TOWN OF TRADE LAKE, WISCONSIN
SOURCE WATER PROTECTION PLAN

March, 2020

Prepared for the Town of Trade Lake
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Sourcewater Protection Program
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BACKGROUND

The Town of Trade Lake has prepared this Source Water Protection Plan for the purpose of minimizing the risk of contamination of groundwater aquifer used by town residents and public water systems for their drinking water supply. Source Water protection is a preventative program designed to reduce the risks to public health from exposure to contaminated water and avoid potential treatment costs (EPA, 2019). Source water protection is achieved by managing land use in the area that contributes directly to the groundwater aquifer serving public or private water supplies. For municipal water system wells constructed since 1992, source water protection plans are required by the WI DNR. For non-municipal water systems and private wells source water protection plans are completed on a voluntarily basis.

WHY SOURCE WATER PROTECTION?

The benefits to a community or town protecting their drinking water source might be best understood by describing the costs of failing to protect it. This includes costs that are relatively easy to quantify in monetary or economic terms and those that are not. Easily quantifiable costs of drinking water source contamination include:

- Treatment and/or remediation of a contaminated well.
- Finding and developing an alternative supply.
- Providing emergency replacement water.
- Abandoning a drinking water well due to contamination.
- Paying for consulting services and staff time.
- Litigating against responsible parties.
- Meeting the regulations of the Safe Drinking Water Act (for public supply wells).
- Loss of property value and/or tax revenue.
- Loss of revenue from tourism opportunities.

Costs that are not easily quantifiable include:

- Human Health related costs from exposure to contaminated water.
- Lost production of individuals or businesses.
- Loss of economic development opportunities.
- Lack of community acceptance of treated drinking water.

The Town of Trade Lake has roughly 300 private wells serving residences and businesses and six public supply wells. A summary of the public supply wells is included below in Table 1.

Table 1

Water System Name	DNR-PWS ID#	WI Unique Well #	Water System Type	Status
ZION LUTHERAN CHURCH TRADE LAKE	80704492	ET373	Transient Non-Community	Active
WILLIAMS CEDAR POINT RESORT CABINS	80701016	KN854	Transient Non-Community	Active
WILLIAMS CEDAR POINT RESORT MAIN WELL	80703777	FJ748	Transient Non-Community	Active
TRADE LAKE BAPTIST CHURCH	80704481	FF329	Transient Non-Community	Active
BIRCHWOOD BEACH RESORT LOWER PUMP HOUSE	80700983	BQ293	Transient Non-Community	Active
BIRCHWOOD BEACH RESORT LAUNDRY	80703711	BQ310	Transient Non-Community	Active

HYDROGEOLOGIC SETTING

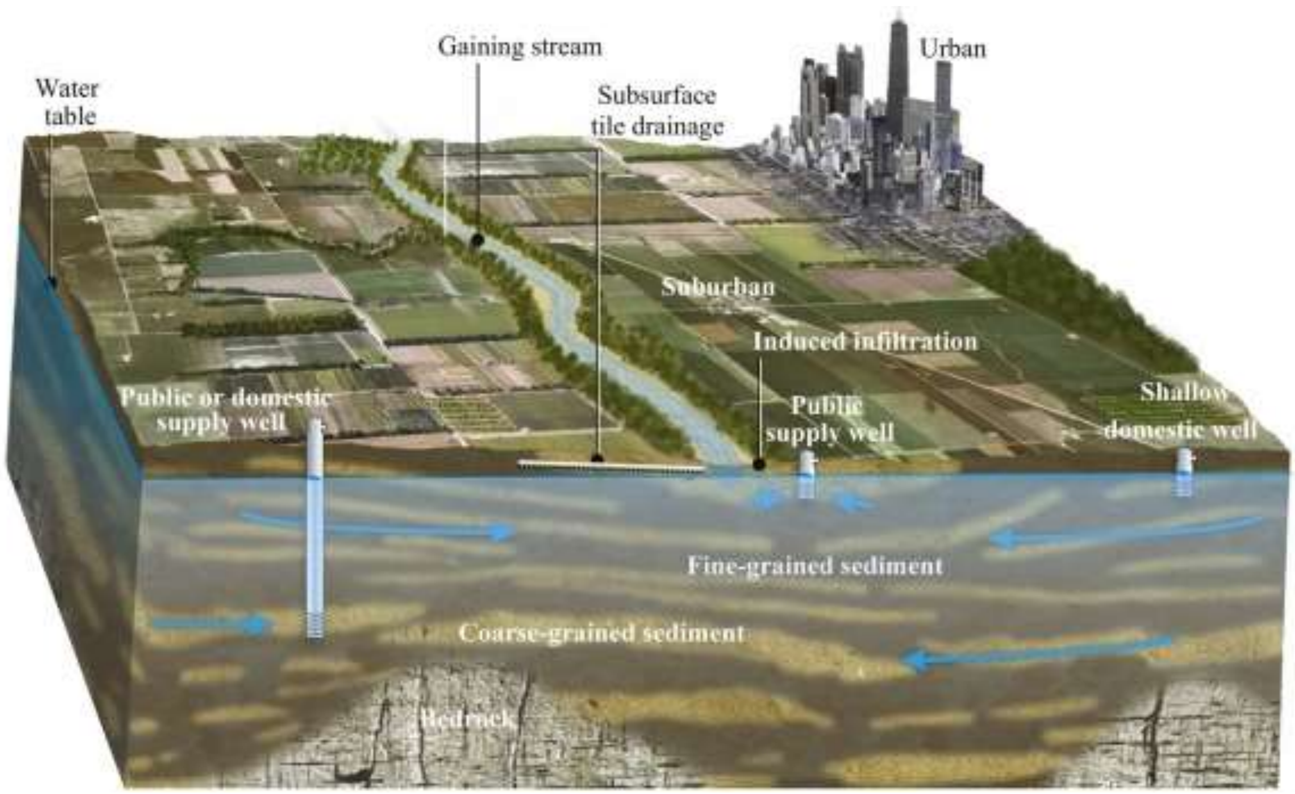
The Town of Trade Lake is located in Southwestern Burnett County. The Trade river snakes its way through the town from south to north, then west and back south eventually emptying into the St. Croix River which forms the western boundary of the County. Surface water flows into two primary watersheds. The Trade River watershed drains the southwestern part of the town and the Wood River watershed drains the northeast part. The topography in the south and eastern three quarters of the town is rolling or "hummocky", with numerous upland areas and lowland areas forming lakes and wetlands. The topography in the northeast part of the town has less relief with somewhat more expansive upland areas. From the western edge of the town the land generally slopes westward to a broad flat lying sand plain in the Town of Anderson.

The landscape in Trade Lake was shaped by glaciers that advanced into and retreated from the area several times starting more than 730,000 years ago and leaving the region for the final time around 14,000 years ago. During the most recent glacial episode, the Grantsburg Sublobe advanced into the town from the southwest and the Superior Lobe advanced through the town from the northwest. At the maximum extent of the Grantsburg Sublobe which dissects the town from north to south, a terminal moraine of glacial till was left behind. This moraine is referred to as the Trade River till plain and covers much of the western half of the town. To the east of the Trade River till plain is a hummocky ridge which extends to higher elevations east of the town and contains outcrops of basalt bedrock (Johnson, 2000).

The source of all groundwater is precipitation which infiltrates and recharges the aquifer. The rate of infiltration and groundwater movement is affected by the properties of the soils and subsurface geology. The NRCS classifies soils into four hydraulic soils groups based on the soil's runoff potential. A soil's runoff potential has an inverse relationship with its infiltration rates, and soils with high runoff potential have low infiltration rates. A soils map showing hydrologic soils group classification is shown in Figure 4, and details of the classification can be found in 'Urban Hydrology for Small Watersheds' published by the Engineering Division of the Natural Resource Conservation Service, United States Department of Agriculture, Technical Release–55. Infiltration rates of the surface soils in Trade Lake are highly variable, with generally high to moderate infiltration rates in the eastern part of the town and more moderate to low with some high infiltration rates in the western part of the town.

