TOWN OF PESHTIGO
W2435 OLD PESHTIGO ROAD
MARINETTE, WISCONSIN 54143

EVALUATION OF OPTIONS FOR LONG-TERM DRINKING WATER SUPPLY

TOWN OF PESHTIGO, WISCONSIN

DECEMBER 2019

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PROJECT NO. 06173-0001

CONTENTS

1 INTRODUCTION

The Town of Peshtigo (the Town) is located in Marinette County and is bordered by the City of Marinette to the north, the Town of Grover to the west, and the bay of Green Bay to the east and south. The Town lies in the southeast corner of Marinette County with State Highway 64 extending east-west at approximately the north edge of the Town and U.S. Highway 41 extends southwest- northeast through the Town. The City of Peshtigo is located wholly within the border of the Town, in the west-central portion of the Town, as shown in Figure 1-1.

As noted in public information available on the Wisconsin Department of Natural Resources (WDNR) Bureau for Remediation and Redevelopment Tracking System (BRRTS) website, multiple site investigations were conducted by Arcadis US, Inc. (Arcadis) on behalf of Johnson Controls, Inc. and Tyco Fire Products, LP (JCI/Tyco) at the Ansul Fire Technology Center (FTC) Site located in the City of Marinette starting in 2016 (Arcadis, 2016 Investigation Report, November 2016 and Arcadis, Site Investigation Report, September 2018). The Ansul FTC Site is a fire suppressant training, testing, research, and development facility where aqueous film-forming foams (AFFF) historically have been used in an outdoor testing/training area (OTA). According to JCI/Tyco, AFFF has not been sprayed outdoors at the OTA since November 2017 (Arcadis, Remedial Action Options Report (RAOR), May and September 2019). Multiple per- and poly-fluoroalkyl substances (PFAS) compounds have been included in various formulations of these foams. These site investigations identified migration of the PFAS compounds away from their testing field and additional testing showed that private wells in the Town of Peshtigo were contaminated with PFAS compounds (Arcadis, RAOR, May and September 2019).

The contaminated wells are located in an approximately 1 square mile area directly south of the City of Marinette in a neighborhood generally bordered by University Drive to the north, County Road B to the west, Rader Road to the south and Shore Drive to the east (the Study Area), as shown in Figure 1-2. Arcadis collected drinking water samples from a total of 168 private wells within the Study Area. Of these samples, detections of PFAS compounds above the laboratory reporting limit were shown in 58 locations and 16 locations show PFAS compounds exceeding the U.S. Environmental Protection Agency (EPA) Health Advisory Limit (HAL) of 70 parts per trillion (ppt) (Arcadis, RAOR, May and September 2019).

With known PFAS contamination in private wells, the affected Town of Peshtigo residents were provided with bottled water and/or point of entry treatment systems as short-term drinking water solutions. The Town of Peshtigo residents within the Study Area require a long-term supply of safe drinking water. On behalf of JCI/Tyco, Arcadis prepared a Remedial Action Options Report for Long-Term Drinking Water Supply with six (6) options for drinking water supply including the following:

- Alternative 1 – City of Marinette Public Water System Expansion
- Alternative 2 – Establish Town of Peshtigo Sanitary District

- Alternative 3 – Existing Private Individual Wells with Point of Entry (POET) Systems
- Alternative 4 – Private Special Casing Deep Water Supply Wells
- Alternative 5 – Town of Peshtigo Public Water System
- Alternative 6 – Combination of Water Supply Methods

The RAOR was submitted to WDNR on May 2019 and WDNR responded on July 9, 2019, requesting that JCI/Tyco also evaluate a City of Peshtigo Public Water System Expansion as Alternative 7.

The Town of Peshtigo expressed concerns with the recommendations of the RAOR and obtaining water from the bay of Green Bay due to probability of the PFAS migrating into the surface water. Cedar Corporation (Cedar) was hired in June 2019 to further evaluate the private deep well option and to evaluate a water supply from the City of Peshtigo (who obtains their water from groundwater) for provision of safe and long-term drinking water. This report will evaluate providing safe drinking water through private deep bedrock wells with special casing to extents below the PFAS contamination at each residence or connection to a municipal water supply from the City of Peshtigo and construction of a new water distribution system within the Study Area.

2 STUDY AREA CHARACTERISTICS

The City of Peshtigo 20-Year Comprehensive Plan (Comprehensive Plan), adopted on February 6, 2007, was prepared by Bay-Lake Regional Planning Commission for both the City and Town of Peshtigo. The Comprehensive Plan provided general background information for the Town including geographic location, geology, soils, water resources, and environmentally sensitive areas. The majority of the existing land uses within the Study Area are residential and woodland areas. Most residences are single family homes scattered along the roadways, with a greater concentration of residences along the shoreline of the bay of Green Bay.

2.1 Geographic Location

The Town of Peshtigo is located in Marinette County, Wisconsin, within the Lower Peshtigo River drainage basin. The Study Area is located in the northeast corner of the Town, just south of the City of Marinette and adjacent to the bay of Green Bay, as shown in Figure 1-1. Topography is generally sloping from west to east with elevations of approximately 600 feet above sea level on the west edge of the Study Area to about 580 feet above sea level near Shore Drive and the bay of Green Bay along the Town's eastern boundary. There are isolated ridges at elevations between 610 and 620 feet above sea level in the western part of the Study Area, as shown on the topographic maps included on Figures 2-1 and 2-2.

2.2 Regional Geology

The geology in the area includes a number of geologic formations which were formed at various ages. A geologic section from top to bottom would generally look as follows:

- **Glacial deposits**
    - ✓ Consist mostly of a combination of till and glaciofluvial medium-grained sands, gravel, cobbles and boulders. These unconsolidated formations are capable of providing good well yields where the formation is thick enough and where layers of course sands and gravel are found. This formation is the primary water source for a majority of the private wells within the Study Area.
- **Ordovician Sinnipee Formation**
    - ✓ Consist of a mixture of shale, dolomite/limestone, and sandstones. From top to bottom, this formation would consist of the Maquoketa shale, Sinnipee Group (Galena-Platteville-Decorah) dolomite, St. Peter sandstone, and Prairie du Chien dolomite. These formations are also generally capable of providing good well yields in the proper location.
        - ➢ ***Maquoketa shale*** - The Maquoketa yields very little water if any, thus is a very important part of geology when dealing with groundwater sources in that it can act as a confining layer separating aquifers above

and below. However, this shale formation can also be discontinuous in nature.

- ***Galena-Platteville-Decorah dolomite*** - This formation is predominantly the bedrock formation located directly below the glacial deposits. Depths to the dolomite range from 10 to 150 feet below the surface. As a water producer, this formation typically yields very little water except along thin fracture zones.
- ***St. Peter sandstone*** - This formation is quite thin in this area. Thickness of the St. Peter Sandstone is typically less than 100 feet. As a water producer, this formation typically has excellent well yield. This formation is the primary source of water for deep bedrock wells in the region.
- ***Prairie du Chien dolomite*** - This formation consists primarily of dolomite but does have some streaks of chert and shale. As a water producer, this formation typically has very poor well yields. Due to its characteristics, this formation acts somewhat as a barrier between the St. Peter and the Cambrian sandstones below. However, it is generally not tight enough to result in true confinement and thus is considered leaky.

- **Cambrian Formation**
  - ✓ Consist primarily of sandstones, with some streaks of dolomite and shale. As a water producer, this formation typically has excellent well yields, especially in the lower portions which contain less dolomite. Due to this characteristic, the Cambrian Sandstones have become the primary producer of municipal water throughout northeast Wisconsin. This formation also has its drawbacks in that there are typically zones high in radioactivity and the water usually has elevated levels of iron and hardness.
- **Precambrian Formation**
  - ✓ Consists of granite and is essentially impermeable to water.

