Shakopee Mdewakanton Sioux Community

Groundwater Protection Plan

For the protection of our groundwater resources

SMSC Land Department

2009

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

Executive Summary

Introduction

The Shakopee Mdewakanton Sioux Community (SMSC) is a federally recognized American Indian Tribe with lands in Scott County, Minnesota. SMSC lands include approximately 3300 acres in the prairie pothole region of Minnesota. This land base contains over 250 acres of wetlands, two lakes, and several intermittent streams.

There are no current threats to groundwater in this area; however, population growth and development within the SMSC and throughout Scott County will stress the future availability of potable groundwater. By adopting a Groundwater Management Plan now, the SMSC can minimize or prevent groundwater shortages and contamination in the future.

Plan Preparation

This Groundwater Management Plan was completed subsequent to the completion of the SMSC Wellhead Protection Plan. Management strategies are based on the information and priorities set forth in that document. The United States Environmental Protection Agency provided funding through a 106 Grant. Tribal, County, State and Federal organizations and agencies have provided further assistance and information.

Plan Objective and Scope

The SMSC land department has developed this Groundwater Management Plan to facilitate protecting existing and future groundwater resources.

The plan's specific goals are:

- Inventory all groundwater resources and delineate sensitive areas.
- Evaluate land use impacts on groundwater quality and quantity.
- Identify potential sources of groundwater contamination (point and non-point source) on and off SMSC lands.
- Identify major issues affecting the SMSC's groundwater supply.
- Anticipate and describe environmental changes attributable to land use and development and its possible affects on groundwater quality and quantity.
- Establish goals and objectives used to address those identified issues.
- Define actions needed to achieve the plan's goals and objectives.

Plan Content

This plan begins with a resource inventory describing the nature of the hydrologic system in the SMSC. Chapter two discusses sensitive areas for planning, Drinking Water Supply Management Areas (DWSMAs) and areas susceptible to contamination. Chapter three covers groundwater policies and objectives. Chapter four discusses the SMSC information management system including databases and education objectives. The plan concludes with an implementation strategy.

1 Physical Environmental Data

1.1 Climate and Precipitation

The SMSC is located in Scott County, MN near the boundary of the semi-humid climate regime of the eastern U.S., and the semi-arid regime to the west. Because it is located near the center of the North American Continent, Minnesota is subject to a variety of air masses that affect its climate. Minnesota is known for its cold winters and hot summers. July is typically the warmest month, while January is normally the coldest. The growing season is generally six months long lasting from May through September.

The normal annual precipitation based on thirty years of data collected in nearby Jordan, MN is 27.57 inches (Figure 1). Nearly two-thirds of Minnesota's annual precipitation falls during the growing season of May through September. Only eight percent of the average annual precipitation falls in the winter (December through February) when dry polar air masses prevail.

The SMSC began monitoring daily weather data at its own weather station[1] in the summer of 1999. Additionally, daily precipitation is monitored manually at a Standard Rain Gauge[2].

1.2 Hydrogeology

The geology in the region is the most important factor influencing groundwater resources. The bedrock geology, characterized by beds of limestone, sandstone, and shale, was deposited in the Ordovician Period (500-425 million years ago) as seas advanced and retreated in numerous cycles. These sediments were subsequently eroded as rivers and streams moved over them dissecting the landscape with deep valleys. Much later, glaciers advanced across the state filling the valleys with drift and leaving behind ridges of sand, gravel and clay.

1.2.1 Sedimentary Bedrock Units

Local bedrock units are sedimentary marine deposits up to 520 million years old. These include, from youngest to oldest, the Prairie du Chien Group, the Jordan Sandstone, the St. Lawrence Formation, the Franconia Formation, Ironton-Galesville Formation, and the Eau Claire Formation (Figure 2, Figure 3, Figure 4). Figure 2 illustrates their thickness and physical description in the immediate vicinity of the SMSC. When the deposition of marine sediments ended, erosion by rivers and streams dissected the landscape. The impact of this erosion on the landscape can be seen in Figure 3.

SMSC property is located on the eastern side of a buried bedrock plateau. This plateau extends over an area of about 40 square miles.and Bedrock valleys formed by fluvial erosion bound the southern and eastern sides of the plateau. The Minnesota River flows through a bedrock valley to the north of the SMSC where bedrock units are exposed in some places.

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[1] Campbell Scientific, Inc. CR10X weather station with the following components installed on a CM10 Tripod: 05103 RM Young Wind Monitor, Licor Silicon Radiation Sensors, HMP45C Vaisala Temperature and RH probe, CS105 Vaisala Barometric Pressure Sensor, Texas Electronics Tipping Bucket Rain Gauge, MSX10 Solar Panel, and

[2] U.S. Weather Bureau Type Rain and Snow Gauge that is all aluminum 8-1/4 diameter x 27" height with a copper receiver. Has a total capacity of 20" rain.

1.2.2 Surficial Geology

The surficial geology in the area of the SMSC is predominantly glacial deposits which are highly variable and range from boulders to clay. The glaciers moved into Scott County from two principal directions. The oldest advances came from northeast and are known as Superior lobe advances. They deposited a reddish-brown drift made up of materials accumulated in the Lake Superior basin and northeastern Canada. A second glacial advance brought the Des Moines lobe into the county. This ice moved across the state from the northwest, mixing the red Superior till and depositing gray till above it. The gray, shale-rich, calcareous materials were carried out of northwestern Canada and North Dakota (Figure 5).

As the Des Moines lobe began to stagnate, pulses of ice continued to bring additional till into the county. This till is exposed at the surface in the area surrounding the SMSC. Like the till beneath it, it is also gray, shale-rich and calcareous, but it contains significantly less reddish-brown drift than the older Des Moines tills.

As the ice melted away, rock debris at the bottom of the glacier was deposited. Additionally, large quantities of sand and gravel, transported by melt water, spread out beyond the ice margin, especially in the Prior Lake area and within the Minnesota River Valley. These sediments can be found on the north end of SMSC property (Figure 6).

Commonly treated as a single geologic unit, the 150 - 200 feet of glacial sediment serves as a confining unit to the primary domestic water source, the Prairie du Chien - Jordan aquifer. Surficial aquifers can be found in this undifferentiated glacial drift that is primarily composed of gray, calcareous, shale rich, clayey till and contains small inclusions of reddish-brown drift (Aronow and Hobbs, 1982). These surficial aquifers are perched above the potentiometric surfaces of the underlying bedrock aquifers due to the low hydraulic conductivity of the surficial sediments. The local water table is a reflection of these aquifers.

1.3 Topography

The present day topography of tribal lands is very much a product of its glacial past. Within the SMSC, elevations range from a high of 1056 feet above sea level in Big Eagle’s Village to a low of 744 feet above sea level at the far Northeast corner of SMSC land.

The southern portion of the reservation, including both of the casinos and the majority of private residences, sits on top of a glacial moraine that is dotted with steep irregular hills and wetlands. There are many closed basins (kettles) associated with this landscape, which complicates storm water management.

The mainly agricultural northern portion of the reservation sits upon on a series of sand and gravel terraces created when Glacial River Warren flowed through what is now the Minnesota River Valley. This broad, flat landscape contains few streams or wetlands due to the lack of depressions and the porous nature of the sandy soils.

1.4 Soils

The history of glaciations in the region has led to a wide range of soil types. In addition, climate, topographic relief, parent material, time, and biological processes have affected the rate of soil formation. Figure 7 shows a distinct difference in soil development patterns on the river terraces versus development on the moraine. Broad bands of soil have developed on the terraces as opposed to more irregular soil pattern on the moraine. The well drained Estherville, Hayden, and Webster soils dominate the terrace soils. Upland soils are predominantly Hayden and Glencoe soils. Within the numerous depressions are primarily peats and muck soils.

Appendix A describes the most common soils of the SMSC.

1.5 Land Use

Historically, row crop agriculture has been the dominant land use in the area of SMSC. Since 1990; however, the population of the SMSC has increased substantially along with that of the entire Twin Cities metropolitan area. The result of the population growth has been the conversion from agriculture to low or moderate density residential use and commercial development (Figure 8).

Residential housing within the reservation consists of one-acre lots with public connections to water, sewer, gas and electricity. Residential areas include homes with driveways and managed lawns. As with residential areas, commercial land use primarily consists of buildings with associated parking lots and roadways. Natural areas contain a combination of forest, wetland, and grassland, whereas parkland consists primarily of managed turf.

The SMSC provides the water and wasted water treatment for the residents and businesses on the reservation. Power utility is provided by MVEC and SPUC. State licensed private contractors provide garbage utility.

1.6 Surface Water

The SMSC Land department has been conducting water quality sampling of the surface waters during the summer months since 1999. Two lakes, five streams and eight wetlands and three ponds have been sampled in the past and most are still actively monitored (Figure 9).

Water quality data is collected electronically with the aid of a Hydrolab[3], measured parameters include temperature, pH, specific conductivity, total dissolved solids, dissolved oxygen, oxidation-reduction potential, and turbidity. Physical water samples are brought to an EPA certified lab and analyzed for Chlorophyll-*a*, Ammonia, Total Kjeldahl Nitrogen, Nitrate, Nitrite, Total Phosphorus and Ortho-phosphorus. Although all surface waters appear to be impacted by surrounding land uses, this has not resulted in any detectable groundwater contamination.

[3] Hydrolab Surveyor 3 logging system and H20 multi-probe

Surface water quantity is also estimated with the aid of direct measurements. Stream flow rates are measured weekly during the spring summer and fall seasons. Wetland stage is measured at the same time to establish a relationship between the streams and wetlands as well as to provide an indicator for changes within these systems.

1.7 Groundwater

The SMSC utilizes two sandstone aquifers for the public water supply, the Prairie du Chien-Jordan and the Franconia-Ironton-Galesville (FIG); consumption is nearly equally split between these two aquifers. There are also discontinuous glacial drift aquifers that may play a significant role in groundwater recharge.

1.7.1.1 Prairie du Chien/Jordan Aquifers

The Prairie du Chien Group and Jordan Sandstone are often treated as a single hydrostratigraphic unit. The Prairie du Chien in comprised of the Shakopee Formation, a highly eroded limestone deposit which overlies the Oneota Dolomite that is considered to be a leaky confining unit. Below the Oneota Dolomite lies the Jordan Sandstone, a fine to coarse-grained, poorly cemented, quartzose sandstone(Figure 4).

Groundwater moves down through the Prairie du Chien Group in dissolution channels and into the pore spaces of the Jordan Sandstone. The Jordan Sandstone is more important for ground-water supply than the Prairie du Chien Group because it has greater overall permeability than the Prairie du Chien Group.

Two of the three public water supply wells penetrate the Jordan aquifer: the Sioux Trail Jordan well (MN unique well # 525938) and the McKenna Jordan well (MN unique well # 554090) (Figure 10). The McKenna well is the sole source for drinking water in the area it serves, while the Sioux Trail Jordan water is blended with water from the nearby Sioux Trail FIG well.

1.7.1.2 Franconia-Ironton-Galesville Aquifer

The Franconia-Ironton-Galesville aquifer is the deepest of the SMSC's aquifers; it extends approximately 600 feet below the land surface (Figure 4). It underlies the St. Lawrence Formation, which serves as a regional confining bed beneath the Prairie du Chien-Jordan aquifer. The Ironton Sandstone is a fine to medium-grained quartzose sandstone that contains a significant amount of admixed silt-size material. The Galesville Sandstone consists of slightly glauconitic, mostly medium grained quartzose sandstone (1982, Kanivetsky and Palen). The Franconia Formation is made up of very fine grained, glauconitic quartzose sandstone and shale. Beneath the SMSC, this unit has a high enough permeability to transmit a substantial amount of water; it is therefore included in the same aquifer as the Ironton and Galesville sandstones. There is significant lateral heterogeneity in the Franconia-Ironton-Galesville Aquifer system. Eight miles east, in the city of Savage, the Franconia has a much lower permeability.

The Franconia-Ironton-Galesville well contributes approximately half of the drinking water of the residents and businesses of the area. It is the preferred source due to the lower treatment costs for water from the FIG aquifer compared to the water from the Jordan Well.

1.7.1.3 Surficial Aquifers

Surficial aquifers occur in sand and gravel lenses that sit above clay layers. The clay slows the downward flow of the water. The high variability of the sand/gravel and clay layers makes it very difficult to predict groundwater movement throughout these aquifers.

These surficial aquifers are underlain by low permeability till which has extremely low hydraulic conductivity. Vertical migration of surficial aquifer water is virtually nonexistent through the underlying confining beds. The lateral migration of surficial aquifers is likely prohibited from rapid transport by the small pore spaces of the clay till. Surficial aquifers in this area are most often used for livestock operations and production farming.

The Scott County MGS Atlas series shows cross sections through the glacial drift and bedrock units. Line C-C' illustrates the subsurface geology beneath the SMSC (Figure 5). These cross sections illustrate the contact points between several bedrock units and overlying glacial drift aquifers. At these junctions, contaminated water moving down through the glacial drift aquifers has an entry point to the bedrock aquifers. It is important not to overlook the importance of glacial drift aquifers, as they are the go-between for water entering the bedrock aquifers.