The subsurface geology of Trade Lake can be divided into two primary formations. The first layer consists of unconsolidated glacial deposits of Pleistocene age. Since the town was subject to several glacial episodes, the unconsolidated deposits consist of a complicated mixture of till, river, lake, gravity-flow and windblown sediment of several different formations that are differentiated based on lithology, texture and color. These formations contain loam, sandy loam, silt loam and clay loam (Johnson, 2000). The unconsolidated deposits are generally fine grained; however, due to the complex depositional environment along the margin of the Grantsburg sublobe, this fine-grained material is often discontinuous and forms lenses that pinch out after short distances (Baker, 2019). Many well logs from the area report one or more layer of silt or clay. It is important to understand that based on the geologic history of the area these silt and clay layers do not form a single confining layer in the aquifer. Water infiltrating the surface that encounters these fine grained lenses flows horizontally until they pinch out then vertically downward to the aquifer. A recent study by the U.S. Geological Survey describes the variability in texture of the unconsolidated glacial aquifer system. I diagram from the publication gives a good conceptual model of the layers and lenses of fine and coarse grain material. The diagram is included as Figure 1 below. The unconsolidated glacial deposits serve as the single groundwater aquifer for residents of the Town of Trade Lake. A general map of the glacial geology is given in Figure 5.

Figure 1 – Hydrogeologic Setting of the Glaciated Area of the Conterminous U.S. (from Erickson et. al., 2019)



Below the unconsolidated glacial deposits is the second primary formation consisting of bedrock. The bedrock geology is mapped as being crystalline bedrock often referred to as “granite” in drillers’ logs. Crystalline is the oldest and deepest bedrock layer throughout the entire state of Wisconsin. They are dense and effectively impermeable and are generally used for water supplies (Kammerer, Jr., 1998). Bedrock maps of the area show a layer of Cambrian age sandstone bedrock above the crystalline bedrock west of the Town of Trade Lake and extending into the western 1/3 of the town. (Nicholson, 2007). All available well logs for the western part of the town were examined to verify the presence and thickness of the mapped sandstone bedrock. The deepest well found was 277 feet, and no wells were found that reached bedrock. It is uncertain whether there is a layer of sandstone bedrock above the crystalline bedrock in the western 1/3 of the town and how thick the sandstone formation would be if present. Based on the available information, it seems unlikely that there is enough of a sandstone formation to serve as an aquifer for the western 1/3 of the town. This leaves the unconsolidated glacial deposits as the sole source aquifer for the Town of Trade Lake. A map of the bedrock geology is given in Figure 6.

AQUIFER CHARACTERISTICS

The source of all groundwater is precipitation which infiltrates and recharges the aquifer. The rate at which groundwater flows in the aquifer is determined by the hydraulic parameters of the aquifer. Important hydraulic parameters are described below. Due to the variable nature of the unconsolidated glacial deposits described above, hydraulic parameters of the aquifer can change greatly over short distances, both vertically and horizontally. Aquifer hydraulic parameters are estimated using a pump test, which is conducted at the time of well construction, and can be found on the well construction report. A pump test provides an estimate of how much water an aquifer can yield and how good the well performs, also known as the wells specific capacity. This is done by measuring drawdown, which is the difference between the static (pre-pumping) water levels and water levels after pumping the well at a given rate for a given period of time. Wells in the town are constructed at very short depths up to more than 270 feet in depth, and calculating the aquifer parameters at wells from different locations drilled to different depths will yield a variety of results. In general, wells are drilled to a depth where they encounter a coarse grain layer that yields water of sufficient quantity and quality. To give a snapshot of the range of hydraulic parameters encountered in the area, hydraulic parameters were calculated using pump tests reported on well logs from the public wells in the town along with the high capacity wells for the Villages of Frederic and Grantsburg. High capacity municipal wells were used for the calculation because they are pumped at a higher rate than smaller private wells. The results are shown in Table 2 and as expected the calculated Transmissivity and Hydraulic Conductivity has a wide range.

- Aquifer Thickness – Vertical thickness of water bearing porous medium.
- Effective Porosity – The ratio of void volume to the total volume of material (estimate)
- Hydraulic Gradient – The change in water table elevation (hydraulic head), divided by the change in distance in a given direction
- Storage Coefficient – The volume of water that an aquifer releases from storage, per unit surface area of the aquifer, per unit change in head. Estimated for unconfined aquifers (Driscoll 1986, pp. 737).
- Transmissivity – The rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is estimated using pump test data, and the “T-Guess” computer solution (Bradbury and Rothschild, 1985).
- Hydraulic Conductivity – The ease with which flow takes place through a porous medium. It is calculated by dividing the transmissivity by the aquifer thickness.

Table 2

Aquifer Hydrologic Parameters	Well #Williams Cedar Point Resort Cabins	Well #Williams Cedar Point Resort Main Well	Well #Birchwood Beach Resort Laundry	Well #Village of Frederic Well #2	Well #Village of Frederic Well #3
Average Aquifer Thickness (ft)	200	200	200	200	200
Effective Porosity	0.2	0.2	0.2	0.2	0.2
Hydraulic Gradient	0.008	0.008	0.008	0.008	0.008
Storage Coefficient	0.001	0.001	0.001	0.001	0.001
Transmissivity (ft2/sec)	0.11	0.18	0.35	0.17	0.031
Hydraulic Conductivity (ft/day)	47.52	77.76	151.20	73.44	13.39

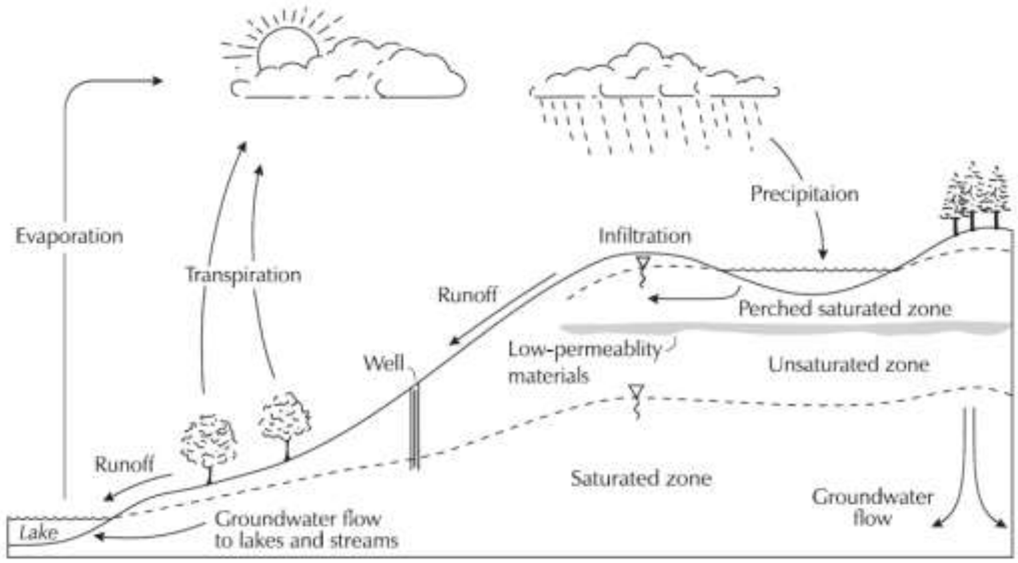
Aquifer Hydrologic Parameters Continued	Well #Village of Frederic Well #4	Well #Village of Frederic Well #5	Well #Village of Grantsburg Well #1	Well #Village of Grantsburg Well #2	Well #Village of Grantsburg Well #3
Average Aquifer Thickness (ft)	200	200	200	200	200
Effective Porosity	0.2	0.2	0.2	0.2	0.2
Hydraulic Gradient	0.008	0.008	0.008	0.008	0.008
Storage Coefficient	0.001	0.001	0.001	0.001	0.001
Transmissivity (ft2/sec)	0.45	0.22	0.1	0.1	0.0074
Hydraulic Conductivity (ft/day)	194.40	95.04	43.20	43.20	3.20