2.3 Soils

The Comprehensive Plan, Marinette County Soil Survey, and the U.S. Department of Agriculture (USDA) Web Soil Survey provided information on soil types and characteristics in the area. Soils information including bedrock and water table locations provides useful data as to the support of structures and construction methods. The dominant soil association located in the Study Area is the Wainola-Deford association which generally covers the majority of the Study Area and includes Wainola, Deford-Cormant, Rousseau and Shawano soil types. Wainola soils are generally found on gentle slopes (0 to 3 percent) in drainageways and depressions on outwash plains and are somewhat poorly drained. Deford-Cormant soils are generally found on gentle slopes (0 to 2 percent) in drainageways, flats, and depressions and are poorly drained. Rousseau soils, which are moderately well drained, are found on the slightly higher flats and ridges with slopes of 1 to 6 percent. The Shawano soils are on broad ridges and side slopes (2 to 6 percent) and are excessively drained. The soils in the Study Area mainly consist of mucky sand and loamy, fine sand, and are primarily woodlands. Most of the urban areas in Marinette County have been developed on these soils.

2.4 Water Resources

Sources of water in Marinette County include surface water from the bay of Green Bay, Menominee, and Peshtigo Rivers, and ground water from sandstone, dolomite, and sand and gravel deposits. Surface water is hard and generally requires treatment but is then suitable for municipal and most industrial uses. Ground water in Marinette County is hard to very hard, and dissolved iron is a problem in a large area of the county.

A southeastward-dipping sandstone aquifer, yielding as much as 500 gallons per minute to municipal supply wells, underlies the Town. Sand and gravel layers in the upper aquifer yield as much as 50 gallons per minute to private wells. Present water problems in groundwater in the vicinity of the Study Area, other than PFAS contamination, may include iron, manganese, and radionuclides. The City of Peshtigo currently obtains their water from three (3) deep bedrock supply wells. Water from each water supply well is treated for removal of radium, iron, and manganese prior to distribution to residents within the City.

2.5 Environmentally Sensitive Areas

Environmentally sensitive areas are defined by the WDNR as areas such as wetlands, steep slopes, waterways, underground water recharge areas, shores, and natural plant and animal habitats that are easily disturbed by development. The WDNR Surface Water Data Viewer shows significant areas of delineated wetlands and wetland indicator soils within the Study area, as shown on Figure 2-3. Construction within these areas may require delineation by an assured wetland delineator to determine if the area is a wetland and/or permit approval by the WDNR and possibly the Army Corps of Engineers.

3 EVALUATION OF PRIVATE DEEP BEDROCK WELLS

3.1 Scope of Evaluation and Background Information

The evaluation to provide private deep bedrock wells at each residence within the Study Area included a review of data on the existing private wells, completion of preliminary well design criteria according to regulatory requirements, evaluation of existing water quality and estimation of potential costs for drilling, well construction, and on-going maintenance of each well. The private deep bedrock wells would replace the existing wells located on each residential property within the Study Area.

As discussed in Section 1, drinking water samples were collected by Arcadis on behalf of JCI/Tyco from a total of 168 private wells within the Study Area and detections of PFAS compounds above the laboratory-reporting limit were shown in 58 of those locations. For the purposes of this evaluation, it was assumed that the wells at each residence within the Study Area would be replaced rather than just the properties with detections of PFAS compounds.

3.2 Existing Well Construction Data

Through the WDNR Drinking Water System Database and Wisconsin Geological and Natural History Survey websites, historical well construction logs were found for approximately 63 of the existing drinking water wells within the Study Area. The existing wells varied in total depth from 24 to 622 feet (ft) below ground surface (bgs). The upper sand aquifer varies in depth from 12 to 110 ft bgs and bedrock depths range from 68 to 622 ft bgs.

Approximately 10 of the existing wells were installed within the bedrock aquifer, as shown on Figure 3-1. The existing deeper bedrock wells varied in total depth from 264 to 622 ft bgs with top of bedrock depths ranging from 86 to 115 ft bgs. The top of bedrock generally deepens from west to east and consists mainly of limestone, shale, and sandstone layers as shown in the cross-section details on Figures 3-2 and 3-3.

3.3 Regulatory Authority

Well construction and pump installation for private drinking water use is regulated by the WDNR in Chapter NR 812 of the Wisconsin Administrative Code (WAC). Chapter NR 2812 states that wells shall be installed by a licensed water well driller and pumps shall be installed by a licensed pump installer. In addition, the regulation outlines requirements for separation of the well from potential sources of contamination; installation procedures; surging and development of the well until the water is practicably clear; disinfection, flushing and sealing the well; pump testing; and sampling for coliform bacteria and nitrate at a minimum.

3.4 Preliminary Well Design

The proposed private deep bedrock wells will be constructed with a double casing to prevent the spread of contamination of PFAS compounds from the upper sand aquifer to the lower bedrock aquifer. It is standard practice to use double cased wells when there is a need to drill through an upper contaminated aquifer to a lower uncontaminated aquifer (U.S. EPA, Design and Installation of Monitoring Wells, February 2008). There is no guarantee that the double casing will prevent all spread of contamination, but it is the best available practice when drilling wells through a contaminated zone. A minimum 14-inch diameter borehole will be drilled from ground surface to approximately 5 feet into bedrock. A minimum 10-inch diameter outer steel casing will be installed inside the borehole and the annular space between the casing and borehole will be sealed with neat cement from the bedrock to the ground surface. A minimum 6-inch diameter inner steel casing will be drilled through the center of the 10-inch casing to the base of the 10-inch casing. The annular space between the inner and outer casings will be sealed with neat cement. The well will then be drilled with an open borehole through the bedrock to the desired final depth of approximately 600 ft. The wells will be installed within the sandstone layer below the limestone and shale layers.

Refer to Figure 3-4 for the preliminary well construction details. The depth of bedrock across the Study Area varies, so the depth of each casing may vary between approximately 80 and 125 ft. Actual depth of construction will be verified during installation activities.

Each well will be finished and sealed above grade. The well will be equipped with a submersible pump, which will be connected to the existing water supply line to each residence, and the existing well will be abandoned. The submersible pump will be set at a minimum of 10 ft below the pump test water level so that the pump is always submerged. Pump testing following well installation will determine the pumping level in each well, which may vary between approximately 80 and 160 ft.

Following completion of the well and pump testing, the well will be sampled for coliform bacteria and nitrates. Additional sampling and testing is recommended for PFAS compounds, arsenic, iron, manganese, sulfur, hardness, and radionuclides.

3.4.1 Proposed Well Maintenance and Treatment

Water treatment for each well may be required depending on the levels of arsenic, iron, manganese, sulfur, hardness, and radionuclides. These compounds are often naturally occurring within rock formations. In addition, water from deep bedrock wells may contain compounds that are not hazardous but do cause issues with taste, color, odor or cloudiness. However, treatment systems can be installed to remove iron, manganese, sulfur, hardness, and radionuclides. A water softening system with iron and manganese filters can be installed to remove iron, manganese, sulfur, and hardness. A reverse osmosis (RO) system can be installed as well for removal of radionuclides. A softening system is recommended as a pre-treatment step for the RO system to ensure the membranes do not become fouled as quickly. Each system requires some maintenance to replace membranes, salt or other filter media; however, these can often be done through an annual service call through the supplier of the water treatment system.

3.5 Estimate of Probable Project Costs

Table 3-1 below includes an estimate of probable project costs for installation of private deep bedrock wells at each residence within the Study Area. Cost estimates were provided by Luisier Drilling, Inc. (Luisier) of Oconto Falls, Wisconsin, for wells installed to a total depth of 600 ft bgs where the top of bedrock varies in depth from 80 to 125 ft bgs. The quotes provided by Luisier are included in Appendix A. Well installation costs include drilling of well, installation of casing and neat cement annular seal, development and disinfection of well, installation of aboveground well cap and seal, bacteria and nitrate samples, ½ horsepower submersible pump and connection to the existing service line. In addition, water treatment system costs include installation by the system vendor.

The estimate of probable project costs is a preliminary budget estimate for construction, technical, administrative and contingency costs. The cost estimate is based on best engineering judgement with preliminary design information. Economic conditions in the construction industry routinely cause price fluctuations in materials and labor; therefore, when final design documents and actual construction takes place there may be an impact on the project cost estimates.