The parcel of land northwest of Artic Lake is an area where the Jordan Aquifer is particularly susceptible to contaminants migrating down through glacial drift. At this location, a valley was eroded down through the bedrock to the Jordan Formation and into the Franconia Formation (Figure 3). This valley was later filled with glacial materials. There is no confining layer between glacial drift and the sandstone, this allows the possibility that surface water could move quickly through the drift and into the bedrock aquifers below (Figure 12).

1.8 Groundwater Flow Direction

Because of the geology described above, it is easy to understand why there are two different types of groundwater flow beneath the SMSC. The first type of groundwater flow occurs in the glacial drift aquifers; this is generally thought of as the water table. Lake levels and wetlands are sometimes an expression of this shallow aquifer, which is usually composed of sand and gravel deposits. The Land Department has been monitoring recharge rates in these shallow aquifers. While highly variable due to the heterogeneous nature of glacial drift, the shallow depth of these aquifers allows them to vary up to 30 inches of elevation or more in the span of a week. Groundwater flow is also highly variable due to the composition of the glacial till.

Bedrock aquifers in this region are considered to be confined aquifers, with impermeable rock units above and below them. The water in these aquifers is generally under pressure. When a well is put into this aquifer, the water level rises above the top of the aquifer. This water elevation is called the potentiometric water level.

The Minnesota Department of Health used potentiometric water levels recorded during well drilling to model groundwater flow direction for the Prairie du Chien-Jordan aquifer and for the Franconia Ironton Galesville. The results of this modeling work indicate that locally, groundwater in both aquifers is moving to the north and slightly west.

1.9 Groundwater Budget

The quantity of water in a groundwater system is in constant flux. Groundwater is continually recharged by precipitation infiltrating through surface water systems. Simultaneously, groundwater is discharged to surface waters and subsequently discharged to the atmosphere through evaporation or transpiration. A groundwater budget is a calculation of the quantity of water recharging the groundwater system compared to the quantity being discharged or pumped out. It is a type of mass balance that is based on the fact that matter (including water) cannot be created nor destroyed (Thompson, 1999). This budget can be expressed by (Freeze and Cherry, 1979)

$$Q(t) = R(t) - D(t) + dS/dt$$

where $Q(t)$ = total rate of groundwater withdrawal
$R(t)$ = total rate of groundwater recharge to the basin
$D(t)$ = total rate of groundwater discharge from the basin
dS/dT = rate of change of storage in the saturated zone of the basin

Each groundwater system is unique in the source and quantity of water entering and leaving the system. Unchangeable factors that determine the groundwater recharge and discharge are precipitation, evapotranspiration, geology, soils and topography. Human impacts such as land use decisions can have a significant impact on a groundwater budget. Impervious surfaces cause the precipitation to runoff instead of infiltrating and recharging groundwater supplies. Disproportionately high water use can deplete storage. Determining a water budget for the SMSC is very important. SMSC groundwater use has an impact on neighboring communities.

2 Sensitive Areas for Planning

With the ongoing shift in land use from rural to suburban and urban use, groundwater resources are under increasing stress. Some areas are more sensitive to land use changes than others. The groundwater management policies developed in this plan are particularly important at these locations.

2.1 Drinking Water Supply Management Areas

Generally, the most sensitive areas for planning fall within SMSC Drinking Water Supply Management Areas (DWSMA) and are a required component of the Wellhead Protection Plan. Easily identifiable landmarks bind these areas and they approximate the ten-year-time-of-travel zones around each of the SMSC's three public water supply wells. In these areas, activities occurring on the land surface have a significant chance of impacting the groundwater flowing into the public supply wells. Within these DWSMA, the Wellhead Protection Plan governs land use. Figure 11 illustrates the ten -year time-of-travel zones for the three SMSC wells.

2.2 Areas with High Susceptibility for Aquifer Contamination

There are other areas that are highly susceptible to groundwater contamination due to lack of protective geologic units between the land surface and deep aquifers. Figure 12 shows the location of these areas in Scott County.

Within the SMSC, these areas are not in particularly close proximity to drinking water supply wells; however, groundwater could become contaminated at these locations and subsequently move toward the wells. The parcel of land around Artic Lake is one of these areas. The isolated eastern segment of the reservation is another. At both of these locations, the glacial till sits directly above aquifers used by SMSC as well as surrounding communities.

3 Groundwater Issues

SMSC lands consist of trust and fee land (Figure 8). This is significant because of the laws that must be followed are different for the two lands. The federal government holds Trust lands for the tribe; state and local laws do not apply on such lands. The U.S. Army Corps of Engineers enforces the Clean Water Act (CWA) Section 404 on trust lands. The U.S. EPA regulates Section 401 of the CWA on SMSC trust lands. Fee lands are owned by SMSC, but not held in trust by the federal government. They are therefore subject to federal, state and local laws.

This assessment of issues impacting groundwater quantity and quality uses the goals and objectives set forth in the SMSC's Wellhead Protection Plan as a guide. Because of the limited size of the Wellhead Protection areas, however, this plan contains issues that are not included in the Wellhead Protection Plan. In completing

SMSC Land department will be the primary department responsible for implementation as well as monitoring objectives and policies. The General Council is the primary legislative body with the constitutional power to enact ordinances regulating the environment; however, the Business Council must approve all projects. Funding for these policies could come from tribal or federal sources. Land Department staff intends to solicit funds from appropriate sources on an as-needed basis. The Business Council must approve all proposed projects.

3.1 Water Supply

3.1.1 Quality

The chemical composition of water determines its suitability for consumption. Certain standards are required to define its "quality". Chemical composition is one of the principle criteria for the quality of water. Additional criteria which are considered are: biochemical oxygen demand, chemical oxygen demand, specific conductance, hardness, alkalinity, presence of harmful trace metals, organic compounds, and other properties as required for specific uses.

The quality of water is expressed in terms of certain defined parameters and by the concentration of toxic elements or compounds whose presence may constitute a health hazard to humans, domestic animals and wildlife.

Standards for many of the contaminants that affect either the aesthetic quality or the safety of drinking water have been established. In 1990, Minnesota standards were amended to indicate standards for 53 toxic pollutants. Minnesota groundwater quality can generally be described as calcium-magnesium bicarbonate water. The groundwater commonly contains concentrations of iron and manganese that exceed secondary drinking water limits and recommended allowable limits.

The SMSC drinking water is tested daily for chlorine, fluoride, and iron. The drinking water is also tested monthly for bacteria and is tested on a three-year cycle for volatile organic carbons (VOCs), soluble organic carbon (SOC) and inorganic carbons (IOC). These tests are requested by the EPA and are based on surrounding land uses. There have been no detections of pathogens or the aforementioned chemicals (**Table 1**, **Table 2**, Table 3).

The schedule for groundwater quality testing and treatment at each well can be found in Table 4.

GOAL: Maintain high standards for water quality

PROJECTS:

1. Comply with EPA Safe Drinking Water Act
2. Monitor regularly, keeping abreast to changes in criteria
3. Follow Wellhead Protection Plan procedures
4. Protect groundwater recharge areas through land use planning.

3.1.2 Quantity

The SMSC is entirely dependent upon groundwater for all of its water needs. The amount of water consumed annually for different entities connected to the public water supply, as well projected annual use through the year 2008 is shown in (Figure 13). Three wells currently supply this water and together are capable of maintaining the current demands as well as the projected needs over the next five years. The SMSC is planning on adding a well to the Sioux Trail system in the Jordan Aquifer in the near future to compensate for times when other wells are undergoing maintenance.

3.1.2.1 Sioux Trail Wells

The increases in the commercial water use from 1994-1997 were due to rapid commercial development. This rate of commercial growth is not expected to occur in the future. The Sioux Trail Jordan well supplies water to approximately 117 residences, several businesses and two casinos.

In the first years of use, the Franconia-Ironton-Galesville acted as a supplementary well, supplying up to 40% of the water in the Sioux Trail System. More recently, the FIG Well has become a primary water source for the SMSC. Because it has only been online since 1999, Land Department staff does not have a lot of data regarding water use for this well.

3.1.2.2 McKenna Well

Annual water use for the McKenna well has more than doubled over the 5-year period of record. The McKenna well currently provides drinking water to 73 residences. An education campaign is underway in an attempt to decrease non-consumptive water uses.

GOALS:

- Stabilize or decrease at least the amount of water use per user.
- Reduce peak pumping rates
- Encourage the adoption of conservative water technologies to future development projects.

PROJECTS:

1. Continue to require new construction to install low flow toilets and faucets as required in the building code
2. Provide assistance to residents about efficient lawn watering and work with irrigation companies to inform them of watering ordinances
3. Investigate restricted watering schedules as an alternative
4. Implement ordinances for water conservation
    - Evapotranspiration sensors required for automatic irrigation systems.

3.2 Public, Private and Abandoned Water Wells

The largest and most readily available source of information on wells, well construction, and subsurface geology is water-well records. Prior to 1974, most drilling contractors kept their own records on wells they had drilled. In 1974, legislation was enacted requiring that logs for all new water wells be submitted to the Minnesota Department of Health. The required information includes location data, owner's name, use, construction information, and geologic materials description.

The areas of concern related to wells are: correct initial well construction, multiple aquifer bedrock wells, proper operation/management, and appropriate sealing of inactive wells.

Figure 10 identifies the locations of all wells on or near SMSC property.

GOAL: Limit and/or reduce the number of wells on or near SMSC property in order to restrict the number of pathways for contaminants to reach groundwater supplies.

PROJECT:

1. Implement an abandoned well inventory and seal all abandoned wells.
2. Consider offering neighboring residents (on a case by case basis) a grant to insure that any nearby abandoned wells are sealed.

3.3 Aboveground and Underground Storage Tanks

Underground storage tanks (USTs) have been recognized as sources of pollution to both soil and groundwater. In the mid 1980's the Environmental Protection Agency (EPA) and the MPCA began programs to identify and correct leaking USTs in response to increased awareness of USTs as pollution sources. Regulations controlling the installation of new tanks, tank standards and the operation, management, and monitoring of old tanks have been established federally and by the State. The locations of these above and underground tanks can be seen in Figure 14.

GOAL: Prevent any storage tank from leaking and if a leak occurs, prompt repair and prevention of the contaminant from seeping into the ground.

PROJECTS:

1. Inform tank owners of maintenance issues and require them to monitor tanks and upgrade if necessary.
2. Require spill containment on tanks.
3. Require yearly report from all tank owners.
4. Continue to provide education opportunities for SMSC employees who operate and maintain storage tanks

3.4 Geothermal Energy Systems

Modern construction methods often seek ways to reduce energy costs or pursue energy solutions that are less tied to carbon based fuels. One method is geothermal assisted climate control measures in which the relatively stable temperature of the Earth's crust is used to regulate the temperature of a building's air or water systems. In this situation, a well or wells are drilled and liquid is pumped down the hole and back up in an effort to bring it to the temperature of the underlying ground. This liquid is then used in a heat exchanger to transfer its energy to a secondary medium.

This method has been utilized in a few building projects over the last year. Care should be taken during installation, maintenance and removal of these systems to ensure that the groundwater quality is preserved.

GOAL: Prevent geothermal energy systems from negatively impacting groundwater quality

PROJECT:

1. Develop guidelines for geothermal installation, use and removal

3.5 Storm Water

3.5.1 Infiltration

Precipitation functions to water vegetation and recharge lakes, streams and aquifers; unfortunately, if it is unable to infiltrate quickly, it becomes storm water runoff. The results of water draining across the land surface are erosion, flooding and water quality degradation. The degradation of surface water may also eventually lead to the contamination of groundwater supplies.

The historical management of urban and rural runoff focused primarily on flooding. In urban areas, impervious surfaces (such as roof tops, streets, parking lots and sidewalks) can generate large quantities of storm water runoff with associated pollutants. In rural areas, tile drains and ditches are designed to quickly remove water from agricultural fields.

In recent years, concern about the quantity and quality of runoff has increased. Storm water runoff has been identified as a significant contributor of pollutants to lakes, streams and wetlands. Groundwater can also be affected in highly sensitive areas. On SMSC lands, this is a particularly important issue near Artic Lake and the east parcel, due to the close connection between surface and groundwater at that location.

Water percolates through the subsurface, which acts as a purifying system, and protects groundwater resources. As the amount of impervious surface increases with the development in the SMSC, percolation is reduced. Water moves across impervious surfaces and into constructed storm-water ponds or wetlands carrying pollutants it picks up on the way. Once in the pond or wetland, this contaminated water may move through the subsurface into an aquifer.

3.5.2 Ponding

When storm water enters a retention pond, it deposits a large portion of the sediment and other contaminates carried by the storm water. Ponds operate as collectors for these pollutants, if water is allowed to infiltrate at these locations, many of these pollutants will be carried along, eventually into an aquifer.

GOALS:

- Encourage construction designs that promote storm water infiltration systems and reduce overland flow.
- Prevent untreated storm water infiltration at storm water ponds located within the DWSMAs.
- Reduce the amount of polluted water entering ponds.