GROUNDWATER FLOW DIRECTION

In a groundwater flow system, groundwater moves continuously in response to gravity, from upland recharge areas to lowland areas of groundwater discharge (lakes, rivers, springs and seeps). The direction of groundwater flow may be inferred from the regional topography and the slope of the water table. The water table is the upper limit of the aquifer and is measured in “head” or elevation above sea level. The water table is estimated by looking at water levels in wells that have a screened interval within the aquifer. Wells provide a point of measurement of the water table elevation. The best available water table maps for the area were developed and published by the Wisconsin Geological and Natural History Survey (Muldoon & Dahl, 1998 and Muldoon & Craven, 1998). A local portion of the water table maps are shown in Figure 7. The water table is shown as contour lines of equal head with a 20 ft contour interval. Groundwater flows approximately at right angles to the contour lines of equal head in the direction of decreasing head. Arrows indicating the general direction of groundwater flow have been added to the map. In the Town of Trade Lake groundwater flows from higher elevation areas to the east/southeast of the town and flows generally west towards the St. Croix River. Localized groundwater flow in the town is affected by local topographic relief. This includes several high points in the water table near the northwest corner of the town. These correspond with elevated areas southwest of Isaac Lake near the radio tower and northeast of Isaac Lake along the divide between the Trade River watershed to the southwest and the Wood River watershed to the northeast. Groundwater flow within the Trade River watershed follows an interesting pattern through the town that is similar to the route of the Trade River.

Groundwater from the southeast corner of the town flows northeast towards Big Trade Lake and Bass Lake, then near the western part of town changes direction and flows in a southwest direction. Groundwater pumped from wells in the town is recharged relatively close to the wells in the area primarily up-gradient from the well. A simplified diagram showing a general groundwater flow system is shown in Figure 2 below.

Figure 2 – Generalized Groundwater Flow System (from Dunne and Leopold, 1978)



POTENTIAL CONTAMINANT SOURCES

In order to design the most appropriate management strategy, it is necessary to know what possible sources of contaminants are present. These are human activity or land use that creates the potential to release contaminates into the groundwater aquifer.

Contaminants released on the land surface are subject to a series of physical, chemical and biological processes that impede, destroy or bind up contaminants moving through the soil and unconsolidated glacial material toward the groundwater. Soils and the unconsolidated aquifer material is described in detail in the Hydrogeological Setting section above; however it is relevant to note that the variability in the soils and glacial material make the flow paths and transport characteristics of contaminates more unpredictable. Contaminants of primary concern to the town are listed below.

<u>Domestic Wastewater</u>
The town is not serviced by municipal sewer and domestic wastewater comes solely from septic system. Sewage from septic systems can contain a variety of pollutants, but the contaminants of most concern in domestic wastewater are pathogens and nitrate. Pathogens (primarily bacteria and viruses) are filtered somewhat as they move through the ground and are viable for a limited time. Pathogens can cause acute illness and result in life-threatening conditions for young children. The risk from pathogens is elevated in areas where the depth to

groundwater is shallow, where soils are thin or in areas of fractured bedrock. There is no fractured bedrock in the Town of Trade Lake, and most areas do not have thin soils or shallow groundwater. Nitrate from septic systems is typically only a concern when there is a high density of residential septic systems or very large septic systems located in a vulnerable aquifer. The low density of septic systems in the town equates to a minimal risk of groundwater contamination from domestic wastewater.

Volatile Organic Compounds (VOCs)

VOCs can be released from a variety of sources, including petroleum storage & transport, auto & machinery repair facilities, dry cleaning chemicals, solvents and degreasers. Some VOCs are heavy and readily move downward through the aquifer. Heavy VOCs consist primarily of chlorinated solvents used in dry cleaning, parts washing (general de-greasing) and brake cleaning operations. The town has no dry cleaners or industrial users of VOC containing chemicals. There are several commercial auto or machinery repair shops in the town and VOC containing chemicals for residential purposes and farm operations are typically used only in small quantities. Petroleum and chemical spills or illicit discharges are hard to control, educating town residents on proper disposal of waste products are important protective measures against spills and illicit discharges. Spills along transportation corridors could cause groundwater contamination. The primary transportation corridor through the town is State Highway 48. Proper spill response preparation is an important protective measure.

Bulk storage of petroleum products is done in above ground storage tanks on several farm operations in the town as well as at the town shop. There are three known petroleum leaking underground storage tank cleanup sites and two contamination cleanup sites in the town that are listed on the DNR's remediation and redevelopment database. All of these sites have been investigated and closed with one site maintaining a continuing obligation due to residual soil and groundwater contamination on the site. The plume of residual contamination was determined by the environmental consultant to be receding and residual contamination will be remediated through natural attenuation. Table 3 contains a list of contamination cleanup sites in the town.

Table 3

	WLS	**Leaking underground storage tank**	**BRRTS ID #**	**Latitude**	**Longitude**	**Status**
1		Trade Lake Valley Store	03-07-106725	45.6893817	-92.5953163	Closed
2		Birchwood Beach Resort	03-07-106725	45.7040072	-92.5583908	Closed
3		AT&T Microwave Radio Tower	03-07-000469	45.7083265	-92.6440596	Closed
	WRP	**EERP Site**	**BRRTS ID #**			**Status**
1		Piotrowski, Mathew	03-07-000029	45.6617031	-92.6505085	Closed
2		NW WI Electric Co-Tober Residence	02-07-256390	45.6693083	-92.6304184	Closed

Agriculture

The primary risk from agriculture is nitrate from fertilizer application and manure applied to fields. Around 90% of nitrogen inputs to groundwater in Wisconsin can be traced to agricultural sources (Shaw, 1990) Nitrate is a water soluble molecule that travels very easily in groundwater with little attenuation. The health-based groundwater quality enforcement standard (ES) and the maximum contaminant level (MCL) for nitrate in public drinking water are both 10 ppm (WI NR140.10, WINR809.11). In the human body, Nitrate can convert to nitrite and then N-nitroso compounds (NOC's), which are some of the strongest known carcinogens. Nitrate exposure has been linked to blue baby syndrome in infants and birth defects (GCC, 2018)

The process of nitrate from fertilizer and manure entering the groundwater system can be referred to as "nitrate leaching". Nitrate leaching from fertilizer and manure application is affected by a number of factors including local weather conditions, timing, application method and application rate. Rain events occurring shortly after application can flush nitrate from the land surface down into the groundwater. The longer manure is in the soil before plants are able to utilize nitrate from the manure, the more nitrate leaching to groundwater can occur. Fall and winter applications of manure have a greater potential for nitrate leaching since there are no plants growing and up taking nitrate. Manure is either applied to the land surface or incorporated into the soil through tillage or subsurface injection. While incorporating manure into the soil can improve surface water conditions by reducing runoff of pollutants into surface waters, it can also increase the amount of nitrate in the soil that is available to leach into groundwater. Application rates of fertilizer and manure should be based on the nutrient needs of the crop being grown. Unfortunately, nutrient application rates and timing can be influenced by other factors including the distance manure needs to be hauled, availability of fields to spread manure on or manure storage capabilities. The primary mechanism used to reduce the movement of nutrients, including phosphorous and nitrate, from agricultural land to surface and groundwater is nutrient management planning. Unfortunately, nutrient management planning has historically focused more heavily on surface water quality and phosphorous and much less on groundwater quality and nitrate. Additionally, many of the nitrate application rates that are used designed to produce the best economic yield and are not necessarily designed to be protective of groundwater. Recent studies have indicated that nutrient management plans are questionably effective at reducing nitrate levels to below the MCL of 10 ppm (GCC, 2018). Several miles east of Trade Lake the Village of Frederic experienced nitrate levels in groundwater above the MCL of 10 ppm due to agricultural activates. The Hydrogeologic setting by Frederic is very similar to Trade Lake and their experience shows how vulnerable the unconsolidated sand and gravel aquifer in the area is to nitrate from agricultural activates. Frederic's case study is outlined in Appendix A.