Table 3-1
Installation of Private Deep Bedrock Well and Well Pump at all Locations within Study Area

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
Replacement Wells	168			
Estimate 35% with Top of Bedrock at 80 ft bgs	58	Per Well	$33,000	$1,914,000
Estimate 65% with Top of Bedrock at 125 ft bgs	110	Per well	$41,000	$4,510,000
Existing Well Abandonment				
Estimate 35% are Sandpoint Wells	58	Per well	$225	$13,000
Estimate 65% are Deeper Wells	110	Per well	$1,480	$163,000
Water Treatment Systems				
Water Softener and Iron/Manganese Filter	168	Per well	$5,500	$924,000
Reverse Osmosis System	168	Per well	$1,300	$218,000
	Total Estimated Well Installation Cost			$7,742,000
	Contingency			$1,161,000
	Engineering, Adm. and Legal			$774,000
	Total Estimated Project Cost			**$9,677,000**

3.6 Summary of Private Deep Bedrock Well Evaluation

The advantages, disadvantages, and additional considerations for installation of private deep bedrock wells at each residence within the Study Area are discussed below and a summary table is included in Appendix B.

3.6.1 Advantages

This alternative is consistent with the existing type of water service at each residence; therefore, the residents would be familiar with this installation. Implementation of this alternative could take place relatively quickly, as there are no regulatory permit approval time-frames, and creation of a Sanitary District would not be required. No monthly municipal water bills or utility fees would be required, and annual operating costs would be low, even if water treatment were required.

3.6.2 Disadvantages

Double-cased, deep bedrock wells involve a greater risk for long-term safe drinking water as there is no guarantee that contamination will not be transferred from the upper sand aquifer to the deeper bedrock aquifer. The transport and mobility of PFAS compounds are not yet well known, so there is no guarantee that contamination would not reach the deeper bedrock aquifer over time.

The water quality and quantity in the deeper aquifer in Study Area location is unknown at this time, and there is the risk of drilling to 600 ft and not finding sufficient water to operate a well. There are known water quality issues with iron, manganese, and radionuclides in the neighboring City of Peshtigo, which may be present in the deep water within the Study Area but will not be known until a well is drilled and sampled.

The DNR has concerns regarding the long-term effectiveness and safety of a deep well water supply within the Study Area. There is no regulatory requirement for periodic testing of private wells once the well is in use so the well may become contaminated in the future. In addition, wells do not provide for a backup water supply; therefore, if something happens to the well a backup water supply, bottled water, or individual treatment systems would be required.

3.6.3 Additional Considerations

Prior to selection of an alternative, negotiation and agreement of terms will be required between the Town and JCI/Tyco. JCI/Tyco has stated they would "replace the water supply that existed at the time of the identification of PFAS presence without intending to improve water quantity or provide for growth through development or subdividing parcels. The intent is to replace what was lost, not upgrade or improve on the previous supply method" (Arcadis, RAOR Section 1.2, May and September 2019). The investigation is not yet complete, so any negotiation or agreement should be written to include any additional areas within the Town that might require a new water supply due to PFAS contamination from JCI/Tyco.

4 EVALUATION OF MUNICIPAL WATER SUPPLY FROM THE CITY OF PESHTIGO

4.1 Scope of Evaluation and Background Information

The evaluation to extend the public drinking water supply from the City of Peshtigo to residents within the Study Area included a review of existing data from the City of Peshtigo Water Utility to determine the adequacy of the water supply and capacity to provide water to the Study Area in addition to City residents, estimation of the average water demand for the residents within the Study Area, completion of a preliminary design of a water distribution system according to regulatory requirements, evaluation of the requirements to form a Sanitary District, evaluation of existing water quality and estimation of potential costs for construction of the water distribution system. This alternative assumed that water would be purchased wholesale from the City of Peshtigo; therefore, a Sanitary District would need to be created for the Study Area to oversee distribution of water to residents. The Sanitary District would be responsible for metering water to residents, reading meters, invoicing and billing residents; operation and maintenance of all equipment, storage structures and piping within the distribution system; periodic sampling and monitoring of the system, and reporting to the Public Service Commission and WDNR, as required.

The proposed project will include a master meter at the connection to the existing water main in the City of Peshtigo; booster pump station with two (2) booster pumps for redundancy and all appurtenant valves, piping, meters and process controls; an elevated water storage tank for supply of sufficient water and pressure for fire protection; a chlorination system to provide disinfection within the Study Area; a water distribution system including necessary isolation valves and hydrants for flushing of the water main and fire protection; and all necessary equipment and personnel to operate and maintain a Sanitary District including water meters, a meter reader and utility equipment. Refer to Figure 4-1 for the preliminary water distribution system routing.

The City of Peshtigo has expressed interest in evaluating the requirements to supply water to the Town of Peshtigo; however, they may complete a separate evaluation to determine how this might affect their current operations. This section of the report will present preliminary sizing and locations of facilities for each alternative.

4.2 Regulatory Authority

4.2.1 Wisconsin Department of Natural Resources

A public water system, as defined by the WDNR, is a water system for the provision to the public of piped water for human consumption, having at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. A public water system is further classified as either a municipal or a community water system:

- *Municipal Water System* means a community water system owned by a city, village, county, town, town Study Area, utility district, public inland lake and rehabilitation district, municipal water district or a federal, state, county, or municipal owned institution for congregate care or correction, or a privately-owned Sanitary District serving the foregoing.

A water system meeting the *Municipal Water System* definition above would be subject to the regulatory authority of the WDNR. The following identify the regulations which would apply to the design and operation of a municipal water system within the Town of Peshtigo. The WDNR regulates the water system design and operation in the following Chapters of the WAC.

- Chapter NR 809 - Safe Drinking Water
  - ✓ Generally, addresses water quality, monitoring requirements, and record keeping.
  - ✓ Subchapter VIII - Water System Capacity, requires demonstrating to the WDNR that the water system shall have and maintain adequate financial, managerial, and technical capacity to meet the requirements of this chapter and the requirements of the Federal Safe Drinking Water Act.
- Chapter NR 811 - Requirements for the Operation and Design of Community Water Systems
  - ✓ Establishes the basic design requirements
  - ✓ Requires submittal of an engineering report and detailed plans and specifications for WDNR approval.
  - ✓ Requires a resident project representative at the site during construction.
- Chapter NR 812 - Well Construction and Pump Installation
  - ✓ Generally, provides requirements for locating and constructing a well.
  - ✓ Generally, provides requirements for well pumps and discharge facilities.

4.2.2 Wisconsin Public Service Commission

Application would be required to the Wisconsin Public Service Commission (PSC) to demonstrate a need and obtain approval to create a municipal water system. The PSC regulates the rate structure and system operation for municipal water systems in the following Chapter of the WAC.

- PSC 184 - Construction of and Placing into Operation of Water and Sewer Facilities
  - ✓ Defines activities requiring Commission authorization

- ✓ Process for applications for Commission authorization
- ✓ Defines Commission procedures

- PSC 185 - Standards for Water Public Utility Service.
  - ✓ Rate Schedules and Rules.
  - ✓ Service and Billing.
  - ✓ Records.
  - ✓ Engineering.
  - ✓ Customer meters and meter testing.
  - ✓ Operating requirements.

4.3 Study Area Water Demand

Many factors affect the use of water in a community. Some of the variables or factors responsible for fluctuations in water use include climate, composition of the community, water pressure, cost of water, metering of water uses and water quality. The water usage, due to these factors can vary considerably from year to year, day to day, and community to community. Temperature and rainfall affect water use because of the demands for lawn sprinkling, gardening, bathing, air conditioning, and/or running water to prevent freezing of water lines.

The volume of water both used by customers and lost throughout the system is affected by water pressure. Communities with low water pressure throughout the system typically tend to have lower water use, due to the reduction in volume of water flow over time. However, high water pressure may require more maintenance to prevent an increase in system and plumbing fixture leakage. Higher pressures also increase the volume of water that will flow through plumbing fixtures per unit of time.

Customers with metered services typically use less water than those on a flat rate. Metered customers can set larger benefits in water conservation as their bill can be lowered. Flat rates pass the risk on to the supplier. Consumers with higher quality water tend to use more water than where water may be objectionable. If water has an objectionable taste or has high chemical and mineral content such as iron, manganese or hardness the consumer tendency is to use less water or provide some type of individual treatment.