PROJECT:

1. Closely examine and review water ponding and encourage the reuse of water in the SMSC to protect surface and groundwater quality and quantity.
2. Carefully manage land use around Artic Lake with consideration for the sensitive nature of the underlying bedrock
3. Encourage infiltration designs on new development

3.6 Lawn and Garden Chemicals

Population growth has resulted in an increase in the number of new homes being built on SMSC land. Because of this trend, the potential for contamination from lawn and garden chemicals is as significant as the threat from agricultural chemicals, and it will soon become the primary concern in the area. Unlike agricultural application of chemicals, most homeowners do not test their soil to determine minimum application rates for fertilizers and pesticides. In many cases, an excessive amount of chemicals is applied to turf. This excess does not stay on the soil surface, but is washed off the lawn and into the nearest storm drain, which in turn leads directly to the nearest water body.

Improved management of the amount, timing and type of chemicals applied to the soil can minimize the potential for groundwater contamination. Most soils in this area have sufficient phosphorus. More efficient use of fertilizers and pesticides can be realized through the use of voluntary best management practices (BMPs), integrated pest management (IPM), and sustainable agriculture.

GOAL: Maintain background levels of Phosphorus and Nitrogen in streams and wetlands. Reiterate to landowners the water related concerns associated with the use of these and other common lawn and garden chemicals.

PROJECTS:

1. Distribute educational materials.
2. Implement free soil testing and assessment program and encourage application of correct chemical concentrations.
3. Strive to eliminate phosphorus application on non-agricultural lands.

3.7 Septic Systems

There are only a couple of individual sewage treatment systems near SMSC lands. The majority of area residents are connected to the Metropolitan Urban Service Area (MUSA) - Blue Lake Wastewater Treatment Plant governed by the Metropolitan Council. As the City of Prior Lake expands its utility systems, these septic systems will be phased out. Almost all of the SMSC residents are now connected to the SMSC Water Reclamation Facility, those that are not either use MUSA or the City of Prior Lake.

GOAL: Monitor these septic systems to ensure that they are maintained properly. Ideally these systems will be eliminated in the near future.

PROJECTS:

1. Provide information to residents about proper septic system maintenance.
2. Investigate the cost of sewer hook-ups for these residents.

3.8 Hazardous Waste, Landfills and Illegal-dumping Areas

Hazardous wastes include solvents, paints, chemicals, acids, oil, lead, acid batteries, heavy metals, and many other substances. These products require special handling, transport, and disposal. Locations where hazardous materials are currently handled, or have been handled in the past, need to be assessed to determine if they are contaminated and, if they are, they need to be prioritized for cleanup.

There is one abandoned landfill on SMSC land, near the Community Center as well as a number of small, illegal-dumping areas on SMSC grounds. As the cost of disposing household wastes increases, illegal dumping may also increase. Local residents need to work together to prevent illegal dumping on SMSC property.

GOALS:

- Reduce the amount of trash produced and ensure that all trash is disposed of in a proper location.
- Ensure that hazardous materials do not end up in the groundwater by ensuring proper disposal. Also, reduce the amount of hazardous waste produced.

PROJECT:

1. Educate residents of the dangers of mishandling hazardous waste.
2. Provide information about the SMSC hazardous waste facility.
3. Educate residents about reducing, reusing and recycling, the benefits of composting, and the problems that may occur as a result of improper dumping
4. Encourage use of the SMSC compost facility

3.9 Feedlots

MNPCA defines a feedlot as "...a lot or building or group of lots or buildings intended for the confined feeding, breeding, raising, or holding of animals." This definition also includes areas specifically designed for confinement in which manure may accumulate or any area where the concentration of animals is such that a vegetative cover cannot be maintained. Pastures are generally not considered feedlots."

The SMSC is seeing a decrease in agricultural and farming activities, so this has become less of an issue over time. Currently there is one feedlot that borders SMSC lands. The stream that flows thru the feedlot is monitored for quantity on a weekly basis and for quality during the summer along with the other sites.

GOAL: Ensure that the feedlot does not impact water quality.

PROJECTS:

1. Monitor stream discharge and quality - alert Scott County if contaminant levels become severe.

4 Information Management (Databases and Public Education)

4.1.1 Data Collection/Management

Many of the objectives in this plan involve gathering additional information about the groundwater and the land uses that impact water quality. To be useful, this information must be stored in such a way that anyone involved with land and water management can access it quickly. Furthermore, information should be provided for users in formats compatible with standard systems. Local, regional, and state governments need to work together to share information to avoid duplication of efforts and wasteful spending. The SMSC has organized their data, including maps and databases, in formats compatible with county, state and federal agencies.

4.1.2 Public Education

Because the quality of SMSC water resources is closely linked to land use activities, education is a vital part of any groundwater protection plan.

GOAL: Educate SMSC members about water quality issues.

PROJECTS:

1. Maintain current land use data in easy-to-use formats for sharing with other departments, organizations and SMSC Members
2. Keep the Land Department website current with annual updates
3. Write a variety of articles each year for printing in the AIPI OAYE

4. Work with the Education Department to involve community member children in Land Department activities

5 Implementation Strategy

5.1 Role of the SMSC in Plan Implementation

SMSC has developed a comprehensive implementation program to accomplish the objectives outlined in this plan. The SMSC hopes to accomplish these objectives directly; however, they require the commitment and cooperation of municipalities and other local units of government. The implementation plan identifies existing private, state and federal programs available for assistance in identifying and resolving problems, as well as funding. A suggested timetable for implementation is included as Table 4. Implementation may vary from this table based upon objective priority, ease of implementation, available staff and financial resources.

The implementation program is designed to provide the SMSC Business Council with a realistic framework for protecting the SMSC's water resources while maintaining the flexibility to operate within the constraints of the SMSC's funding.

SMSC is aware of the importance of groundwater planning and recognizes that the county, township and city governments must also play a key role in local groundwater planning. Scott County also recognizes that future requests for state or federal funding to support water related activities in the County would be reviewed in the context of the SMSC's groundwater plan and its initiatives.

The units of government that implement land use planning are responsible for developing local groundwater management plans; therefore they are also responsible for the incorporation of groundwater issues into the local water plan. The SMSC must work with surrounding units of government and local residents to ensure the full protection of local groundwater quality and quantity.

5.2 Role of SMSC Departments and Associated Companies in Program Implementation

The full implementation of this plan will require cooperation between a number of SMSC departments, SMSC businesses and residents, and city and county governments. Table 4 lists those that are most likely to be the lead organization or department in charge of implementing the objective(s) indicated.

The entity that will work initially to develop and implementation strategy is also identified in **Error! Reference source not found.**. This entity will not necessarily be the same as the one responsible for the implementation of an objective. The program developer and the program implementer will work together to accomplish the objective. The initial program development could involve efforts that go beyond the scope and ability of the implementing agency.

It is hoped that everyone will be able to incorporate implementation strategies into their daily activities. For instance, building inspectors could be trained to identify and report improperly abandoned wells and storage tanks during the course of their routine business. Local government personnel are generally the most familiar with the activities that take place within their jurisdiction. This should give them an advantage in implementing the objectives in this plan.

5.3 Role of other Agencies and Institutions in Program Implementation

State and Federal agency involvement is critical for a number of objectives identified in the plan. Scott County recognizes that the costs and expertise required to correct many of the problems identified in this plan are beyond the financial resources of the SMSC. The SMSC will develop and maintain ongoing working relationships with all state and federal agencies involved in SMSC water planning issues.

There are many organizations in Minnesota at the local, regional, State and Federal levels that are involved with water and land issues either in a regulatory capacity, or through education and information development. The resources provided by many of these organizations will be helpful during the implementation of this groundwater plan. These organizations include:

- City of Prior Lake
- City of Shakopee
- Scott County
- Minnesota Rural Watershed Association
- Minnesota Geological Survey
- Minnesota Pollution Control Agency
- Minnesota Department of Natural Resources
- Minnesota Department of Health
- Minnesota Board of Soil and Water Resources
- U.S. Environmental Protection Agency

5.4 Implementation Schedule

The implementation schedule was developed by prioritizing each objective relative to the concern expressed by the Land Department, the ease of implementation, and whether or not programs were already in place Table 4. The relationships between individual objectives were then examined to determine which objectives could be implemented together and how much time is needed to complete an objective.

The Land Department hopes to implement all of the objectives outlined in the plan; however, implementation is contingent upon the approval by the Tribal Council and/or available funding.

Some objectives in this plan are dependent upon the prior implementation of other objectives. If an objective requires more time to accomplish than expected, implementation of subsequent objectives may need to be postponed. As new concerns or priorities develop, this schedule will need to be re-assessed. Accomplishments will be examined on a yearly basis and the schedule will be revised as needed.

6 Groundwater Plan Amendment Process

The Groundwater Management Plan is intended to extend through the year 2014. The plan should be updated at least every five years as well as with revisions to the Wellhead Protection Plan. The SMSC will propose amendments before the end of any calendar year.

Notice of public hearing on proposed plan amendments and a description of the amendments shall be published by the SMSC in at least one legal newspaper in Scott County. Publication shall occur at least 10 days before the hearing. Notice shall also be given at least 30 days before the hearing to all SMSC residents and businesses, Scott County, Metropolitan Council, Prior Lake/Spring Lake Watershed District, MN DNR, MPCA, MDH, and BWSR. At the hearing, the SMSC will solicit comments on the proposed plan amendments. These comments will be reviewed for incorporation into the plan.

7 Conflict Resolution

At this time, no conflicts exist between the SMSC Groundwater Protection Plan and the plans of neighboring local units of government. If conflicts should arise, they may be addressed in an informal or formal resolution process.

References

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8 Tables

Table 1 McKenna Jordan Well Drinking Water Sample Analysis Results

Chemical	Date	Units	Result	EPA MCL (Maximum Contaminant Level)
Copper	9/07	mg/L	0.78	1.3
Lead	9/07	mg/L	ND	0.015
Barium	9/06	mg/L	0.151	2.0
Radionuclide	11/03	pCi/L	5.8	15.0
Radium 226	11/03	pCi/L	0.79	5.0
Nitrates/Nitrites	9/08	mg/L	0.05	10.0
Fluoride (340.2)	5/98	mg/L	0.15	2.0
Sulfate (375.4)	5/98	mg/L	4	250
Total Dissolved Solids (160.1)	5/98	mg/L	265	500
Barium (200.7)	5/98	mg/L	0.163	2.0
Iron (200.7)	5/98	mg/L	0.429	0.3
Manganese (200.7)	5/98	mg/L	0.167	
Beryllium (210.2)	5/98	mg/L	0.00008	0.004
Lead (239.2)	5/98	mg/L	0.0019	0.015
Silver (272.2)	5/98	mg/L	0.00035	0.1

Table 2 Sioux Trail Jordan Well Drinking Water Sample Analysis

Chemical	Date	Units	Result	EPA MCL (Maximum Contaminant Level)
Copper	9/07	mg/L	0.95	1.3
Lead	9/07	mg/L	0.0008	0.015
Barium	9/06	mg/L	0.061	2.0
Radionuclide	11/03	pCi/L	4.5	15.0
Radium 226	11/03	pCi/L	0.72	5.0
Nitrates/Nitrites	9/08	mg/L	0.08	10.0
Fluoride (340.2)	5/98	mg/L	0.20	2.0
Sulfate (375.4)	5/98	mg/L	6	250
Nitrate	5/98	mg/L	0.03	10
Total Dissolved Solids (160.1)	5/98	mg/L	311	500
Barium (200.7)	5/98	mg/L	0.476	2.0
Iron (200.7)	5/98	mg/L	1.627	0.3
Manganese (200.7)	5/98	mg/L	0.283	0.05
Arsenic (206.2)	5/98	mg/L	0.0056	0.05
Cadmium (213.2)	5/98	mg/L	0.00053	.005
Silver (272.2)	5/98	mg/L	0.00043	0.1
Calcium (215.1) Magnesium (242.1)	5/98	mg/L mg/L	71.0 29.0	
Sodium (273.1)	5/98	mg/L	4.60	250
Potassium (258.1)	5/98	mg/L	3.00	
Gross Alpha	5/98	pCi/L	15.6	15.0
Gross Beta	5/98	pCi/L	14.0	50.0