Private Wells

Water or contaminants from at or near the land surface can migrate downward to the groundwater along the outside of an improperly grouted or cased well or through a well that has a compromised casing or is in disrepair. Such wells can create a direct conduit for contaminants to move quickly from the surface to the groundwater. Damaged or missing well caps provide a direct path for vermin, insect and other organisms to enter a well and potentially contaminate the aquifer. Wells are the sole source of drinking water for residents and businesses in the Town of Trade Lake. Proper inspection and maintenance of wells is an important groundwater protection measure. If wells are found that don't meet construction code, are unused or are in disrepair, they should be properly abandoned in accordance with NR 812.26. As of June 1, 2008, only licensed well drillers and pump installers can fill and seal wells under Wisconsin Law.

Land Development and Re-development

Development of un-developed land and re-development of commercial and industrial land can help to grow existing businesses and establish new ones. It is important that land use decisions are made that to help protect the town's groundwater. Residential development is typically protective of groundwater provided lawn chemicals and fertilizers are not over utilized and septic system density is minimized. Commercial and industrial development should focus on businesses that don't use or handle large quantities of hazardous materials. The Town of Trade Lake is un-zoned, so land use permits are issued by Burnett County. The town should work with the county to insure that groundwater protection is considered while reviewing any land use permit application.

MANAGEMENT STRATEGY

The management strategy outlines the town's plan to implement the source water protection plan. "Implementation" means taking specific actions to protect the town's groundwater aquifer that serves as the water supply for town residents.

Groundwater Monitoring

Groundwater monitoring is essential for understanding and managing the town's drinking water source. Consistent monitoring provides the data necessary to identify any changes or negative impacts to the town's groundwater resources. Groundwater monitoring should focus on both groundwater quality and groundwater quantity. Monitoring is also informs town residents and decision makers on how to best protect groundwater.

Groundwater quality can be monitored using existing private water supply wells or specifically designed and installed monitoring wells. The best way to establish a baseline of water quality in the town is to sample multiple private wells at the same time. This provides a point in time snapshot of water quality across the town. After an initial sampling event, areas of interest can be re-sampled at regular intervals or monitoring wells can be installed to more closely monitor water quality at specific sites.

- The town should conduct a private well testing program to collect water samples from private well owners in the town at least once per year. Suggested procedures are listed below.

- Town wide sampling should be done annually in the months of May or June.
- Sample bottles and lab forms should be distributed ahead of time.
- Samples should be collected on a single day at a designated location in town.
- Results should be analyzed to identify any areas of interest or further sampling.

UW-Steven's Point Center for Watershed Science and Education has an excellent program for helping organize community well testing programs. Information is available here: https://www.uwsp.edu/cnr-ap/watershed/Pages/WaterEdProgram.aspx

Groundwater quantity is monitored by regularly measuring water levels in either private water supply wells or monitoring wells. Water levels can be measured using a variety of equipment. The simplest way is physically measuring the depth to water in a well using a measuring device such as a tape & popper or electric tape. A more advanced method is to use a water level data logger. This is a small tool that is hung in a well and collects water level measurements at a defined interval. The tool is removed periodically and the data is downloaded to a computer. The most advanced way to monitor water levels are completely automated solutions such as Wellntel. Wellntel outfits wells with sensors and then utilizes remote telemetry and a cloud platform to collect and deliver water level data. More information on Wellntel can be found here: https://www.wellntel.com/

Policy And Regulations

Policy and regulations are an important measure for protecting groundwater in the town. Land use regulations that help prevent groundwater pollution should focus on the management of waste products and the use and storage of substances that have the potential to pollute groundwater. Local governments have the authority to protect groundwater through planning and zoning activities (Kent & Dudiak, 2001).

Zoning:

Zoning regulates how a parcel of land in a community may be used and the density and type of development. The intent of zoning is to balance individual property rights with the interests of the community to create a healthy, safe and orderly living environment. Burnette County has adopted a general zoning ordinance and the Town of Trade Lake has adopted the county ordinance. This means that zoning is regulated at the county level and the county issues new land use and sanitary permits. If the town wants to take over zoning control they would need to obtain village powers and get county approval under Wis. Stat. §60.62 (Center for Land Use Education, 2007).

Land use and sanitary permits are important regulatory tools for managing potential businesses and industry's that would use or store substances that have the potential to pollute groundwater. Due to the rural nature of the Town of Trade Lake large scale residential development that would greatly increase the amount of domestic wastewater being discharged to groundwater through septic systems is unlikely. Additionally, commercial and industrial development within the town is not likely. The current county zoning controls for residential, commercial and industrial development should adequately protect groundwater.

A majority of the land within the Town of Trade Lake is zoned agriculture. As discussed above, waste management from agricultural activities is a leading cause of elevated nitrate levels in groundwater. To help protect the groundwater in the Town of Trade Lake, the town board has developed an ordinance to regulate the operation of Large-Scale Concentrated Animal Feeding Operations of 1,000 animal unites or greater (CAFO). The ordinance requires anyone wanting to operate a CAFO in the town to apply for an operating permit from the town. The Town Board then has the ability to decide whether to approve and issue the CAFO operations permit. Additionally, the town board can issue conditions of operation that protect public health by preventing groundwater pollution. The Town of Trade Lake adopted Ordinance 1-2020 Concentrated Animal Feeding Operations Ordinance on January 9th 2020.

<u>Hazardous Waste Collection</u>
The Northwest Regional Planning Commission in cooperation with Burnette County coordinates an annual hazardous waste collection program “cleansweep”. Northwest Cleansweep provides hazardous waste collection services to households, farms, farm-related businesses, schools, municipalities, and businesses through a mixture of multiple single-day collection events during the summer months and a mobile collection of hazardous wastes in the spring and fall of each year.

<u>Steering Committee</u>
A steering committee has been formed to provide input on the development of this plan. The committee consists of the following individuals:

- Jen Goldman, Town of Trade Lake Resident
- Steve Johnson, Town of Trade Lake Property Owner
- Sandra Johnson, Town of Trade Lake Property Owner
- Howard Pahl, Town of Trade Lake Resident
- Dorthy Richard, Town of Trade Lake Resident
- Kathy Anderson, Town of Trade Lake Resident
- Doug Wickstrom, Town of Trade Lake Resident
- Zach Lade, Town of Anderson Resident
- Jeff Lade, Town of Trade Lake Resident
- Marcia Altaffer, Town of Trade Lake Resident
- Allan Johnson, Town of Anderson Resident
- Roger Hinrichs, Town of Trade Lake Resident
- Andrew Aslesen, Source Water Specialist, Wisconsin Rural Water Association

The Town of Trade Lake is located in Burnett County. Cooperation will be sought with the county in implementing this plan.

Contingency Planning

Contingency planning is done so to lay out steps that can be taken in the event that a portion of the town's groundwater of a groundwater well within the town becomes contaminated. The Wisconsin Department of Natural Resources (DNR) recommends that every private well is tested for bacteria every year and when there is a change in taste, color or smell. The DNR recommends that every private well is tested for nitrate once a year and before the well is used by women who are or may become pregnant.