Since the Town of Peshtigo does not have a water system to provide water use data, estimates of water use will be based on data representing typical water use information. For this evaluation, water use will be estimated for residential use and fire protection. Residential and employees for business areas are considered domestic water users.

4.3.1 Population

Projections of water use for residential purposes are usually based on water use per capita (person). Census data is often used to project growth and demand for residential water use; however, the Study Area that is part of this evaluation is a very small portion of the Town of Peshtigo so using the Town population data will not be accurate. Instead, the number of wells that were sampled (assuming one well per household) and total number of parcels within the Study Area will be used as the basis for our population estimate. The Wisconsin Department of Administration (WDOA) prepares household projections for Wisconsin municipalities. The 2010 Census data shows the number of persons per household as 2.51 persons per household with declining projections per household of 2.40 in 2020, 2.35 in 2030, and 2.31 in 2040. The household projection for the year 2020 will be used for this report.

4.3.2 Residential Water Demand

The use of a variety of terms for water demand allows evaluating different components of the water system. This evaluation uses the following terms for water demand:

- *Average Day Demand* – The volume of water used on a typical day. Typically expressed in gallons per day (gpd).
- *Maximum Day Demand* – The largest volume of water used on any given day, expressed in gpd. Typically, maximum day demand ranges between 1.8 to 2.8 times average day demand. Since there is no information to determine maximum day water use, an average of 2.4 times average day demand will be used to determine the maximum day demand.
- *Peak Hour Demand* – The hour of the day when most water is used, expressed in gpd. This is often difficult to determine unless there are comprehensive records of hourly water pumped. Typically, peak hourly demand ranges between 2.5 to 4.0 times average day demand. Since there is no information to determine peak hour demand, an average of 3.2 times the average day water use to determine the peak hour demand will be used for this report.
- *Per Capita Demand* – The average volume of water used per person. Calculated by dividing the average daily water use by the population served by the water system. Typically expressed in gallons per capita per day (gpcd).

Average day water demand is generally used to determine the minimum amount of water that should be provided. Peak day water demand is used to determine the required water supply and peak hour water demand is used to determine the amount of water storage required for redundancy and operation fluctuations.

Private wells are not monitored to collect residential water usage as it would with a municipal water system; therefore, published per capita usage estimates for Wisconsin residents will be used. The USDA Rural Development uses an average of 50 gpcd for estimating water use. U.S. Geological Survey Circular 1081, Estimated Use of Water in the United States in 1990, provides an estimated water use for Wisconsin of 52 gpcd. The Wisconsin Water Library states that Wisconsin uses an average of 56 gpcd. An average of 56 gpcd will be used to calculate residential water demand considering it will provide the most conservative estimate.

Approximately 168 households are located within the Study Area; however, there are approximately 215 parcels. Estimates for residential water demand will be calculated using both the approximate number of households and parcels in order to provide an estimate for future growth. Using the 2020 WDOA estimate of 2.40 persons per household results in approximately 404 people within the Study Area currently and 516 people if all parcels are built upon. This number of persons will be used to calculate average day demand, maximum day demand, and peak hour demand using the peaking coefficients discussed above. Table 4-1 presents the estimated residential water demands.

Table 4-1
Estimated Residential Water Demands

POPULATION	AVERAGE DAY WATER DEMAND(1)		PEAK DAY WATER DEMAND(2)		PEAK HOUR WATER DEMAND(3)	
	GPD	GPM	GPD	GPM	GPD	GPM
404	22,620	15.7	54,300	37.7	72,380	50.3
516	28,900	20.1	69,360	48.2	92,480	64.2

(1) Population x 56 gallons per capita day.

(2) Multiply average day water demand by peaking factor of 2.4.

(3) Multiply average day water demand by peaking factor of 3.2.

4.3.3 Fire Protection Demand

Although the amount of water used in a typical year for extinguishing fires is usually a negligible part of total water used, the rate and volume of water used during a fire can be so great that it becomes the deciding factor in engineering the capacities of water storage, water supply, and water distribution.

The Insurance Services Office (ISO) or Commercial Risk Service rates water systems for the purpose of insurance. The three items of fire protection are rated by ISO: Alarm Reaction System, 10%; Fire Department, 50%; and Water Supply, 40%. Although the fire department has the largest portion of the scoring system at 60 points (alarm reaction plus fire department), the water supply portion accounts for a total of 40 points in the rating system. Of these 40 points used in rating a water supply, 35 points is for the performance of the water supply and 5 points is for hydrant condition and maintenance. It is recommended fire hydrants should be operated and maintained in accordance with American Water Utility Association Manual of Water Supply Practices No. M17.

The ISO or Commercial Risk Services also determines recommended fire flows in a given area of the community. The fire flow as defined by ISO is the estimated rate of flow needed, for firefighting purposes, to confine a major fire to the buildings within a block or other group complex. The determination of this fire flow depends upon the size, construction, occupancy, and exposure of buildings within and surrounding the block or group complex. The ISO also identifies a basic fire flow for use in areas not included in the specific area identified. This flow is indicative of the quantity of water needed for handling fires throughout the community. A municipality is not required to provide this basic rating within or throughout the water system. Lower fire flow availability will result in higher insurance rates for industrial and commercial developments. Therefore, a municipality must weigh the capital costs of fire protection with the insurance rates paid for by the water customers.

The WDNR per NR 811.63.3 requires water distribution mains serving fire hydrants be designed to convey a minimum of 500 gallons per minute (gpm) at a pressure of 20 pounds per square inch (psi) or greater for firefighting capabilities. For the purpose of this evaluation, the goal will be to provide 500 gpm fire flows for a period of 2 hours in residential areas.

4.4 Water Supply from the City of Peshtigo

4.4.1 General Background

The sources of water for water supply typically come from surface water or groundwater. Surface water sources are normally rivers, lakes, or impoundments, such as manmade reservoirs. Groundwater sources are normally described as coming from glacial deposits or bedrock formations.

Surface water sources are usually easily obtainable, if available, but tend to require a high degree of treatment to remove the solid matter, objectionable taste, odor, and color which are commonly found in river and lake water. Surface water quality also can vary throughout the year and thus make supplying a consistently quality product more difficult than typical groundwater.

Groundwater is usually clear and free of organic matter due to the filtration effect on water moving through soil, sand, gravel, or bedrock. Its quality, temperature, and mineral content are normally constant throughout the year, as well as, over long periods. Water from deep wells (bedrock wells) is usually clearer and is usually less susceptible to contamination than shallow wells (glacial deposits). Water from deep wells in a given area is generally similar in quality but is frequently higher in mineral content than shallow wells. Groundwater from deep wells can have high levels of inorganic chemicals and radionuclides.

The primary goal of a municipal water supply system is to furnish water safe for human consumption. A secondary objective is to provide water that is appealing and acceptable to the consumer. The US EPA has developed primary and secondary drinking water standards. Primary standards are established and set based on dangers to health. If primary standards are exceeded, the water supplier must either provide additional treatment or an alternative water supply source to protect the health of the consumers. The primary standards include Maximum Contaminant Limits (MCLs) for inorganic and organic chemicals, turbidity, coliform bacteria, and radionuclides. These standards are to be met at the entry point to the system and at the customer's tap. Therefore, water must be supplied in a form that does not introduce contamination from the distribution system.

While primary regulations apply to trace elements, compounds and micro-organisms affecting the health of consumers, secondary regulations deal with the aesthetic qualities of drinking water. The contaminants included in these secondary standards do not have a direct impact on the health of consumers, but generally affect taste, odor, color, or cloudiness of the water.

4.4.2 Basis for Analysis

The water supply of a municipal water system is evaluated for the quantity and quality of water that can be delivered. In determining the adequacy of water supply facilities, the source of supply must be large enough to meet the peak day system demand, with the additional supply to meet peak hour demand coming from storage.

Good engineering practice dictates that the water supply should be capable of delivering water under peak demand conditions with the single largest water supply source out of service. If the system was designed to provide the entire capacity of the supply to meet peak day demand, any portion of the supply that is placed out of service due to malfunction or maintenance will result in a deficient supply. For example, a community that relies primarily on groundwater for its supply should, at a minimum, be able to meet its peak day demand with at least one of its largest wells out of service.