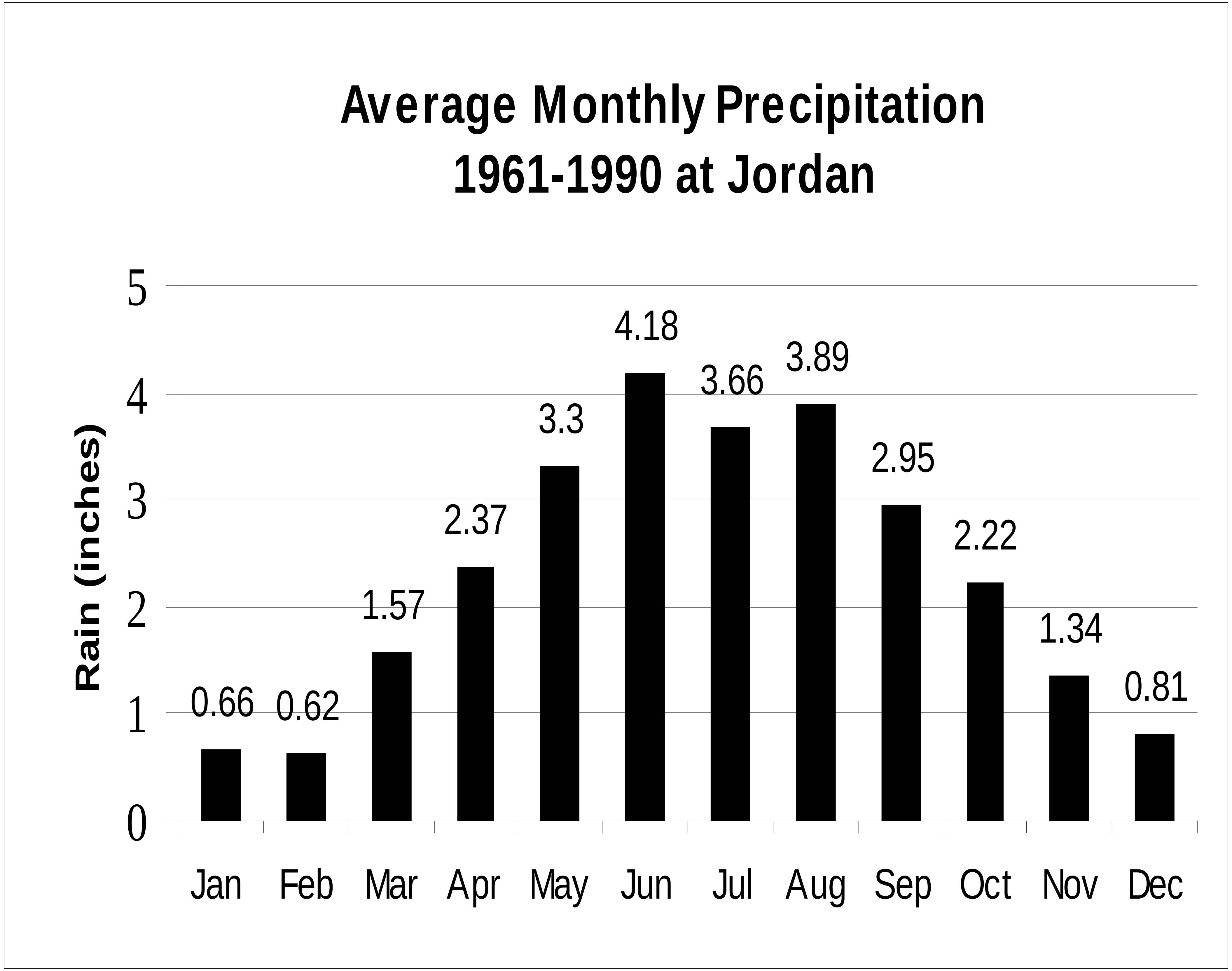
Table 3 Sioux Trail Franconia-Ironton-Galesville Well Drinking Water Analysis

Chemical	**Date**	**Units**	**Result**	**EPA MCL (Maximum Contaminant Level)**
Copper	9/07	mg/L	0.95	1.3
Lead	9/07	mg/L	0.0008	0.015
Barium	9/06	mg/L	0.061	2.0
Radionuclide	11/03	pCi/L	4.5	15.0
Radium 226	11/03	pCi/L	0.72	5.0
Nitrates/Nitrites	9/08	mg/L	0.08	10.0
Benzene (502.2)	9/98	ug/L	0.2	5.0
Chloroform (502.2)	9/98	ug/L	0.6	
Methylene Chloride (502.2)	9/98	ug/L	1.3	5.0
Toluene (502.2)	9/98	ug/L	0.9	1000
Trichlorethene (502.2)	9/98	ug/L	2.5	5.0
Total Trihalomethanes (502.2)	9/98	ug/L	0.6	100
Arsenic (206.2)	9/98	mg/L	0.002	0.05
Barium (200.7)	9/98	mg/L	0.05	2.0
Boron (200.7)	9/98	mg/L	0.14	
Calcium (200.7)	9/98	mg/L	110	
Fluoride (300.0)	9/98	mg/L	0.23	2.0
Hardness, Total (200.7)	9/98	mg/L	420	
Iron (200.7)	9/98	mg/L	0.8	0.3
Manganese (200.7)	9/98	mg/L	0.06	0.05
Magnesium (200.7)	9/98	mg/L	36	
Sodium (200.7)	9/98	mg/L	7	250
Total Dissolved Solids (160.1)	9/98	mg/L	430	500
Sulfate (300.0)	9/98	mg/L	58	250
Turbidity (180.1)	9/98	NTU	11	0.5-1.0
Zinc (200.7)	9/98	mg/L	0.01	5.0
Gross Alpha (900.0)	9/98	pCi/L	12±4	15
Gross Beta (900.0)	9/98	pCi/L	12±2	50

Table 4. Plan implementation and Lead SMSC Agencies

Issue	Project	Timeframe	Lead agency
Water Supply			
Quality	1	Ongoing	Public Works
	2	Test dependant (daily/monthly)	Public Works
	3	Ongoing	Land Department
	4	As needed	Business Council
Quantity	1	Ongoing	Business Council
	2	Annually	Land Department
	3	Within 18 months	Land Department
	4	Ongoing	Business Council
Public, Private and Abandoned Water Wells			
	1	As needed	Land Department
	2	Within 18 months	Land Department
	3	As needed	Business Council
Storage Tanks			
	1	Annually	Land Department
	2	As needed	Business Council
	3	Annually	Land Department
	4	Every 2 years	Land Department
Geothermal Energy Systems			
	1	Within 18 months	Land Department
Storm Water			
	1	As needed	Land Department
	2	During development	Business Council
	3	Ongoing	Land Department
Lawn and Garden Chemicals			
	1	Annually	Land Department
	2	Upon request	Land Department
	3	Ongoing	Land Department
Individual Sewage Treatment Systems			
	1	Within 12 months	Land Department
	2	As needed	Public Works
Hazardous Waste Handling and Transport			
	1	Within 18 months	Land Department
	2		
	3		
	4		
Feedlots			
	1	When possible	Land Department
Public Education			
	1	Ongoing	Land Department
	2	Annually	
	3	Quarterly	
	4	Annually	

9 Figures



SMSC GWMP

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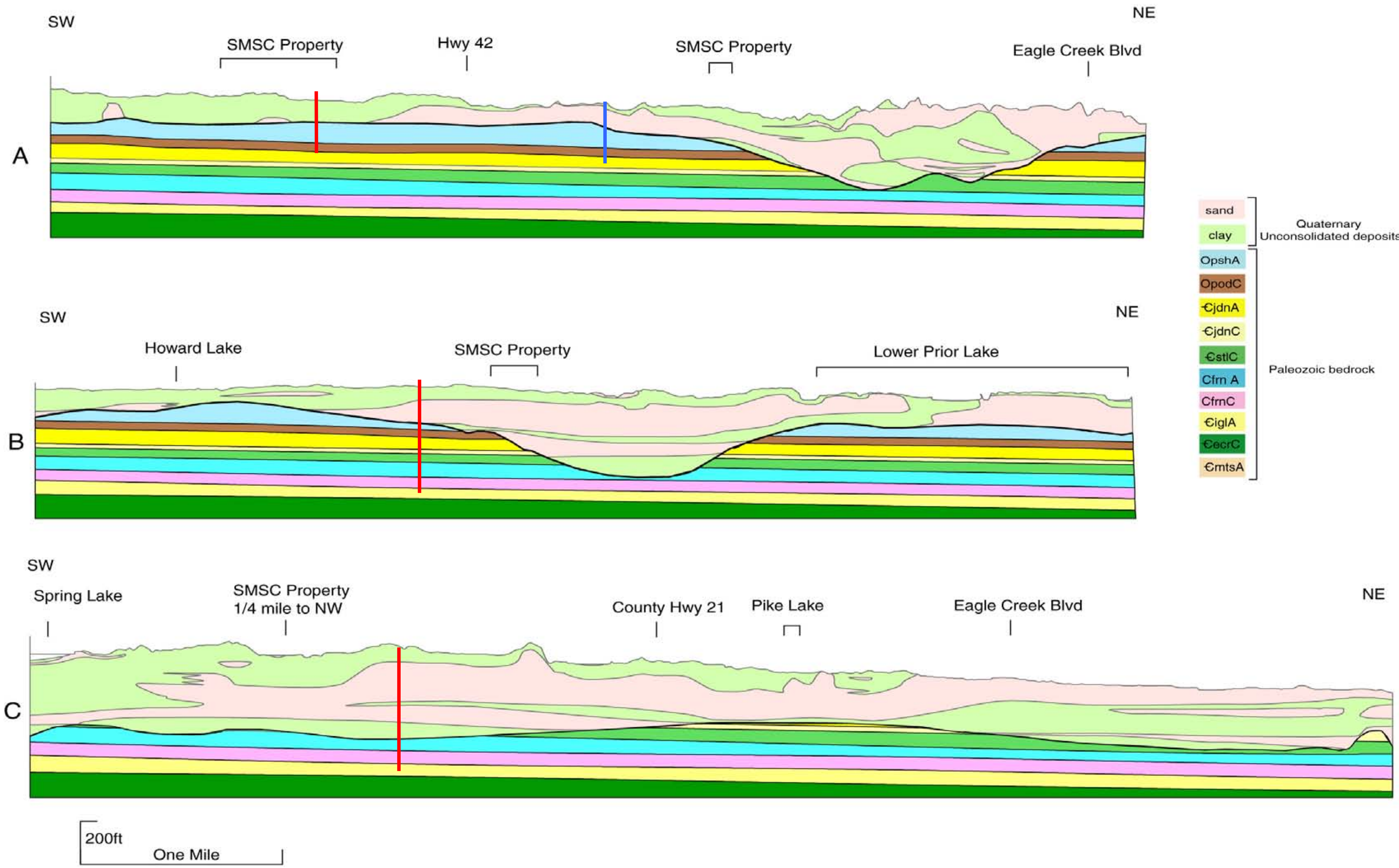
Prior Lake, Minnesota 55372

Figure 1

Normal Precipitation

SMSC GWMP



Legend

OpshA – Prairie du Chein group Shakopee

OpodC – Prairie du Chein Oneota

CjdnA/C – Jordan

CstlC – St Lawrence

CfmA/C – Franconia

CiglA – Ironton Galesville

Cerc – Eau Claire

CmtsA – Mt. Simon

McKenna well

Sioux Trail wells

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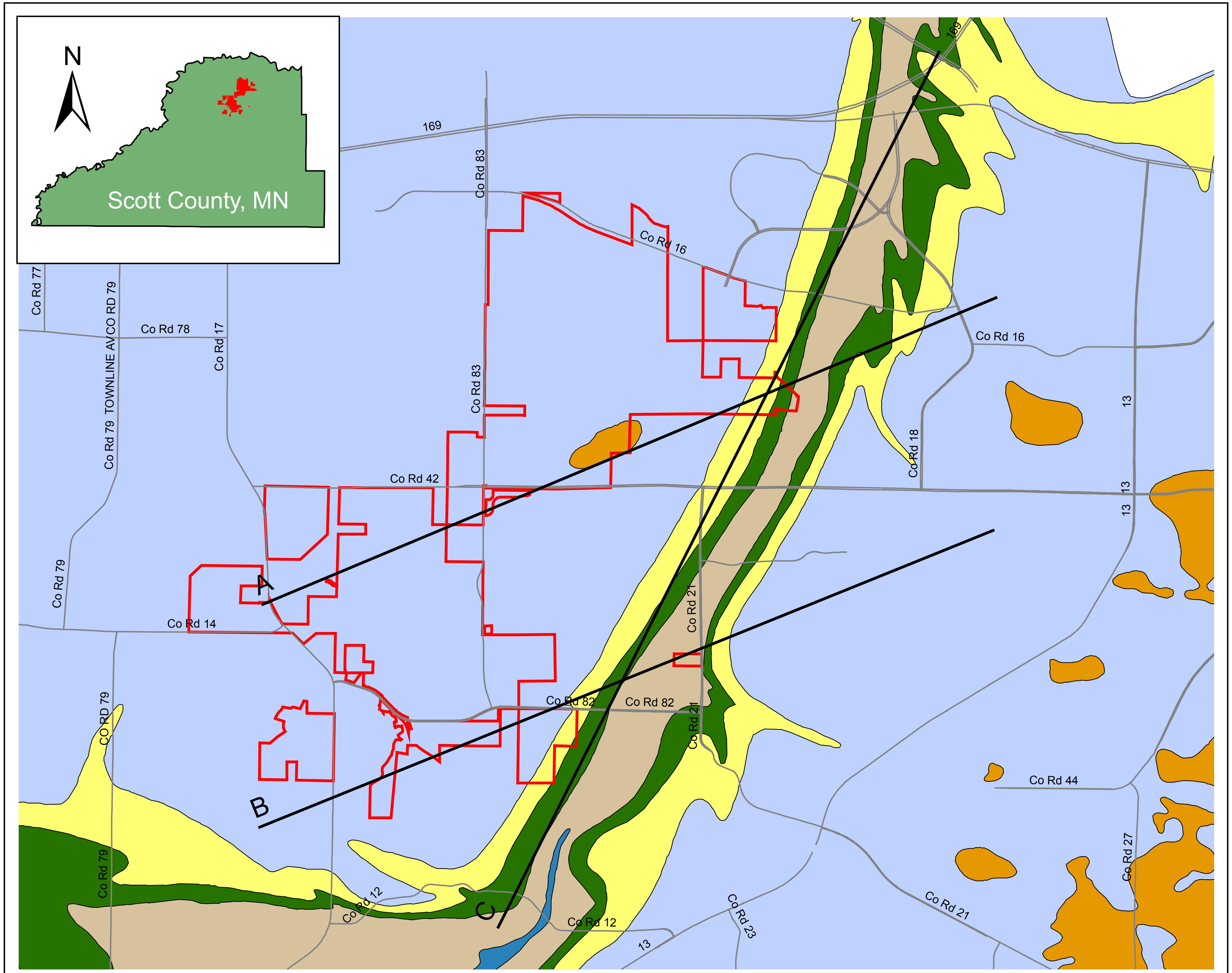
Figure 2