In the event that a well becomes contaminated there are two options, find an alternative water source or install treatment. Finding an alternative water source typically consists of drilling a well that is likely deeper and potentially in a different location. The maximum depth of the usable sand and gravel aquifer in Trade Lake is at the most around 270 feet. Below the sand and gravel aquifer is crystalline bedrock which is not a usable aquifer. Drilling a deeper well will only be an option if the contaminated well is very shallow. Almost all contaminants in groundwater can be removed using various treatments systems at a cost to the well owner. Certain treatment systems cost more to install and maintain than others. For wells that are contaminated with bacteria the typical approach is to treat the well with a chlorine product to disinfect the well. For wells that become contaminated with other chemical constituents such as nitrate, the typical approach is to install a treatment system in the home, which could include ion exchange or reverse osmosis. These treatment systems come at a substantial cost to install and operate.

For an extensive list of information and resources on well water quality and well ownership visit the DNR's website https://dnr.wi.gov/topic/Wells/homeowners.html. Local well drillers and pump installers can be consulted about any water quality of concern and are able to perform disinfection procedures on wells contaminated with bacteria. Licensed plumbers or companies that specialize in water treatment can provide additional information and cost estimates for installing more advanced treatment systems such as ion exchange or reverse osmosis.

Below is a short resource contact list of local officials or for water quality concerns, dealing with spills or emergency situations.

Contact List		Phone Number
Local:	Trade Lake Town Hall and Shop	715-488-2694
	Trade Lake Town Clerk – Melissa McQuay	715-220-9399
	Trade Lake Town Building Inspector – Dennis Quinn	715-371-8971
	Fire Department – Grantsburg	911 or 715-463-2294
County and Regional:		
	Burnett County Sheriff	911 or 715-349-2127
	Burnett County Emergency Management	715-349-2171

	Burnett County Health and Human Services	715-349-7600
	DNR-Regional Spill Coordinator (Northern Region)	715-623-4190 ext. 3110
	DNR-Private Water Supply Field Staff (Spooner)	715-635-4027
State:	DNR-State Spill Response	800-943-0003
	DNR-Private Water Supply Field Supervisor	715-267-2449
	DNR-Private Water Supply Section Chief	715-267-7649
	State Lab of Hygiene	608-263-3280