4.4.3 City of Peshtigo Water Utility Supply

According to the City of Peshtigo, Wisconsin Groundwater Treatment Facilities Operation and Maintenance Manual (O&M Manual), the City of Peshtigo Water Utility consists of three (3) water supply well stations, 24.5 miles of distribution system pipeline, two (2) elevated storage tanks and Groundwater Treatment Facilities, as shown on Figure 4-1.

The water supply wells were constructed between 650 and 720 ft bgs and each well pump is sized for 460 gpm. The Groundwater Treatment Facilities are designed for an average annual demand of 516,000 gpd (358 gpm), a maximum day demand of 1,100,000 gpd (920 gpm) and can meet the maximum day demand with one (1) well out of service. The Water Utility has approximately 450,000 gallons of elevated storage, which is used to meet the projected peak hour demand. The Groundwater Treatment Facilities are sized to meet the average annual demand and maximum day demand with not more than 12 hours and 20 hours of operation, respectively.

Groundwater Treatment Facilities include a hydrous manganese oxide (HMO) filtration system that is operated at each well station to treat the raw groundwater. The Groundwater Treatment

Facilities were designed to reduce the combined radionuclide levels in the water to below the primary standards established by the WDNR and to lower the iron and manganese concentrations of the groundwater below the secondary standards established by the WDNR. A chlorination system is also provided for oxidation of ferrous iron and disinfection, and a fluoridation system is provided at each well station to minimize dental cavities.

A review of monthly operating reports from June 2018 through June 2019 was completed to identify the average day and maximum day pumping rates. As summarized in Table 4-2 below, the maximum water usage over this time period was 547,000 gpd (380 gpm), which is well below the 460 gpm operating limit of a single well pump.

Table 4-2

City of Peshtigo Water Utility
Monthly Operating Report Data (June 2018 through June 2019)

MONTH	AVERAGE DAY WATER USAGE		PEAK DAY WATER USAGE	
	GPD	GPM	GPD	GPM
June 2018	291,600	203	547,000	380
July 2018	290,161	202	439,000	305
August 2018	283,710	197	478,000	332
September 2018	247,233	172	361,000	251
October 2018	236,871	164	319,000	222
November 2018	210,833	146	278,000	193
December 2018	219,065	152	262,000	182
January 2019	222,710	155	288,000	200
February 2019	233,786	162	316,000	219
March 2019	233,903	162	294,000	204
April 2019	232,067	161	396,000	275
May 2019	240,516	167	400,000	278
June 2019	270,567	188	456,000	317

4.4.4 Proposed Water Supply

The proposed residential water demand for the Study Area, as shown in Table 4-1 above, is summarized below:

- Average day demand ranges from 22,620 to 28,900 gpd, resulting in an average 24-hour water supply of 15.7 to 20.1 gpm.
- Maximum day demand ranges from 54,300 to 69,360 gpd, resulting in an average 24-hour water supply of 37.7 to 48.2 gpm.

- Peak hour demand ranges from 72,380 to 92,480 gpd, resulting in an average 24-hour water supply of 50.3 to 64.2 gpm.

As discussed above, the City of Peshtigo Water Utility has a design capacity of 920 gpm and a reported maximum daily use of 380 gpm; therefore, has 540 gpm of available capacity, with one (1) well off-line. Assuming an average day demand of 20.1 gpm, the Water Utility will have 519.9 gpm remaining capacity after supplying water to the residents within the Town of Peshtigo Study Area.

4.5 Water Distribution System

4.5.1 General Background

After a water supply is obtained and treated, the distribution system delivers the water to all customers throughout the water system. The system must maintain adequate pressures for normal use and the high flows required for fire protection. The distribution system will include elevated storage, booster pumps, pipelines, control valves, hydrants, service connections, valves, and individual meters.

4.5.2 Basis for Analysis

The pipes of a distribution system are sized utilizing hydraulic criteria including the length of pipe, friction loss, changes in elevation, flow restrictions due to pipe fittings or valves, and rates of flow. The most important criterion is configuration; the pipes should be arranged in a gridiron or looped pattern. This gridiron pattern allows water to reach a location in the system through more than one path. A grid system also allows maintenance and repair of sections of the distribution piping without totally cutting off the water supply to large areas; thus, a water main break can be isolated and repaired while service is supplied by a different leg of the gridiron system. In actual practice, however, there are economical and logical reasons to have some dead-end pipes in the system. The dead-end pipes are usually located where water service is required for only a few users or where a future extension is contemplated for completion of the grid.

According to WAC Chapter NR 811 and the WDNR, the water distribution system should be sized and configured as follows:

- Deliver water under normal flow conditions at pressures ranging from 35 to 100 psi.
- Deliver desired fire flows (minimum 500 gpm) at a minimum pressure of 20 psi.
- Provide isolation valves located not more than one block or 800-foot intervals in residential districts.
- Provide hydrants from 350 to 600 feet depending on the type of area being served and the individual fire hose length and firefighting practices utilized.

Good engineering practices also come into effect when planning and constructing distribution piping. The velocity in the water mains should not exceed 5 feet per second (fps) under design conditions to reduce head losses and potential pressure surges. Consideration should also be given to the amount of friction loss in the pipes to minimize operation costs for the pumps and motors. Minimum flow velocity of 2 fps should be maintained to help keep the pipelines clean.

Valves should be adequately located and maintained throughout the distribution system to enable a section or sections of the piping to be shut off for maintenance, repair, or construction of an extension to the system with minimal service interruptions to users.

Hydrants should be strategically located to assure a reliable flow of water for firefighting and operation and maintenance purposes. The hydrant locations should be such that firefighting equipment can be attached and used with efficient fire hose layout and minimum amount of pressure loss through the hoses. In addition to the above flow maximizing characteristics, the following should also be considered:

- Hydrants along busy roadways should be installed with valves on the hydrant lead so that hydrant failure or damage will not interrupt customers during repair and maintenance.
- Hydrants should be within 200 ft of the potential fire source to maximize available fire flow from the hydrant and minimize the time required to layout hoses in the event of a fire.
- Hydrants should be standardized for universal connections and ease of maintenance.
- Hydrants should be located at the end of a service line and at intermediate locations as necessary to remove sediment from the line and optimize water quality within the distribution system.

4.5.3 Recommended Water Distribution Pipe Sizes and Routes

The Sanitary District would be responsible for connection to the existing water main in the City, installation of the master water meter, and all components of the proposed water transfer, distribution, storage, and chlorination system. Chlorination facilities will be provided to maintain a reasonable chlorine residual within the distribution system. The City of Peshtigo provides disinfection; however, due to the length of water main, the residual will not be maintained before it reaches residents in the Study Area.

The actual connection location to the City of Peshtigo water system has not been determined, but for the purposes of this report the recommended connection point is at the east end of the existing water main on Maple Street, just west of the intersection of Old Peshtigo Road, as shown on Figure 4-1. The connection point will include necessary isolation valves and backflow prevention devices as required to prevent backflow to the City of Peshtigo water system. Also, a master water meter will be required to record whole-sale water flow to the Sanitary District.

Based on flow and pressure data for the hydrants on Maple Street provided by the Water Utility, adequate pressure is not available in the system to transfer water approximately 23,765 ft (4.5 miles) to the Study Area and an additional 38,200 ft (7.3 miles) within the Study Area. Therefore, a booster pump station will be required to supply the water at adequate pressure to serve the Sanitary District's water system and proposed elevated storage. Duplicate pumps and motors will each provide peak day water demand to the Study Area water distribution system and a standby electrical generator will be installed to provide backup power to the pump station.