Geologic Cross Sections



SMSC GWMP

Legend

- Cross Sections
- Major Roads
- SMSC Boundary
- St. Peter sandstone
- Prairie du Chien Group
- Jordan sandstone
- St. Lawrence formation
- Franconia formation
- Ironton_Galesville SS

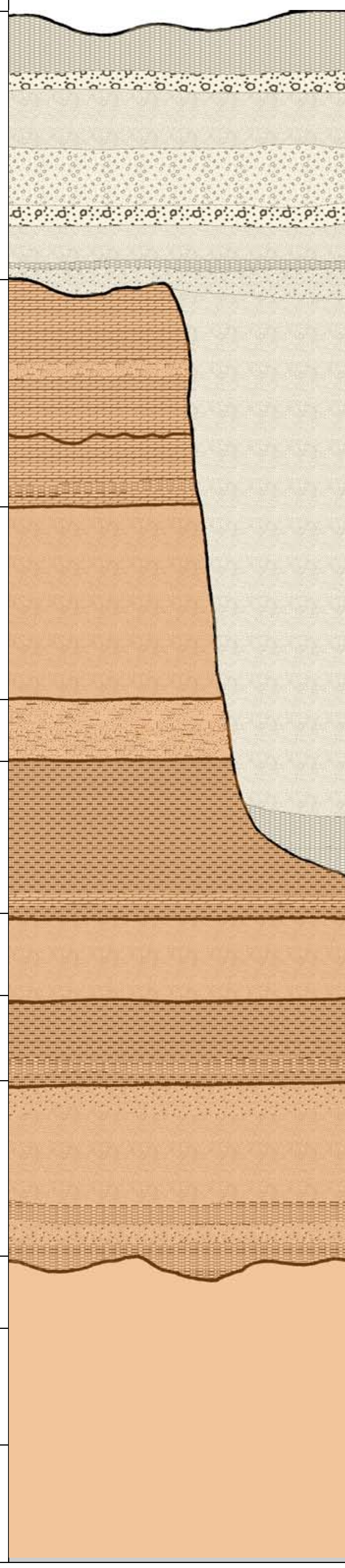
0 0.5 1 2
Miles

Updated 1/29/2009
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Figure 3

Regional Bedrock

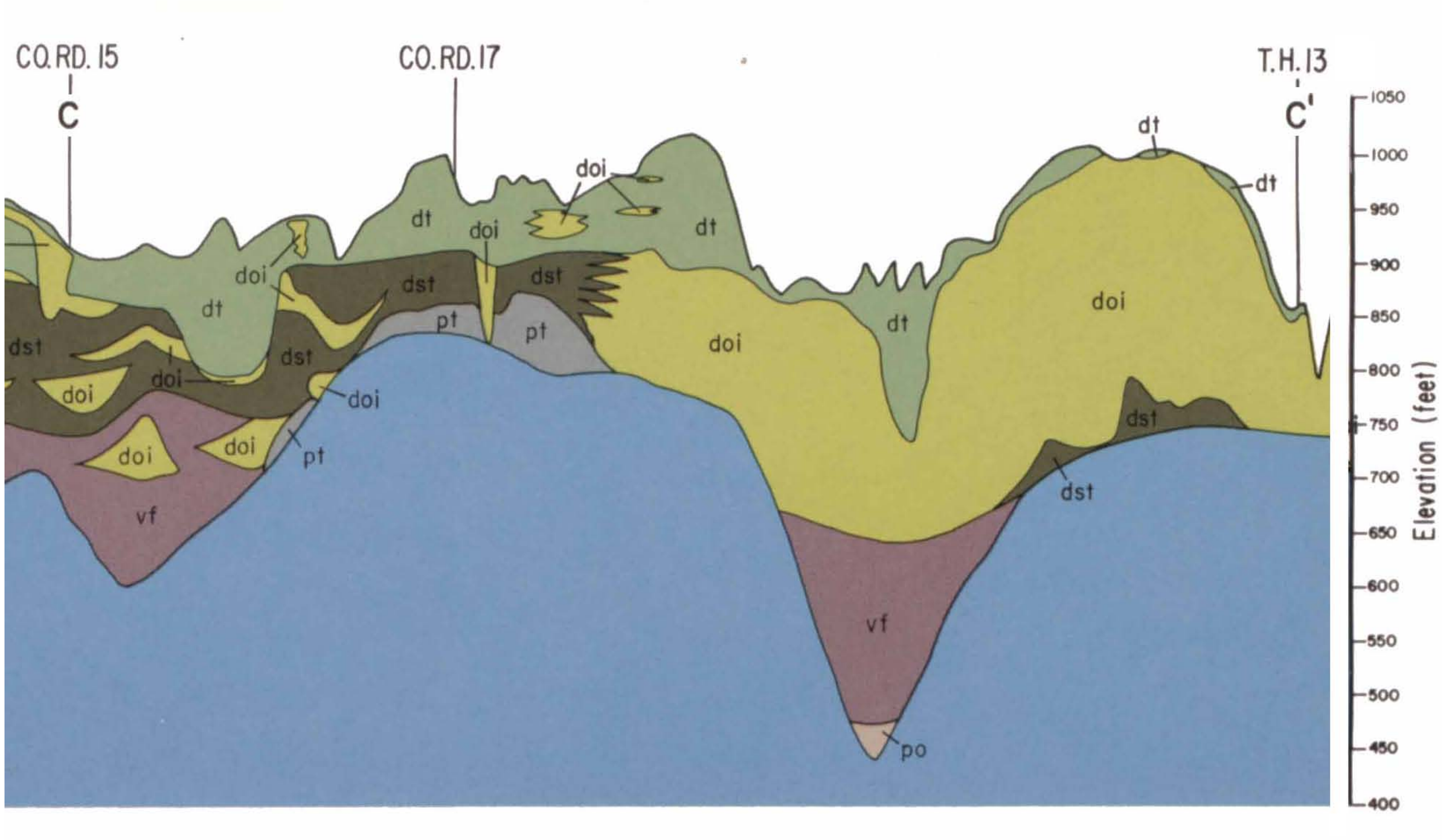
Hydrostratigraphy of the Shakopee Mdewakanton Sioux Community
Scott County, Minnesota

Erathem	System or Series	Formation Or Group *Map Symbols*	Thickness (ft) at SMSC FIG wells	General Lithology near SMSC	Hydrogeologic Unit and Water-bearing Characteristics
Cenozoic	Quaternary	Unconsolidated Glacial Sediments	145-252		**UNCONSOLIDATED QUATERNARY AQUIFER OR CONFINING UNIT** *Horizontal Hydraulic Conductivity (K) (ft/d): 1.61 – 137.14 (Wuolo 2004)* *Sand and Gravel Horizontal K (ft/d): 25 (from grain size analysis of local sediment core)* *Recharge Rates (ft/d): 0.0018 – 0.0019 (Ruhl et al 2002)* Glacial drift serves as a confining unit to the underlying Prairie du Chien - Jordan aquifer. Drift includes outwash, ice-contact, till, lake, terrace, and valley fill deposits. Surficial aquifers can be found in sand and gravel lenses that sit above lower permeability till, where the low hydraulic conductivity of the till prohibits vertical migration of surficial aquifer water. Lateral migration of ground water is likely prohibited from rapid transport by the small pore spaces of the clay till. The local water table is a reflection of these aquifers.
Paleozoic	Lower Ordovician	Prairie du Chien Group *Op*: Shakopee Formation	88-144		**SHAKOPEE PARTIALLY-CONFINED AQUIFER:** *Horizontal K (ft/d): 163 (Runkel et al 2003); up to 1,000+ (Stobel & Delin 1996)* *Vertical K (ft/d): 1.75 (Runkel et al 2003)* *Leakage (ft/d): 0 - .0027 (Ruhl et al 2002)* Hydraulic conductivity is primarily due to joints, fractures, and solution cavities in the sandy, dolomite.
		Prairie du Chien Group *Op*: Oneota Dolomite			**ONEOTA LEAKY CONFINING UNIT:** *Horizontal K (ft/d): 7.5 x 10^{-3} (Runkel et al 2003)* *Vertical K (ft/d): 1.5 x 10^{-4} (Runkel et al 2003)*
	Upper Cambrian	Jordan Sandstone *Cj*	100-181		**JORDAN CONFINED AQUIFER:** *Horizontal K (ft/d): 31 (Ruhl 1999); 25.1 - 40.7(Stobel & Delin 1996)* *Transmissivity (ft^2/d): 6,267 (Ruhl 1999); 4,710 - 7,660 (Stobel & Delin 1996)* *Storativity: 1.193 x 10^{-4}(Ruhl 1999); 8.24 x 10^{-5} - 1.6 x 10^{-4}(Stobel & Delin 1996)* *Ratio of Vertical to Horizontal K: 5.29 x 10-4 (Ruhl 1999)* Hydraulic conductivity is primarily due to flow between course sand grains.
		St. Lawrence Formation *Cs*	45-58		**ST. LAWRENCE LEAKY CONFINING UNIT:** *Vertical K (ft/d): 7.9 x 10^{-5} - 4.6 x 10^{-4} (Kanivetsky 1998); 10^{-5} - 0.1(Stobel & Delin 1996); 0 .328 (Wuolo 2004).* Glauconitic quartz sandstone & shale w/occasional dolomite.
		Franconia Formation *Cf*: Reno & Tomah Members	130 - 150		**UPPER FRANCONIA CONFINED AQUIFER:** *Horizontal K (ft/d): <30 – 1,000 (Runkel et al 2005); 1.3 – 7.5 (Runkel et al 2006)* Bedding plane fracture dominates flow.
		Franconia Formation *Cf*: Birkmose Member			**LOWER FRANCONIA CONFINING UNIT:** *Vertical K (ft/d): 10^{-3} - 10^{-5} (Runkel et al 2006)*
		Ironton & Galesville Sandstones *Cig*	65-77		**IRONTON-GALESVILLE CONFINED AQUIFER:** *Horizontal K (ft/d): 10 – 14.4 (Winterstein 2005); 1.6 – 7.9 (Runkel et al 2006)* *Transmissivity(ft^2/d): 450-650 (Wintersten 2005)* *Storage coefficient: 4.2 – 5.7 x 10^{-5} (Winterstein 2005)*
		Eau Claire Formation *Cec*	65-80 (USGS)		**EAU CLAIRE CONFINING UNIT** *Horizontal K (ft/d): 0.3 to 3.1(Hunt et al 2003)* The unit consists of interbedded siltstone, mudstone and shale with scattered beds of very fine-grained quartzose sandstone (Hunt et al 2003).
		Mt. Simon Sandstone *Cms*	140-165 (USGS)		**MT. SIMON – HINCKLEY CONFINED AQUIFER** *Horizontal K (ft/d): 4.9 (Hunt et al 2003)* Medium to coarse-grained, poorly cemented quartzose sandstone may contain pebbles to granules of quartz in lower 20' as well as thin beds of mudstone. Fine to coarse-grained quartzose sandstone of the Hinckley sporadically overly the interbedded shale and arkosic sandstone of the Fond du Lac Formation (Stobel & Delin 1996).
Precambrian	Middle Proterozoic	Hinckley & Fond du Lac Formations *MPs*	>1000 (USGS)		
		Solor Church Formation	>1000 (USGS)		**PRECAMBRIAN BASEMENT CONFINING UNIT** The Hinckley and Fond du Lac Formations are composed of interbedded mudstone, siltstone and lithic sandstone (Stobel & Delin 1996). Underlying basalt flows have been largely inferred from gravity and magnetic studies (Stobel & Delin 1996).
		Chengwatana Volcanic Group *MPc*	>1000 (USGS)		

Legend

- Dolomite
- Limestone
- Shale
- Sandstone
- Crystalline Basement
- Gravel/Boulders
- Sand
- Clay

Figure 4. Generalized hydrostratigraphic column showing regional aquifers and confining units in the SMSC area. Approximate unit thicknesses are based on logs from SMSC FIG wells. Formation symbols refer to maps and cross-sections found throughout this report. The general geometry of the buried bedrock valley east of the SMSC is illustrated.