Figure 3 – Town of Trade Lake Overview

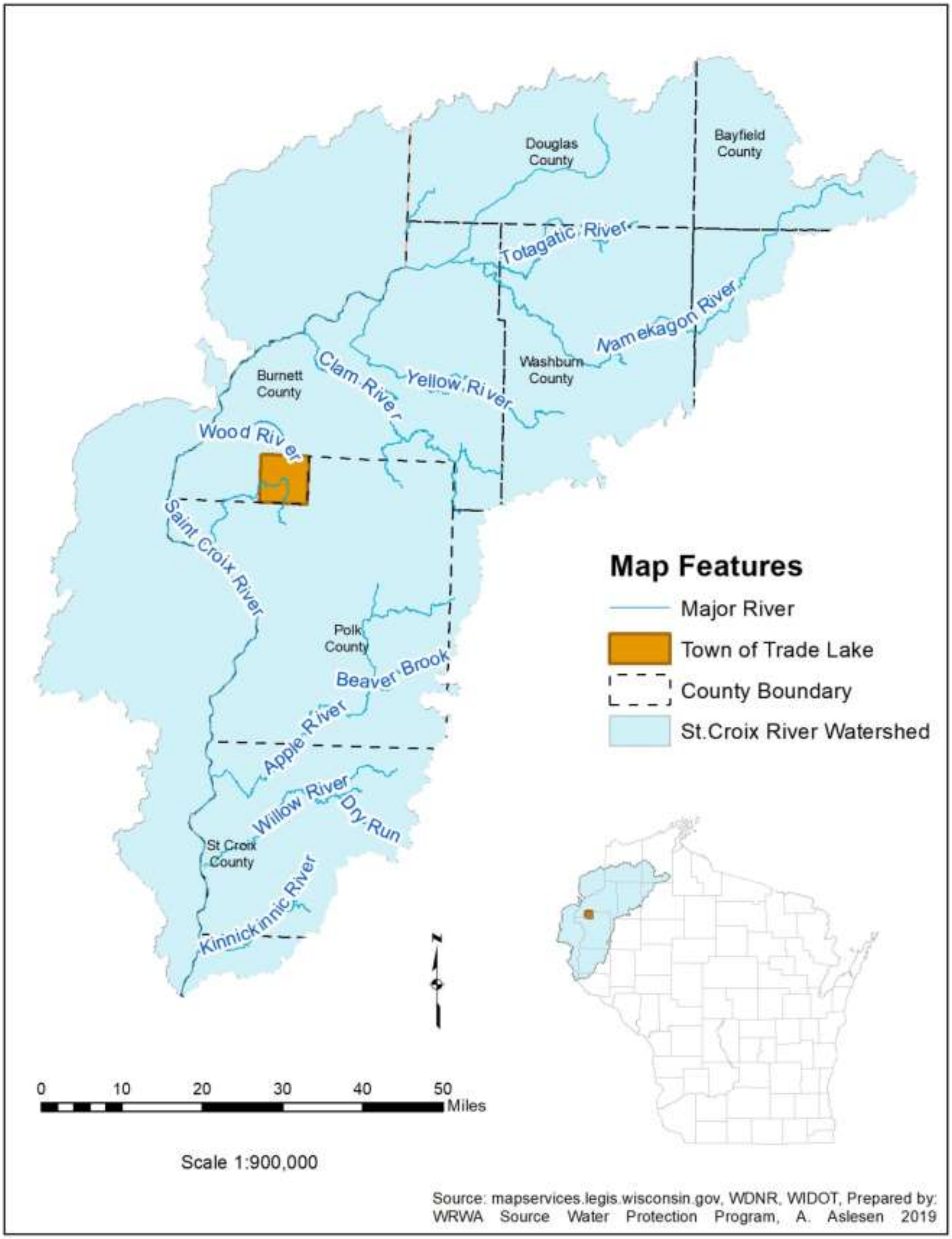


Figure 4 – Hydrologic Soils Group

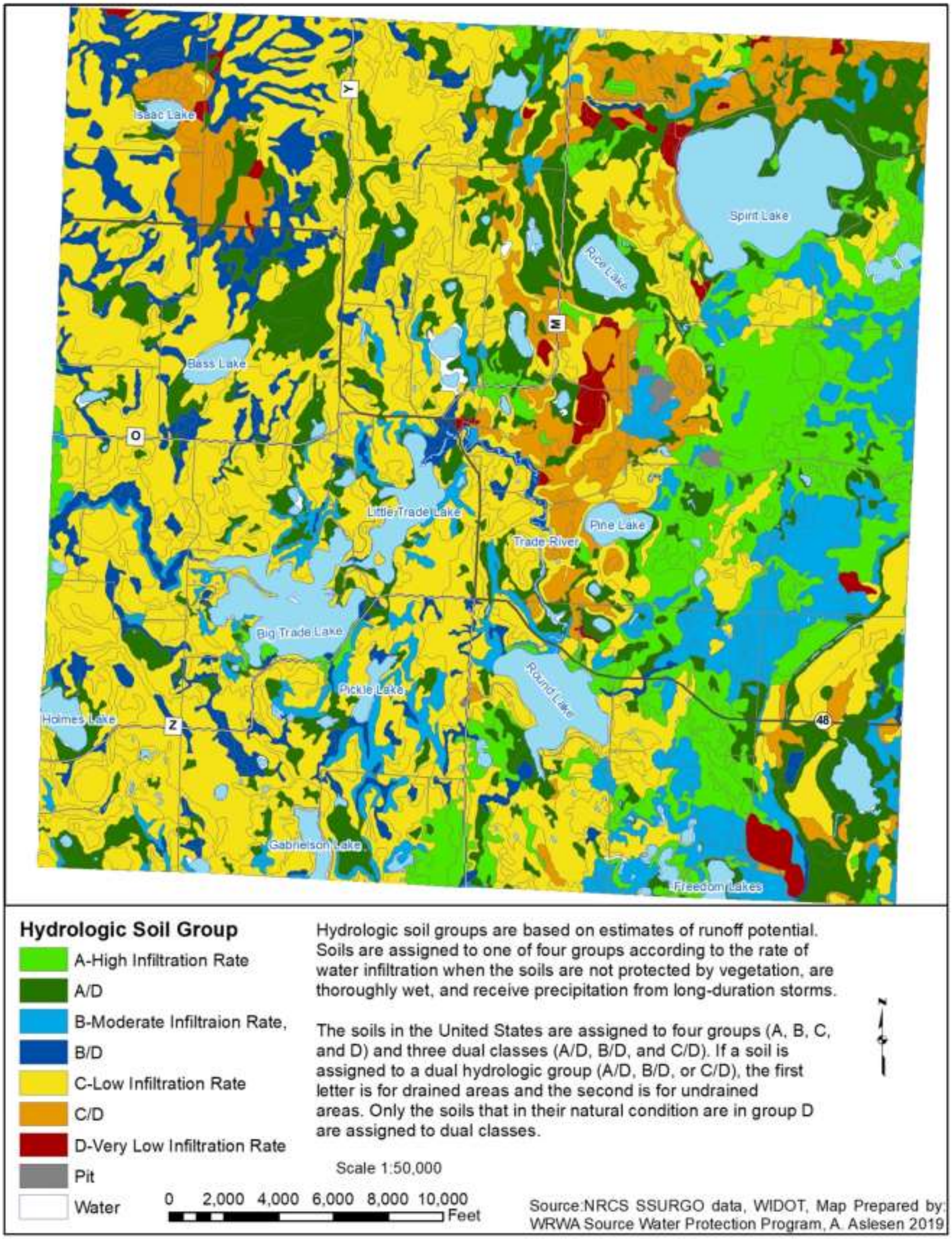


Figure 5 –Glacial Geology

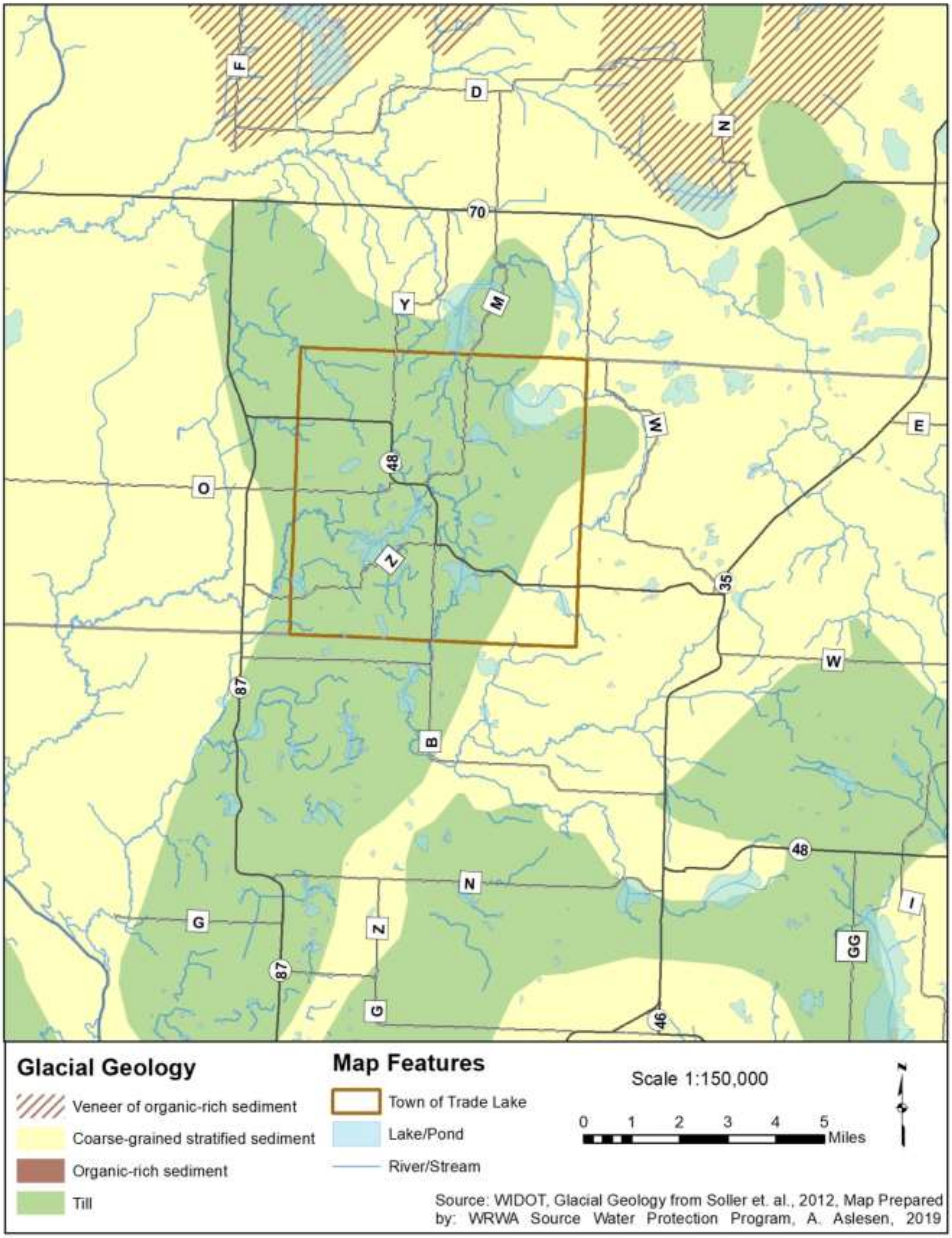


Figure 6 – Bedrock Geology