As shown on Figure 4-1, the proposed water main was located along existing roads between the City of Peshtigo and the Study Area. It was assumed that the main transmission line between the City of Peshtigo and the Study Area would be installed in the right of way adjacent to the roads, and the water main within the Study Area would be installed within the roadway and therefore would require restoration of the pavement. The following describes the location the proposed water main:

- Connect at the east end of Maple Street in the City of Peshtigo and continue northeast to Old Peshtigo Road.
- On Old Peshtigo Road, continue eastward and cross the existing railroad and under US Highway 41 overpass.
- Continue northeast on Old Peshtigo Road to Rader Road.
- Rader Road south and then east to the intersection of County Road B.
- County Road B northeast to the intersection of University Drive.
- At the intersection of County Road B and Madsen Road, continue approximately 2,800 ft westward on Madsen Road.
- University Drive east to the intersection of Woodland Road.
- Woodland Road southward to Oak Wood Beach Road and Cooke Lane.
- Shore Drive from University Drive southward to approximately 1,600 ft south of the intersection of Shore Drive and Rader Road.
- Weigers Road, westward from Shore Drive.
- Rader Road from the intersection at Shore Drive to the intersection at County Road B.
- Green Gable Road between University Drive and Rader Road.
- Stanley Lane from the intersection at Rader Road.

Water main within the Study Area was sized to provide 500 gpm fire flows to residential areas. To minimize pressure losses and maintain minimum cleaning velocities, it is recommended to design the water transmission main for 185 gpm with a 6-inch diameter pipe to provide at least 2 fps cleaning velocity and minimum head loss. A 6-inch diameter water main is also recommended within the Study Area to comply with NR 812 recommendations for minimum pipe sizing when providing fire protection. Along the length of the water main, sufficient valves and pressure loss controls will be placed to easily identify and isolate maintenance needs or breaks within the line that need repair.

4.6 Water Storage

4.6.1 General Background

The principal functions of a water storage facility are to:

- Store the water required to meet variations in normal operating demand.
- Provide reserves for fire protection or failures in pumping facilities.
- Stabilize system flows and pressures.
- Reduce the demands and capacity on the water supply facilities.

Water storage facilities may be of several different types or styles, including elevated tanks or in-ground reservoirs (as long as they are located high enough above the service area). Generally, storage facilities are constructed of steel or standard reinforced concrete. Local topography typically determines the style of reservoir to be constructed. In some areas where topography does not permit the economical location of storage at the desired hydraulic elevation, ground storage tanks and pumping may be the most logical means of providing adequate storage. The economy and desirability of pumped storage as compared to elevated storage must be determined in each individual area.

4.6.2 Basis for Analysis

The amount of water storage required is determined in part by customer demands, fire flow requirements, and the capacities of the water supply system. Fire flow conditions require a large amount of water in a short period of time. Thus, it is typically more economical to store most of the water requirements for fire flow conditions rather than design the water supply system to handle these large flow rates.

Storage is typically provided for what is termed as peaking or large demands for short periods of time. Storage is needed because the constant speed water supply pumps on wells or ground reservoirs generally operate below the peak hour demand rates. Thus, water is stored so it can be used to supply water when the demand rate exceeds the pumping rate and to allow the pumps to turn off. Usually water demand is lowest in the early morning hours and the tanks are filled during this time period. As the day progresses, water demand increases and usually peaks in late afternoon; the water storage tanks feed back into the system during this time period. An elevated water storage tank functioning in this manner helps maintain a relatively constant system pressure.

Standard water system engineering and WAC Chapter NR 811 requirement is to provide a minimum of the average daily water demand in elevated storage at an elevation to provide the users with water pressures that range from 35 to 100 psi of pressure at ground level.

Decreased water quality in storage tanks results from short-circuiting, incomplete mixing, low volume turnover, and high-water age. As a result, problems can occur with temperature stratification, loss of disinfectant residual, disinfection by-product (DBP) spikes, bacteria regrowth, biofilm growth, taste and odor, and nitrification (chloramines). To maintain water quality in a water storage tank it is recommended that volume turnover be maximized to minimize water age and obtain mixing to eliminate short-circuiting of older water. A tank's volume turnover determines the average age of water in the tank. A common goal is a 20 to 30 percent daily turnover resulting in water age of 3 to 5 days. Water age, however, assumes complete mixing of a tank's contents. If a tank is not mixed, and if the oldest water is not drawn from the tank first, the tank will short-circuit and cause a localized increase in water age.

4.6.3 Elevated Water Storage Tank Recommendations

The water supply from the City of Peshtigo Water Utility will discharge into a 75,000-gallon elevated storage tank, which will provide a little more than the peak hour demand. This storage volume will also supply fire protection volumes of 500 gpm for a period of 2 hours. The functional water storage volume includes system operational volume, equalizing volume and fire/emergency volume. Operational volume is the difference in volume between water supply pump on and pump off levels. Equalizing volume is to provide water during the daily water use variations when water demand is more than the water supply pump flow rate. Fire/emergency volume is water used for firefighting or water used for an emergency situation such as when a water supply pump is out of service. Operational volume and equalizing volume will be provided from water supply rather than from water storage during a fire condition.

Table 4-3 provides water storage volume requirements based on minimum required volume and fire flow volume.

Table 4-3
Water Storage Volume Requirements

	FIRE/EMERGENCY VOLUME (500 GPM FOR 2 HOURS)	MIN AVERAGE DAY DEMAND	AVERAGE DAY TURNOVER OF TANK
PROPOSED DEMAND	60,000 gal.	22,620 gal.	30%

The smallest standard tank size of 75,000 gallons would meet the needs estimated for a 500 gpm fire flow for 2 hours. To provide mixing it is recommended that both a passive mixing system and an active mixing system be provided. The active mixing system is especially needed to provide mixing of water ages and to prevent freezing during winter operation during the initial years of operation.

It is recommended that the tank be located on property at a higher elevation than the majority of the Study Area. There are isolated high points on County Road B near Madsen Road and at the west end of Stanley Lane with elevations of approximately 620 ft above sea level. However, it is likely that the Sanitary District will have to negotiate with private landowners to purchase or lease the required land to place the storage tank. Locating the tank with a ground elevation of 620 ft and establishing the high-water line in the tank at elevation 758 ft (tank height of 137 ft) would provide minimum static pressure during normal operation of 60 psi at the highest ground elevation of 620 ft and maximum static pressure during normal operation of 77 psi at the lowest ground elevation of 580 ft along the shoreline of Green Bay.

4.7 Estimate of Probable Project Costs

Tables 4-4 through 4-6 below include estimates of probable project costs for installation of a municipal water supply from the existing City of Peshtigo system to the Town of Peshtigo Study Area. The costs have been separated into three (3) phases including the elevated storage tank, booster pump station and water distribution system from the City of Peshtigo to the booster station; the water distribution system from the booster station to the Study Area at the intersection of County Road B and Rader Road; and the water distribution system within the Study Area. Fire service has only been estimated within the Study Area; however, this may be expanded to the main transmission line as well or removed from the estimate if fire protection is determined not to be needed.

The estimates of probable project costs are preliminary budget estimates for construction, technical, administrative and contingency costs. The cost estimates are based on best engineering judgement with limited design information. Economic conditions in the construction industry routinely cause price fluctuations in materials and labor; therefore, when final design documents and actual construction takes place there may be an impact on the project cost estimates.