SMSC GWMP

Legend

do – outwash deposits
di – ice-contact stratified drift
doi – sand and gravel (combination of do and di)
dp – till forming plateaus
dpc – till covered by ice walled-lake deposits
dt – till
dst – mixture of gray and reddish-brown tills
vf – valley fill sediments
po – outwash sand and gravel
pt – compact clayey till

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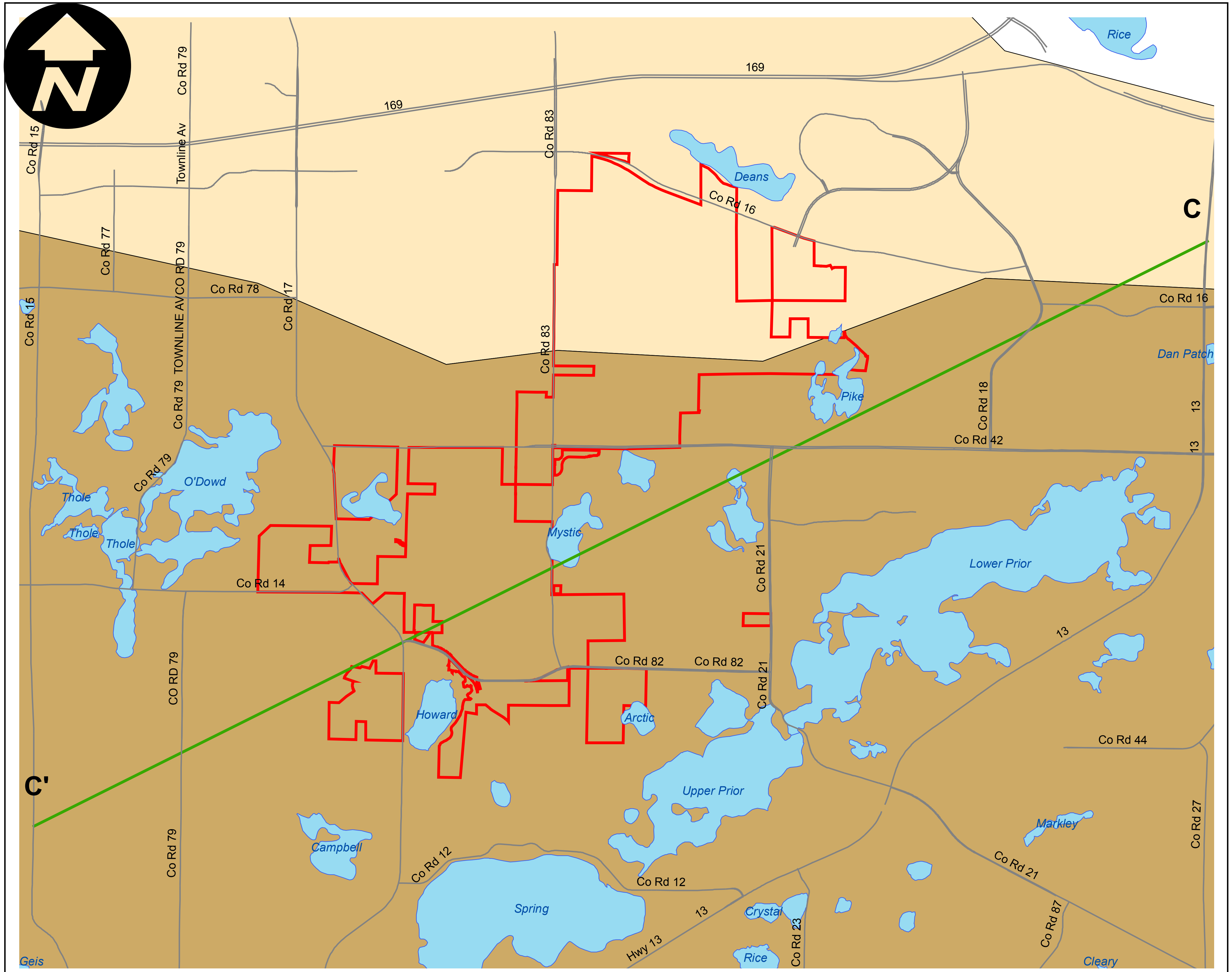
Figure 5

Geologic Cross Section - Quaternary



SMSC GWMP

Legend

- Major Roads
- Cross Section C-C`
- SMSC Boundary
- Glacial Moraine (Till)
- Glacial Outwash Terrace

0 0.5 1 2
Miles

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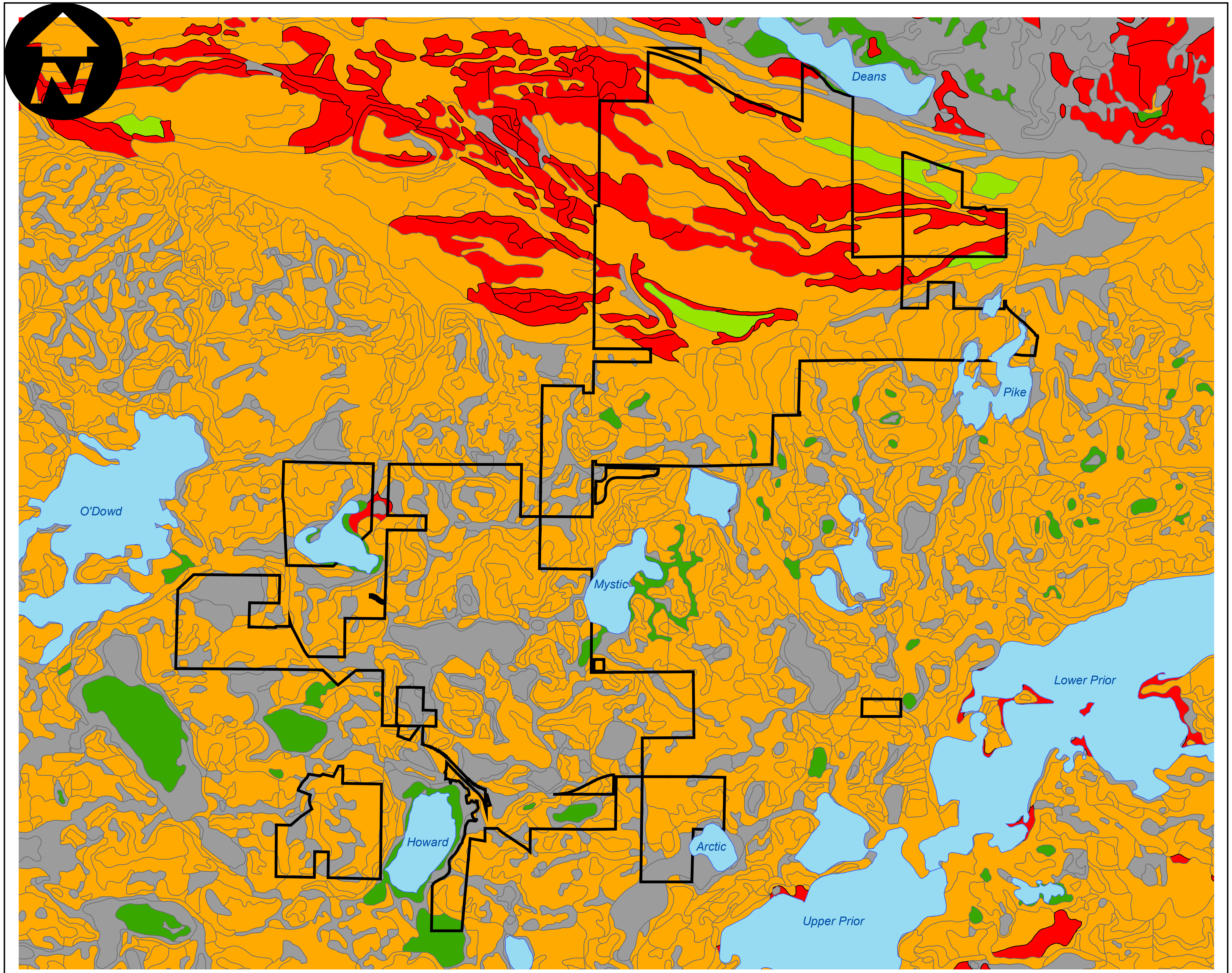
Figure 6

Glacial Origin



SMSC GWMP

Legend

- SMSC Boundary
- Mixed
- A: High Infiltration/Low Runoff
- B: Moderate Infiltration/Moderate Runoff
- C: Low Infiltration/High Runoff
- D: Very Low Infiltration/Very High Runoff

0 0.25 0.5 1
Miles

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Figure 7
Soil Infiltration Rates

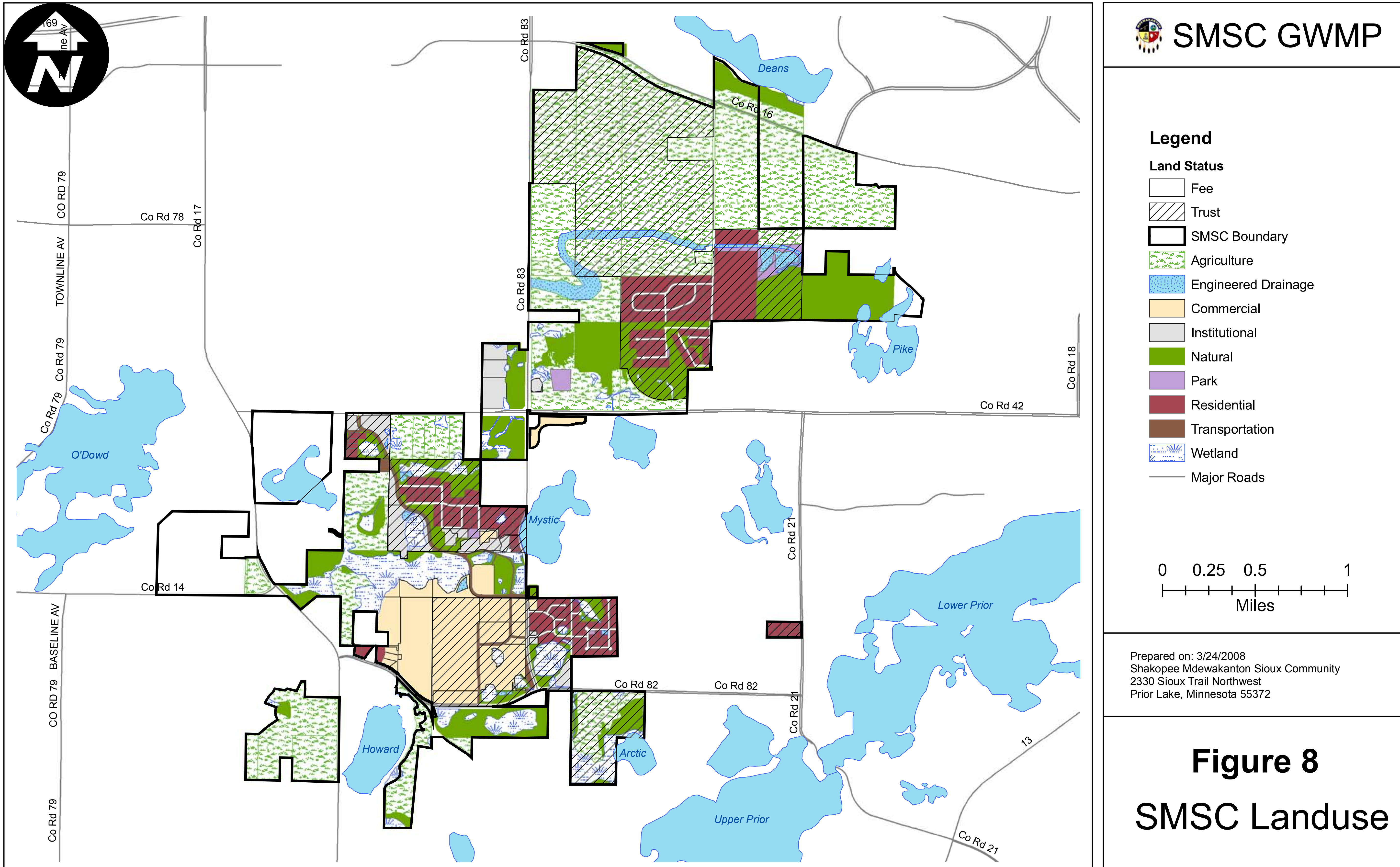
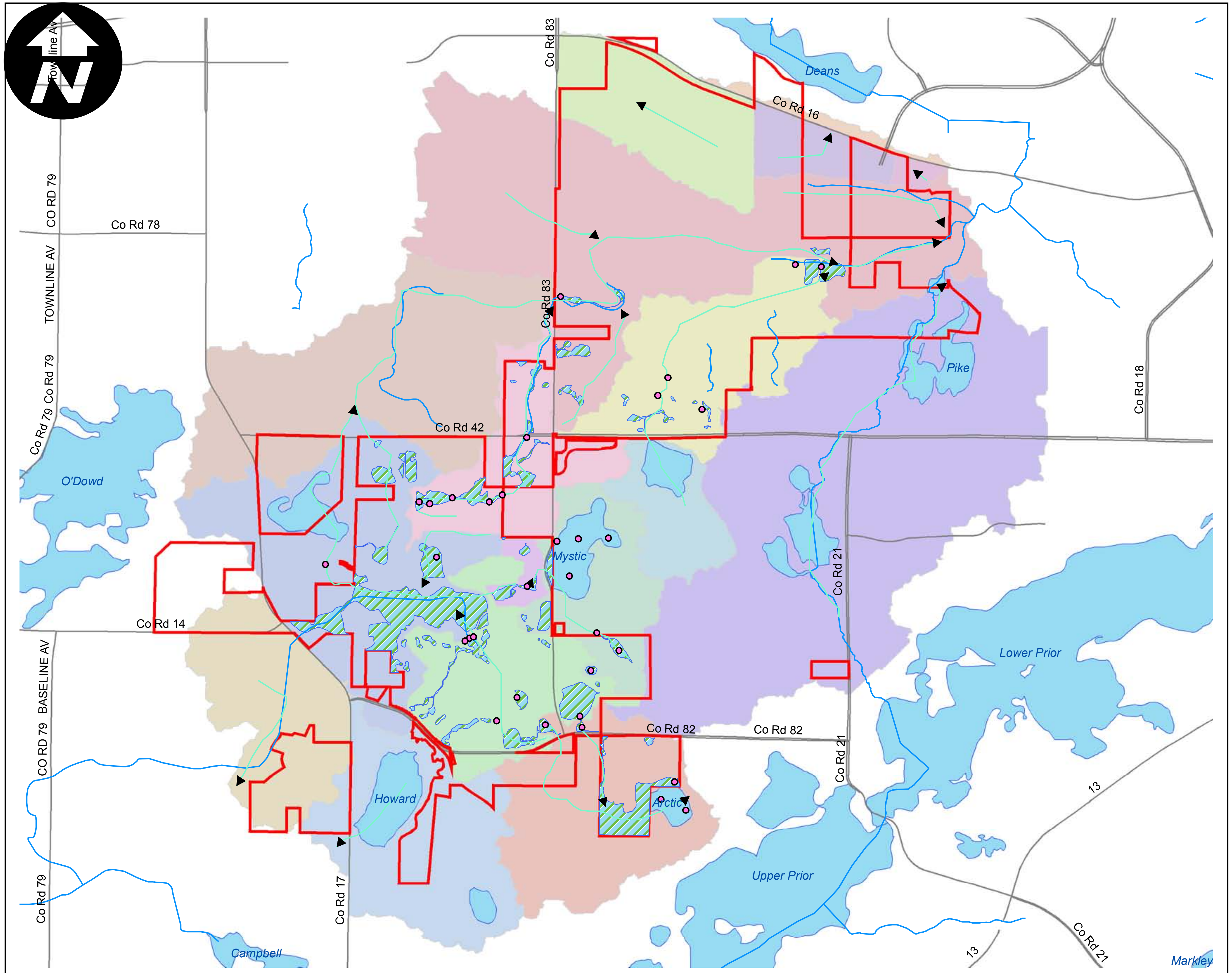