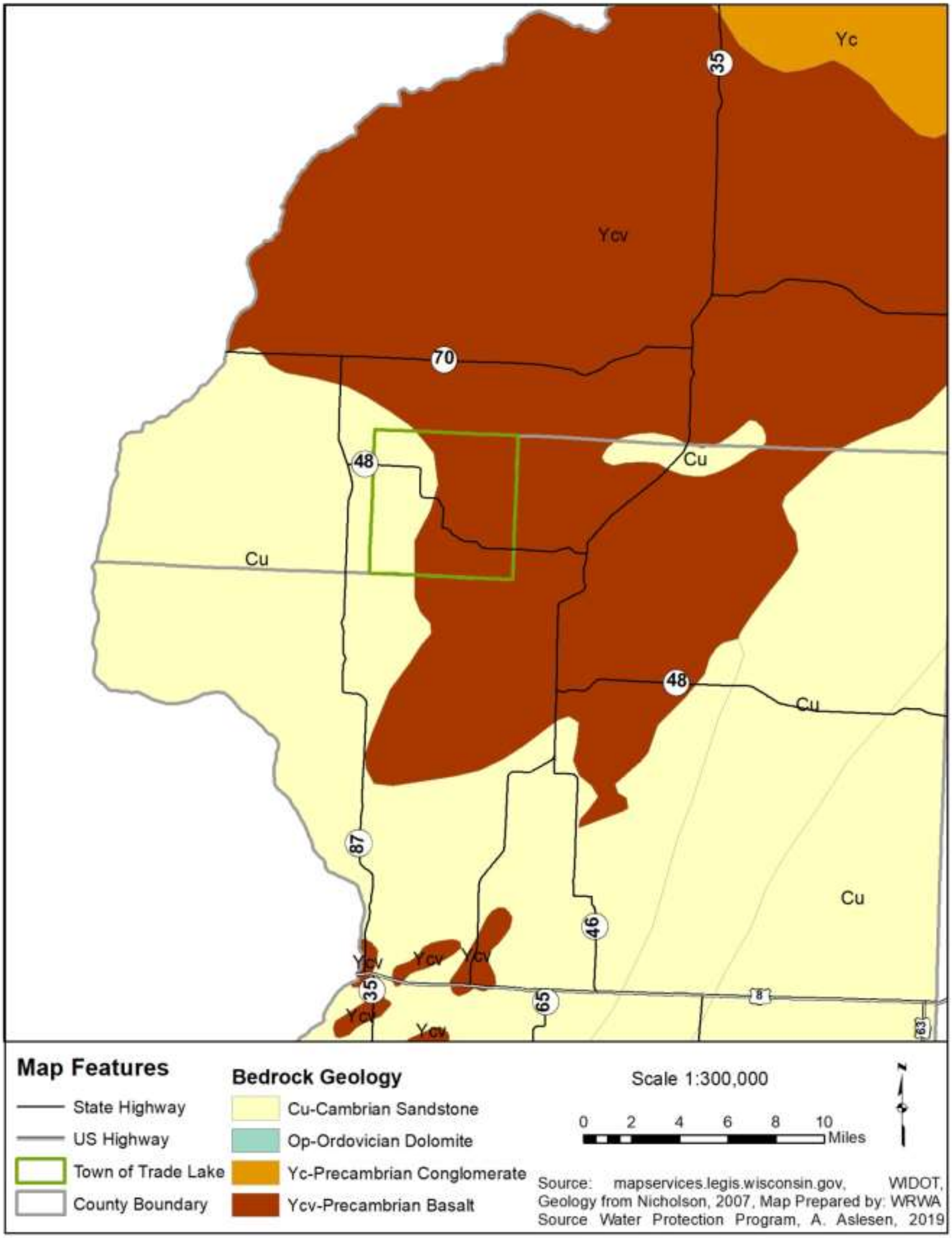
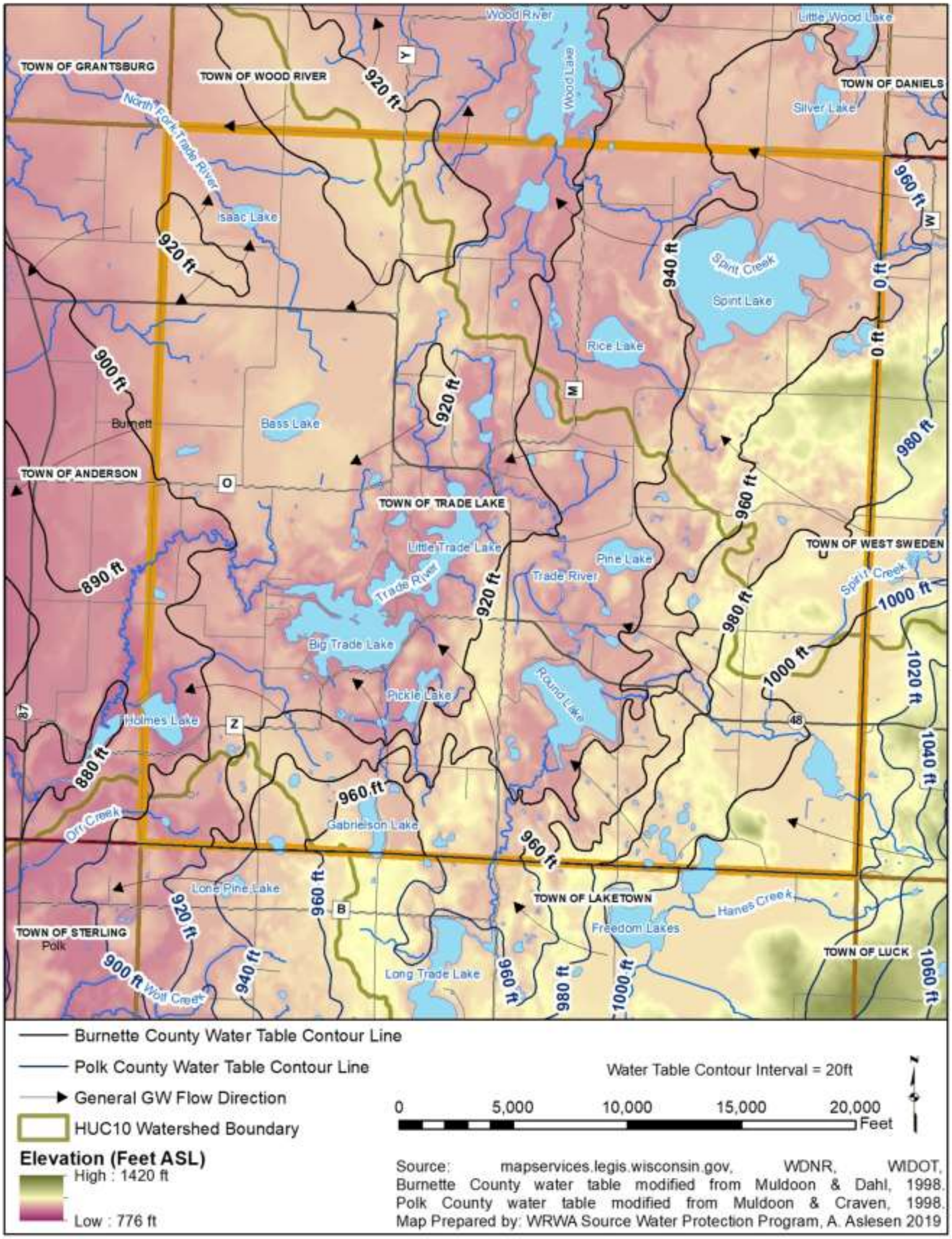


Figure 7 – Groundwater Flow



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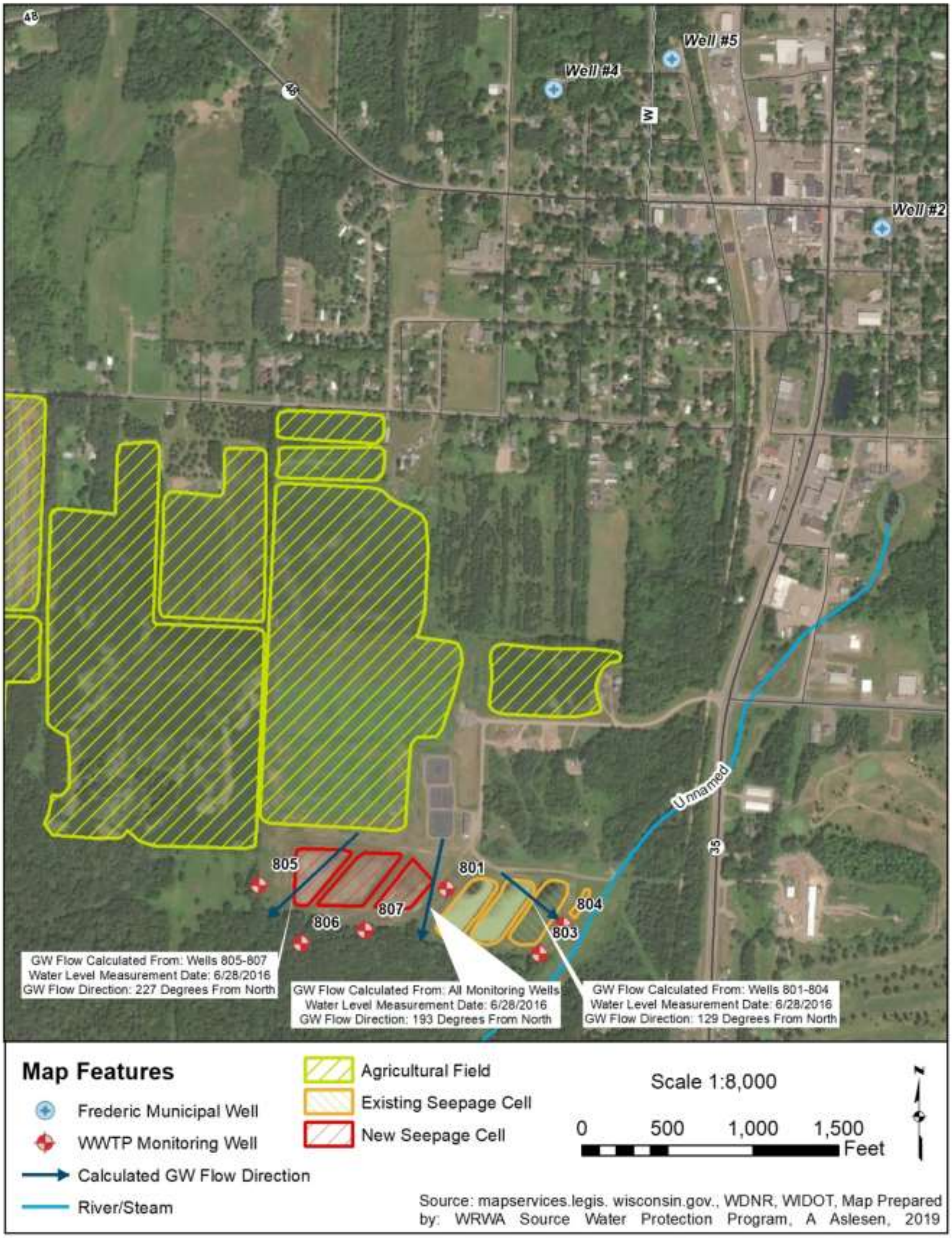
Appendix A, Frederic Wastewater Treatment Plant Nitrate Case Study