Table 4-4

Phase 1. Elevated Water Storage Tank, Booster Pumping Station and Water Distribution to the Booster Station

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
75,000 Gallon Elevated Water Storage Tank	1	L.S.	$535,000	$535,000
Booster Pump Station Building	400	S.F.	$500	$200,000
Mechanical (Booster Pumps, Piping, Valves, Meters)	1	L.S.	$75,000	$75,000
Chlorination System	1	L.S.	$20,000	$20,000
Electrical	1	L.S.	$15,000	$15,000
SCADA System	1	L.S.	$25,000	$25,000
Site Work	1	L.S.	$10,000	$10,000
Three Phase Power by Power Company	1	L.S.	$75,000	$75,000
C-900 PVC Water Main	5,500	L.F.	$88	$484,000
Gate Valve w/ Valve Box	8	Each	$3,000	$24,000
Horizontal Boring Under Railroad and Hwy 41	300	L.F.	$700	$210,000
Erosion Control	1,000	L.F.	$3	$3,000
Traffic Control	1	L.S.	$21,000	$21,000
Landscaping (top soil, seed , fertilizer)	16,000	S.Y.	$3	$48,000
			Estimated Construction Cost	$1,745,000
			Contingency	$263,000
			Engineering, Adm. and Legal	$384,000
			Total Estimated Phase 1 Cost	**$2,392,000**

Table 4-5

Phase 2. Water Distribution System from the Booster Pumping Station to the Intersection of County Road B and Rader Road

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
C-900 PVC Water Main	18,265	L.F.	$88	$1,607,000
Gate Valve w/ Valve Box	24	Each	$3,000	$72,000
Erosion Control	2,000	L.F.	$3	$6,000
Traffic Control	1	L.S.	$36,000	$36,000
Landscaping (top soil, seed , fertilizer)	51,000	S.Y.	$3	$153,000
			Estimated Construction Cost	$1,874,000
			Contingency	$281,000
			Engineering, Adm. and Legal	$412,000
			Total Estimated Phase 2 Cost	**$2,567,000**

Table 4-6

Phase 3. Water Distribution System within the Study Area
(Bordered approximately by Rader Road, County Road B, University Drive and Shore Drive)

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
C-900 PVC Water Main	38,200	L.F.	$88	$3,361,600
Gate Valve w/ Valve Box	49	Each	$3,000	$147,000
HDPE Service to Residence (Assume 125 feet per parcel)	26,875	L.F.	$50	$1,344,000
Fire Hydrant	65	Each	$4,000	$260,000
C-900 PVC Hydrant Lead	1,625	L.F.	$45	$73,000
Gate Valve on Hydrant lead	65	Each	$1,500	$98,000
Erosion Control	7,000	L.F.	$3	$21,000
Traffic Control	1	L.S.	$85,000	$85,000
Asphalt Pavement	14,900	Ton	$85	$1,267,000
Aggregate Base Course	21,200	C.Y.	$20	$424,000
Landscaping (top soil, seed , fertilizer)	181,000	S.Y.	$3	$543,000
Existing Well Abandonment:				
Estimate 35% are Sandpoint Wells	58	Each	$225	$13,000
Estimate 65% are Deeper Wells	110	Each	$1,480	$163,000
	Estimated Construction Cost			$7,800,000
	Contingency			$1,170,000
	Engineering, Adm. and Legal			$1,716,000
	Total Estimated Phase 3 Cost			**$10,686,000**
	Total Estimated Project Cost			**$15,645,000**

4.8 Summary of Municipal Water Supply Evaluation

The advantages, disadvantages, and additional considerations for installation of a municipal water supply from the City of Peshtigo to the Town of Peshtigo Study Area are discussed below, and a summary table is included in Appendix B.

4.8.1 Advantages

The City of Peshtigo water supply is a regulated and treated drinking water supply; therefore, is likely the safest source and represents the least overall risk for a long-term supply of drinking water. The City currently treats their water for removal of radium, iron, and manganese so no additional treatment would be required for homes within the Sanitary District.

The City of Peshtigo has a sustainable and redundant water supply, with adequate supply to provide water to the Sanitary District including the option for fire protection flow, which may potentially increase property values and/or reduce home insurance costs. Groundwater flow direction is generally east-southeast towards Green Bay so the potential for PFAS contamination from the Ansul FTC Site in the City of Marinette reaching the City of Peshtigo water supply wells is minimal. Overall, the proposed municipal water supply will reduce the risk of residents drinking contaminated water.

4.8.2 Disadvantages

The municipal water supply alternative will take longer to implement than drilling private deep bedrock wells. Creation of a Sanitary District to oversee, regulate, and administer the supply of municipal water supply to residents within the Study Area is a separate and potentially time-consuming process that will need to be completed in addition to the design, permit approval and construction phases of the project. Multiple agencies including WDNR and PSC will require design review and permit approvals prior to construction. The water main will have to be horizontally bored beneath the existing railroad and Highway 41 overpasses in the City of Peshtigo, and coordination with the railroad and WDOT for these crossing permits may take additional time. Depending on the location of construction, a wetland delineation may be required and potential wetland disturbance permitting with the Army Corps of Engineers for installation of water main may be required. Higher costs for construction, capital, and operating costs will be required and customers will receive water bills, which they are currently not used to.

4.8.3 Additional Considerations

Negotiation with City of Peshtigo will be required to determine whether they wish to pursue this project and what the wholesale costs of water would be. A Sanitary District will need to be established for the Study Area and staffed. Customer use rates will need to be defined based on wholesale water costs from the City and the operation, maintenance and administrative costs associated with operating a Sanitary District. Operation of the approximately 12 miles of water distribution system will require a licensed operator to provide routine maintenance, flushing of the water mains, maintaining chlorine residual, meter reading, and any necessary repairs, etc.; and administrative staff to provide billing/invoicing, customer service and routine report preparation for multiple state agencies.

Prior to selection of an alternative, negotiation and agreement of terms will be required between the City, Town, and JCI/Tyco. JCI/Tyco has stated they would “replace the water supply that existed at the time of the identification of PFAS presence without intending to improve water quantity or provide for growth through development or subdividing parcels. The intent is to replace what was lost, not upgrade or improve on the previous supply method.” (Arcadis, RAOR, May and September 2019). The investigation is not yet complete, so any negotiation or agreement should be written to include any additional areas within the Town that might require a new water supply due to PFAS contamination from JCI/Tyco.

Before any public water system can be constructed, authorization will need to be obtained from the PSC. The final system design will need to be completed and submittal of that report to the PSC begins the process of obtaining PSC approvals. It will take PSC approximately 60 days to respond or request additional information after they receive the application. If there are questions, it could take up to 180 days for authorization. If they decide a public hearing is necessary, then more time may be necessary before PSC authorizes the formation of the Sanitary District and authorization to proceed with the proposed project. In addition, the submittal of the final design report to WDNR begins the approval process with WDNR, which could take up to 90 days.

The time required to implement this alternative would include design, bidding, and construction of the proposed water distribution and storage system, creation of a Sanitary District and all necessary permit approvals. Timing of this process would be estimated once an alternative is selected and negotiations with JCI/Tyco and the City of Peshtigo are complete.

5 CONCLUSIONS

The deep bedrock well alternative would be a greater risk for long-term drinking water supply to the Town when compared to a municipal water system. There is no guarantee that contamination will not be transferred from the upper sand aquifer to the deeper bedrock aquifer and there is no regulatory requirement for periodic testing of private wells. Once the well is in use it may become contaminated in the future. Additionally, there are known water quality issues with iron, manganese, and radionuclides in deep bedrock wells within the region, which may also be present in the deep bedrock aquifer within the Study Area. The actual water quality will not be known until a well is drilled and sampled, which then might require individual treatment systems in order to be useable.

A municipal water supply is a regulated and treated drinking water supply. Testing of the water supply is required and on-going, so any issues that may be present in the water source will be treated prior to distribution to residents within the Town. A municipal water supply is considered the safest source and represents the least overall risk for a long-term supply of drinking water.

Prior to selection of an alternative, negotiation and agreement of terms will be required between the Town and JCI/Tyco which may affect which alternative is chosen. WDNR involvement would also be expected when selecting the final alternative. The investigation is not yet complete, so any negotiation or agreement should be written to include any additional areas within the Town that might require a new water supply due to PFAS contamination from JCI/Tyco.