Figure 8

SMSC Landuse



SMSC GWMP

Legend

- Water Quality Sampling Sites
- Flow Paths
- Streams
- Wetlands
- SMSC Boundary

Watersheds

- 0
- Mystic Lake
- Mystic Golf Course
- Wetland C-1L
- MWCC North
- Wilds Golf Course
- East Village
- Arctic Lake
- Dockendorf
- Howard Lake
- Stream Site 3
- County Road 83
- Stream Site 5
- PL Outlet Channel
- Tollefson
- ECES
- 217
- MWCC South

0 0.25 0.5 1

Miles

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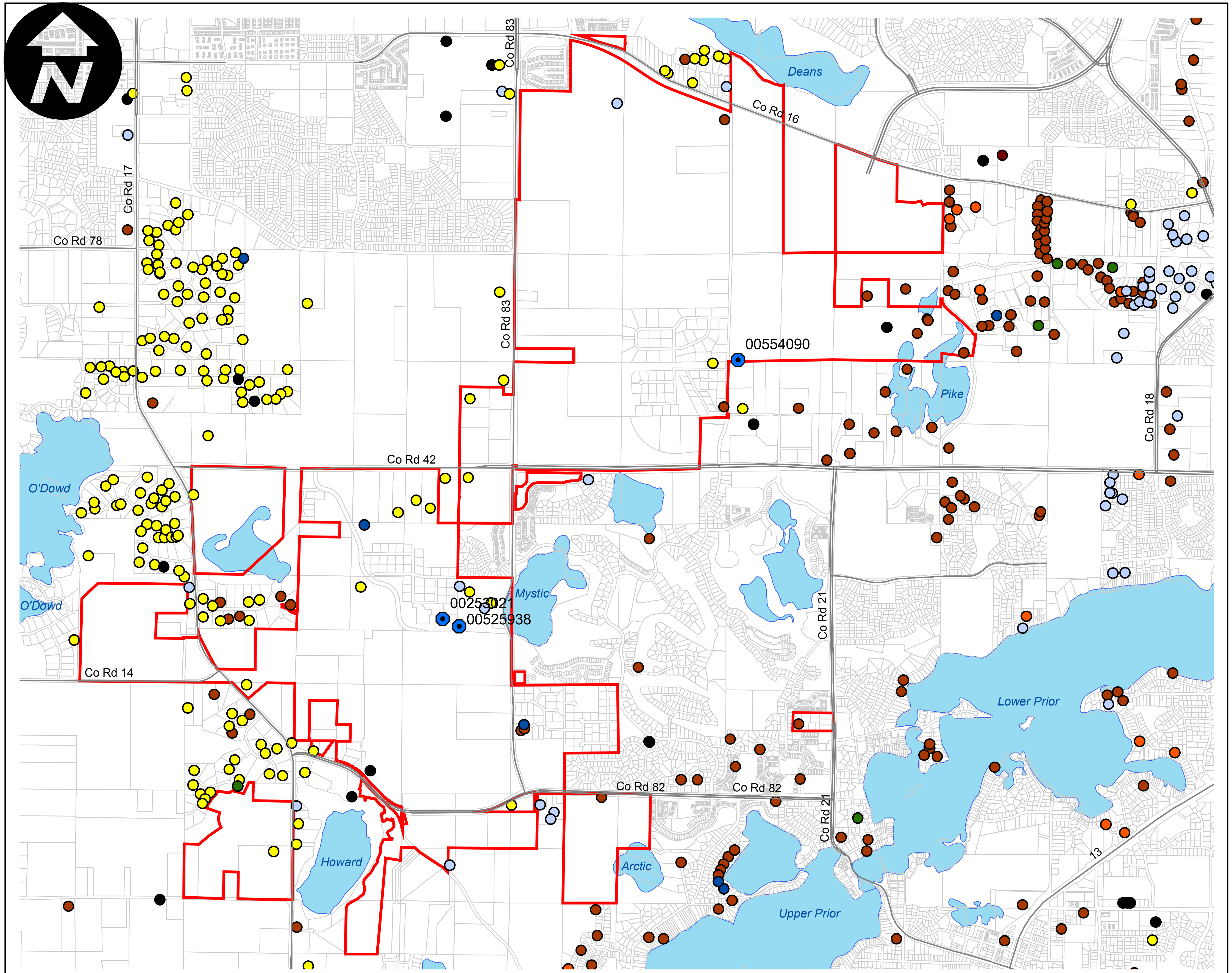
Figure 9

Surface Water



SMSC GWMP

Legend

- SMSC PWS wells
- Major Roads
- SMSC Boundary
- County Parcels

CWI Wells

Aquifer

- Quaternary
- St. Peter
- Prairie du Chien
- Jordan
- St. Lawrence
- Franconia-Ironton-Galesville
- Mt. Simon
- Multiple
- Unknown

0 0.3 0.6 1.2

Miles

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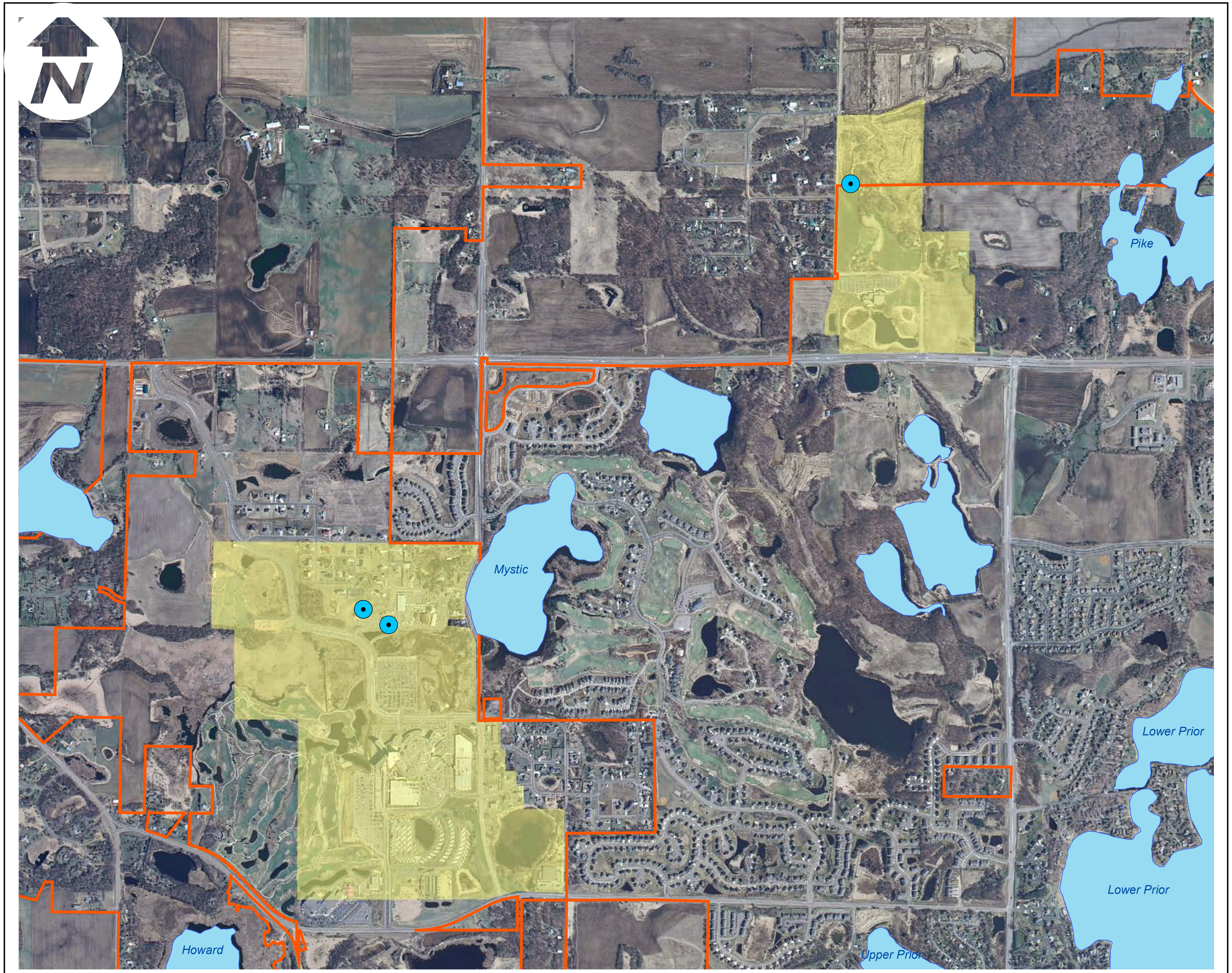
Figure 10

Area Wells



SMSC GWMP

Legend

- SMSC Water Supply Wells
- Lakes and Ponds
- SMSC Boundary
- DWSMA (drinking water supply management area)