The village of Frederic in Polk County Wisconsin treats the village's wastewater using aerated lagoons which then discharge to seepage cells located south of the village. To insure that wastewater discharged to the seepage cells does not degrade groundwater quality, three monitoring wells 801, 803 & 804 are used. In 2004 Frederic's wastewater treatment plant was approaching the maximum capacity that they are able to discharge to their existing three seepage cells. To increase discharge capacity of the plant, the village installed three additional seepage cells and three additional monitoring wells, 805,806 & 807, in 2005. Initial groundwater sampling results from monitoring wells 805, 806 & 807 showed nitrate levels elevated above the groundwater enforcement standard of 10 mg/L. Since the groundwater was already above 10 mg/L the DNR would not allow the village to discharge to the seepage cells. Nitrate levels in the monitoring wells were measured quarterly, with levels remaining elevated. A summary of the measured nitrate concentrations in the monitoring wells from 2005-2014 is given below. The only upgradient source of nitrate is from agricultural activities north of the seepage cells. There are several fields north of the newly constructed seepage cells that are rented from the city by a local producer. The producer applied nitrate fertilizer at typical rates need for crop production; however nitrate levels in groundwater remain elevated. Frederic's experience demonstrates that in the shallow sand and gravel glacial aquifer groundwater is vulnerable to nitrate contamination from agricultural activates even when fertilizers are applied at recommended rates.

The map below shows the locations of the Village of Frederic's three existing seepage cells, three newly constructed seepage cells, monitoring wells and the agricultural fields up gradient of the monitoring wells. The flow direction of shallow groundwater at the site was calculated using the EPA's on-line tool for calculating hydraulic gradient and direction from at least three points. Calculations were done based on measured groundwater levels in the wells on June 28th, 2016. When calculated using all six monitoring wells the direction of GW flow is south and slightly southwest. When calculated using only MW801-804 GW flow is southeast. When calculated using only MW805-807 GW flow is southwest. This is likely because groundwater is recharging on the topographically high area north of the seepage cells and flowing south, southeast and southwest towards topographically low areas south southeast and southwest of the seepage cells.

Village of Frederic wastewater treatment plant seepage cells and surrounding area.



Village of Frederic WWTP monitoring wells quarterly nitrate sampling results 2005-2014.

Monitoring Well #805					Monitoring Well #806				
	3/15/2005	**6/29/2005**	**9/19/2005**	**12/20/2005**		**3/15/2005**	**6/29/2005**	**9/19/2005**	**12/20/2005**
NO2+NO3	2.46	2.22	no recharge	no recharge	NO2+NO3	0.77	0.91	1.85	0.66
	3/15/2006	**6/30/2006**	**9/28/2006**	**12/19/2006**		**3/15/2006**	**6/30/2006**	**9/28/2006**	**12/19/2006**
NO2+NO3	1.70	4.30	1.2	9.90	NO2+NO3	1.50	1.00	3.4	24.00
	3/14/2007	**6/21/2007**	**9/26/2007**	**12/14/2007**		**3/14/2007**	**6/21/2007**	**9/26/2007**	**12/14/2007**
NO2+NO3	12.00	30.00	26.00	20.00	NO2+NO3	9.90	29.00	8.80	12.00
	3/25/2008	**6/30/2008**	**9/10/2008**	**1/12/2008**		**3/25/2008**	**6/30/2008**	**9/10/2008**	**1/12/2008**
NO2+NO3	24	27	19	16	NO2+NO3	22	6.6	2.3	0.56
	3/20/2009	**6/12/2009**	**9/10/2009**	**12/29/2009**		**3/20/2009**	**6/12/2009**	**9/10/2009**	**12/29/2009**
NO2+NO3	24.00	19.00	dry	dry	NO2+NO3	0.48	0.42	0.22	dry
	3/18/2010	**7/2/2010**	**9/28/2010**	**12/20/2010**		**3/18/2010**	**7/2/2010**	**9/28/2010**	**12/20/2010**
NO2+NO3	dry	dry	dry	dry	NO2+NO3	dry	13	0.4	11
	3/29/2011	**6/27/2011**	**9/27/2011**	**12/31/2011**		**3/29/2011**	**6/27/2011**	**9/27/2011**	**12/31/2011**
NO2+NO3	dry	23	23	28	NO2+NO3	0.29	0.3	1.2	0.32
	3/22/2012	**6/25/2012**	**10/4/2012**	**12/11/2012**		**3/22/2012**	**6/25/2012**	**10/4/2012**	**12/11/2012**
NO2+NO3	27	28	18	19	NO2+NO3	0.045	0.43	0.64	0.33
	3/27/2013	**8/6/2013**	**9/25/2013**	**12/17/2013**		**3/27/2013**	**8/6/2013**	**9/25/2013**	**12/17/2013**
NO2+NO3	no recharge	17.1	no recharge	no recharge	NO2+NO3	0.3	0.4	0.5	1.4
	3/30/2014	**6/24/2014**	**9/23/2014**	**12/22/2014**		**3/30/2014**	**6/24/2014**	**9/23/2014**	**12/22/2014**
NO2+NO3	no recharge	no recharge	13.7	13.3	NO2+NO3	0.5	29.1	8.5	14

Monitoring Well#807				
	3/15/2005	**6/29/2005**	**9/19/2005**	**12/20/2005**
NO2+NO3	1.82	1.86	Dry	2.00
	3/15/2006	**6/30/2006**	**9/28/2006**	**12/19/2006**
NO2+NO3	1.40	2.80	3.30	3.30
	3/14/2007	**6/21/2007**	**9/26/2007**	**12/14/2007**
NO2+NO3	6.60	8.40	35.00	19.00
	3/25/2008	**6/30/2008**	**9/10/2008**	**1/12/2008**
NO2+NO3	no recharge	23	19	20
	3/20/2009	**6/12/2009**	**9/10/2009**	**12/29/2009**
NO2+NO3	14.00	17.00	no recharge	dry
	3/18/2010	**7/2/2010**	**9/28/2010**	**12/20/2010**
NO2+NO3	11	12	no recharge	11
	3/29/2011	**6/27/2011**	**9/27/2011**	**12/31/2011**
NO2+NO3	14	13	dry	12
	3/22/2012	**6/25/2012**	**10/4/2012**	**12/11/2012**
NO2+NO3	16	0.84	11	12
	3/27/2013	**8/6/2013**	**9/25/2013**	**12/17/2013**
NO2+NO3	no recharge	9.6	10.3	15.5
	3/30/2014	**6/24/2014**	**9/23/2014**	**12/22/2014**
NO2+NO3	14.5	11.9	15.8	18.5