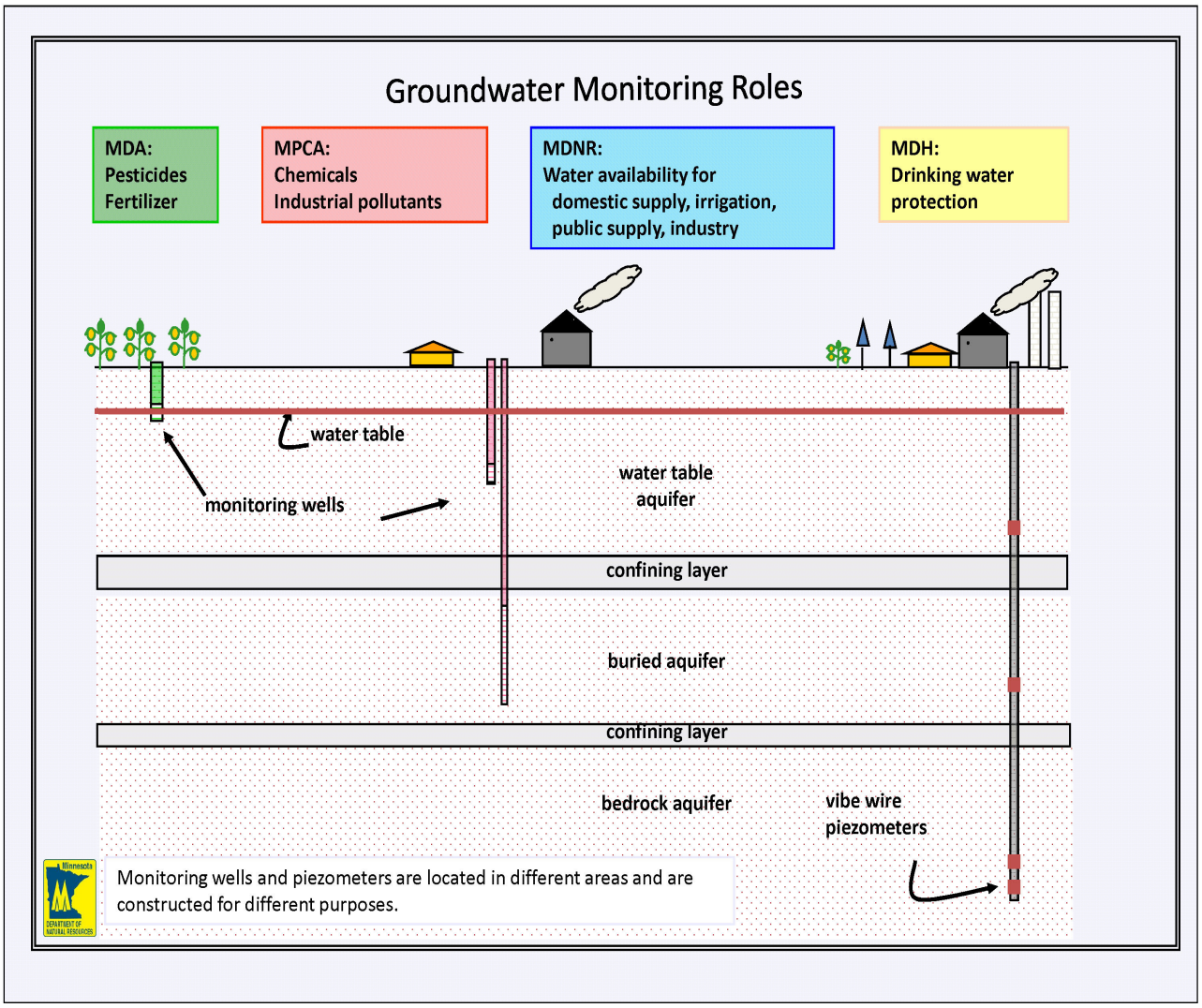


Table 1

Data elements in Minnesota DNR ground water level database

Field name

DNR well number
MDH Unique well number
UTM North
UTM East
UTM survey method
Township
Range
Section
Quarter section
Nearest town
Ground elevation (MSL)
Elevation survey method
Well name

Well depth
Well construction date
Well diameter
Well screen length
Well casing depth
Well casing material
Stickup distance (from ground to top of casing)

Date started measurements
Date ended measurements

USGS site number (if applicable)
USGS quadrangle map number
Watershed number
County code (numeric)
Remarks about the well
Measured by (DNR or other partner)

Aquifer code (from MN Geological Survey)
Aquifer type
Aquifer name

Date water level measurement collected
Tape Held
Wetted length
Depth to water from ground surface