0 0.2 0.4 0.8
Miles

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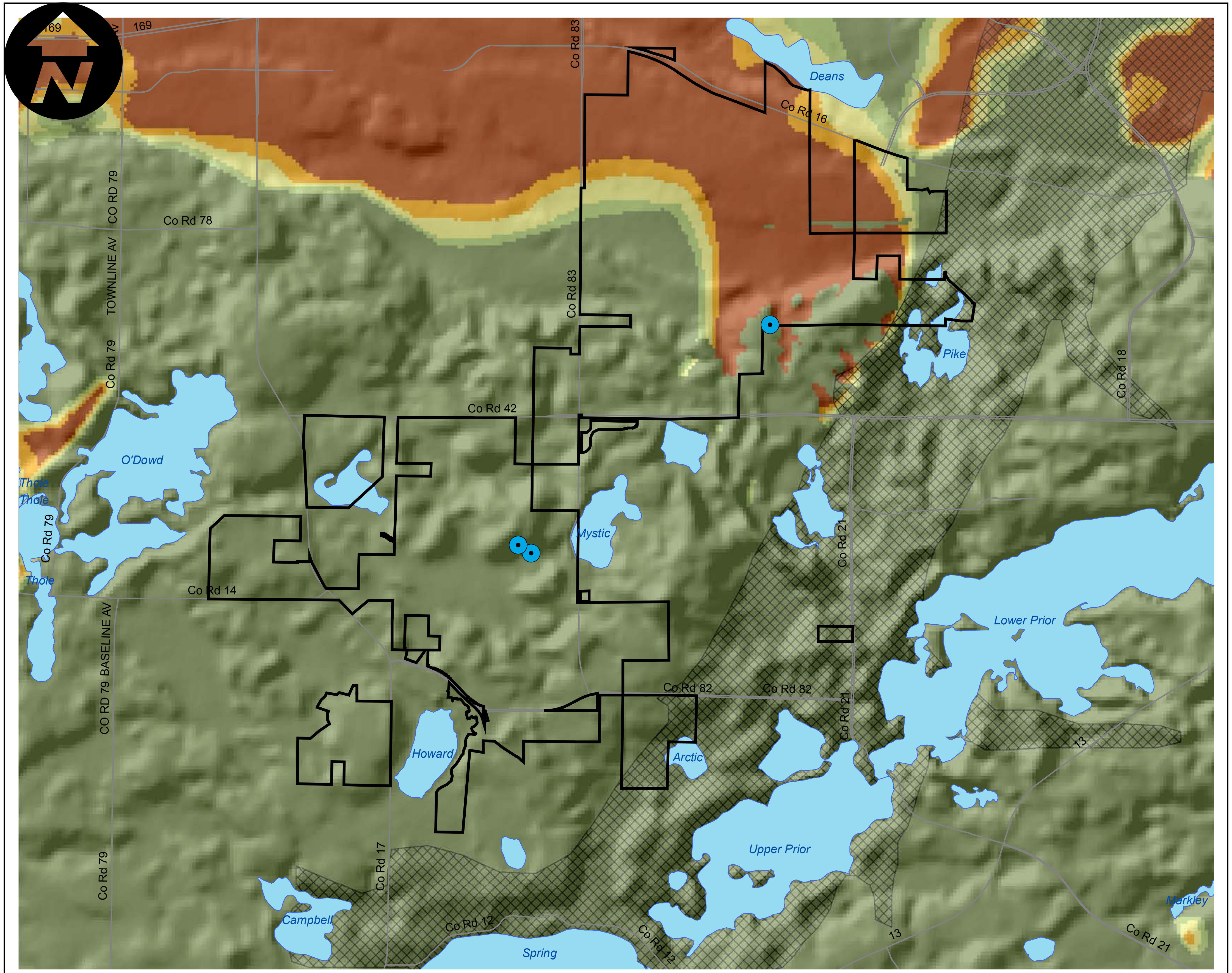
Figure 11

SMSC DWSMAs



SMSC GWMP

Legend

- SMSC Boundary
- Water Supply Wells
- Major Roads
- Buried Valley

Infiltration rates to bedrock

- Very Fast - hours to months
- Fast - weeks to years
- Moderate - years to decades
- Slow - decades to a century
- Very Slow - a century or more

Hillshade

Value

High : 254

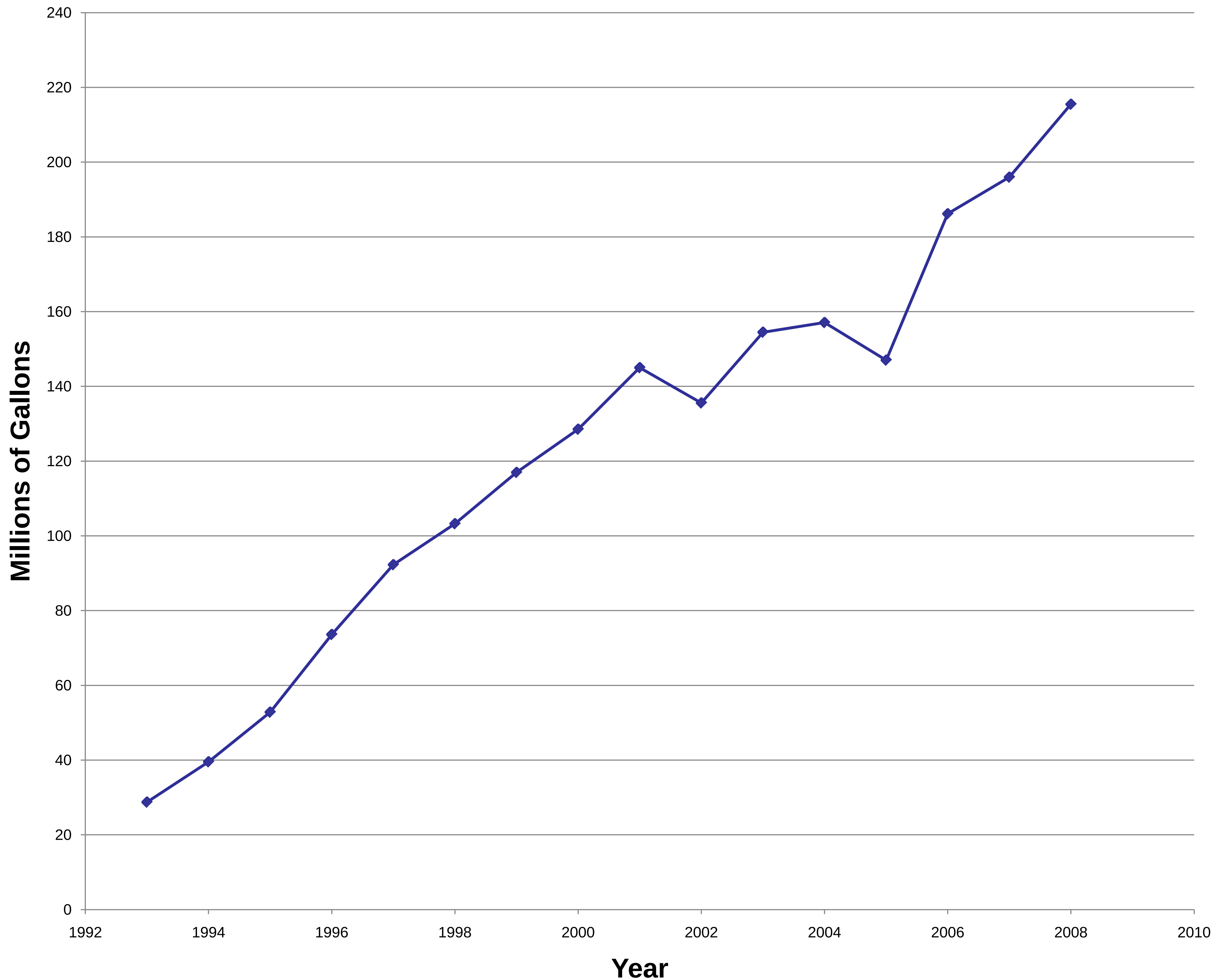
Low : 0

0 0.3 0.6 1.2

Miles

Prepared on: 3/24/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Figure 12
Infiltration Rates to Bedrock

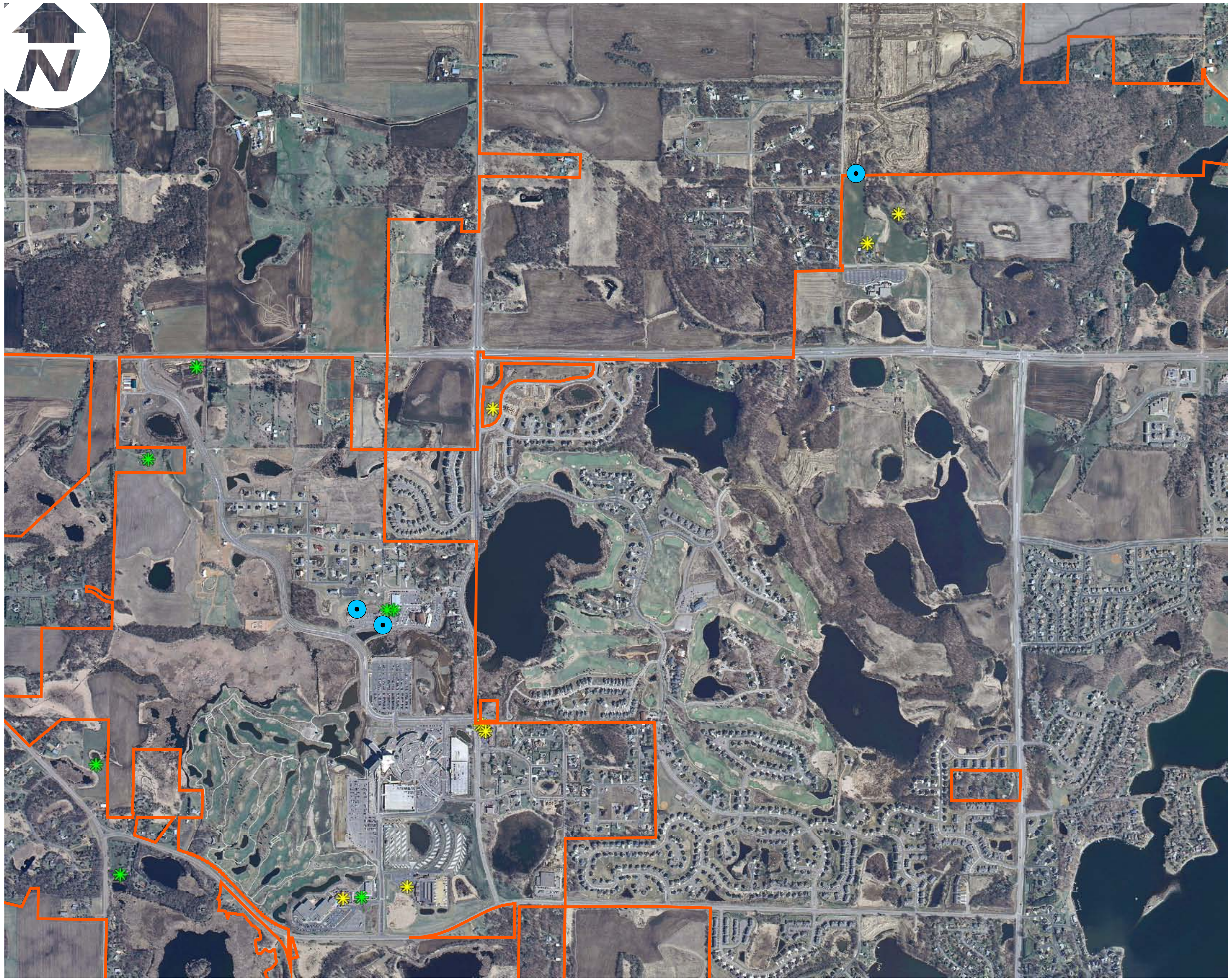


SMSC GWMP

Prepared on: 8/18/2009
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail NW
Prior Lake, Minnesota 55372

Figure 13

SMSC Water Use



SMSC GWMP

Legend

- SMSC Water Supply Wells
- SMSC Boundary

Storage Tanks

- Above Ground Storage
- Under Ground Storage

0 0.2 0.4 0.8

Miles

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Figure 14
Storage Tank Locations

Appendix A

Soil Series	Description
Blue Earth Series	In the Blue Earth series are poorly drained soils that occur in the shallow basins of former lakes. Generally they are on the uplands. They are similar to the Glencoe soils but have a surface soil that is more highly calcareous, grayer, fluffier, and generally of finer granular structure.
Glencoe Series	The Glencoe soils are very poorly drained upland soils derived from limy clay loam glacial till. They are widely distributed in depressions and low drainage ways. In many places deposits washed from surrounding higher land cover these soils to varying depths. The dark-colored surface soil is high in organic matter and ranges from 14 to 20 inches in depth. In many places a thin layer of partly disintegrated peat covers the surface and imparts a fluffy feel when it is mixed with the dry surface soil cultivation.
Estherville Series	The Estherville soils are dark-colored soils that developed under prairie grasses on gravelly and sandy outwash plains and terraces. They tend to be droughty because they are underlain by gravel at depths of 6 to 24 inches.
Hayden Series	The light-colored, well-drained Hayden soils formed under a mixed hardwood forest from limy clay loam glacial till. They are undulating to hilly, and the slopes are mostly irregular.
Lakeville-Burnsville Series	The Lakeville soils are dark-colored soils that developed from sandy and gravely calcareous till. The Burnsville soils are similar to the Lakeville but have a lighter colored surface soil. The topography for both soils is complex, ordinarily, morainic hills and ridges. Both surface runoff and internal drainage are excessive.
Lester Series	The Lester series is made up of moderately dark colored, well-drained, calcareous clay loam till. The topography ranges from undulating to rolling, and most of the slopes are complex.
Marsh	Marshes occupies shallow lakes and ponds that may be dry during years with less that normal precipitation. Most areas, however, remain wet all year.
Peat and Muck Soils	Peat and Muck are organic soils located in very poorly drained scattered depressions in Scott County. Peat has formed in depressions that are wet much of the year.
Terril Series	The Terril are gently sloping to sloping, well-drained upland soils developed by gravity and water. In places they occur on slopes between the steep bluffs and the river terrace. Calcareous clay loam glacial till lies below 40 inches. Terril soils are dark to moderately dark.
Webster Series	The Webster soils are on the nearly level upland flats and in the upper drainage ways of Scott County. The underlying material is composed of clay loam glacial till. The Webster soils are dark-colored and poorly drained.
Source: Scott County Soil Survey, 1959	