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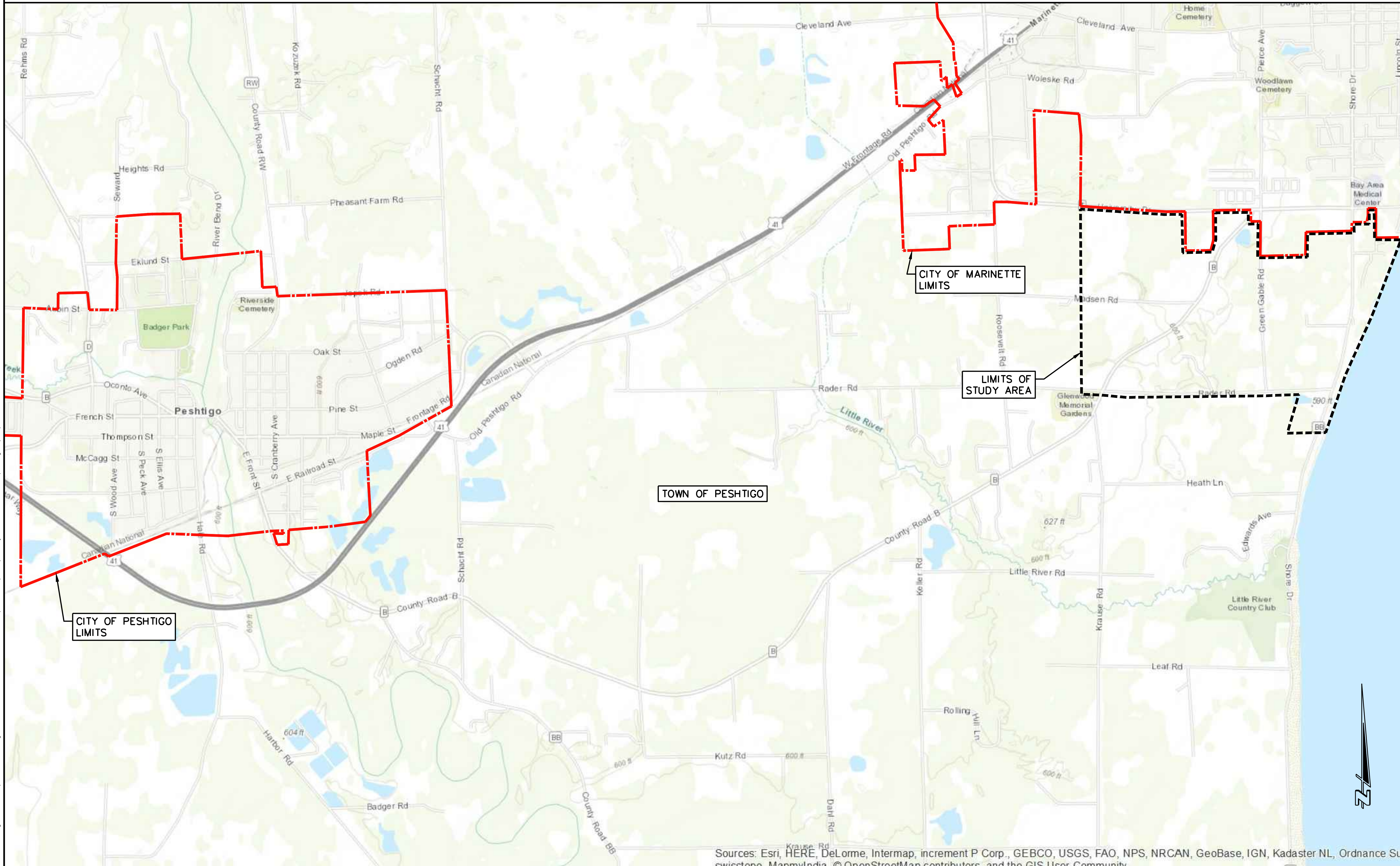
FIGURES

List of Figures:



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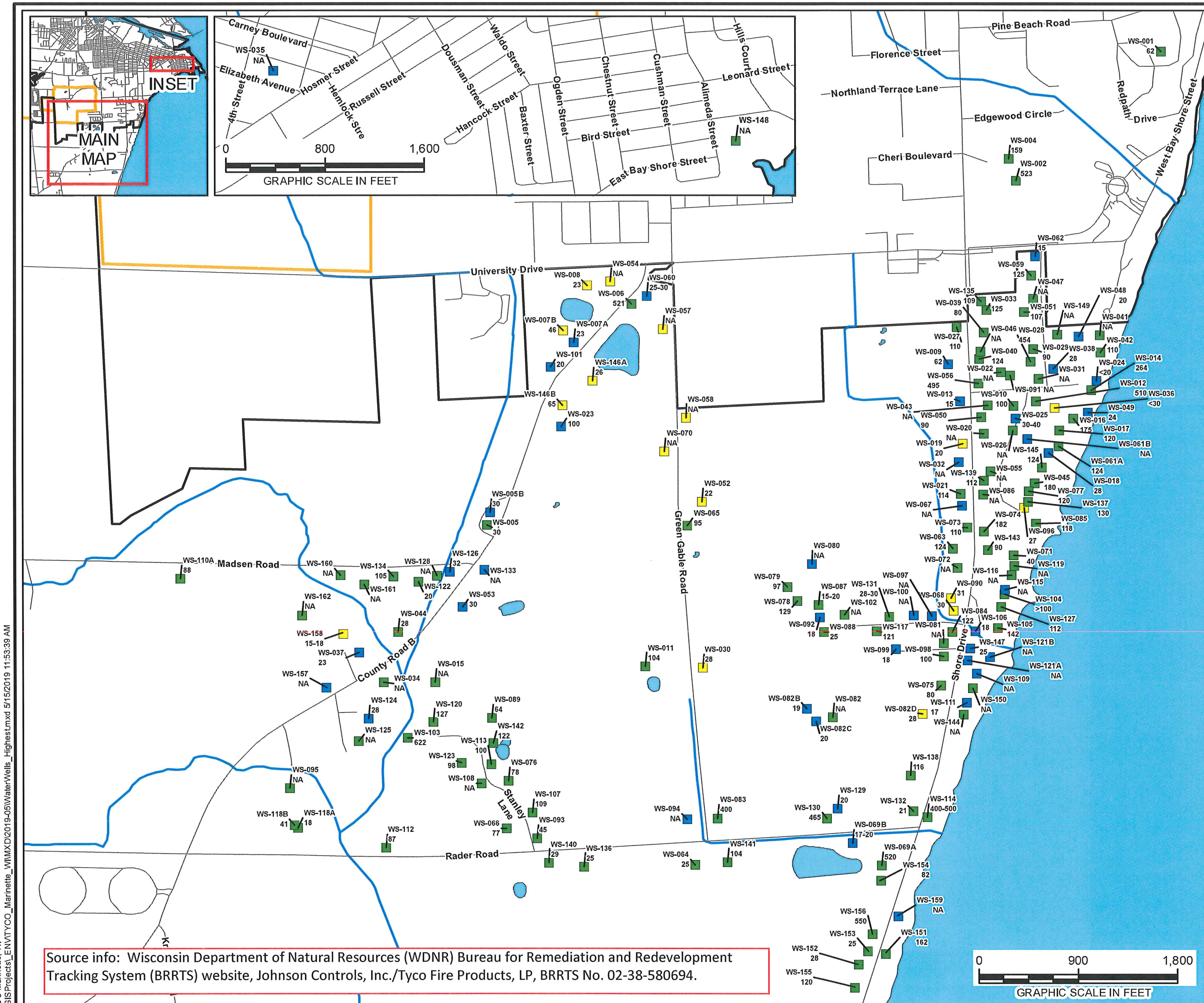
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
VICINITY MAP

SHEET NO.
FIGURE 1-1



LEGEND:

DRINKING WATER WELL LOCATION

- PFOA AND/OR PFOS BELOW REPORTING LIMIT
- PFOA AND/OR PFOS DETECTION ABOVE HAL
- PFOA AND/OR PFOS DETECTION BELOW HAL
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

WS-049 - LOCATION NAME
24 - WELL DEPTH

YELLOW SHADOWING PFOA DETECTION ABOVE HAL
BLUE SHADOWING PFOA DETECTION BELOW HAL
GREEN SHADOWING PFOA NOT DETECTED

VAP-08 - LOCATION NAME
42.3 - PFOA CONCENTRATION IN ng/L
(8-12) - VAP SAMPLE DEPTH INTERVAL IN FEET

5/15/2019

CONTAINS PERSONALLY IDENTIFIABLE INFORMATION

NOTES:

1. THE DATA REFLECTED IS THE HIGHEST VALUE DETECTED FROM THE VARIOUS ANALYSES.
2. WELL LOCATIONS ARE APPROXIMATE.

TYCO FIRE PRODUCTS LP
MARINETTE, WISCONSIN

DRINKING WATER WELL LOCATIONS WINTER 2019

ARCADIS

FIGURE 1-2

City: Minneapolis/Citrix Div/Group: IMDVC Created By: Last Saved By: msmiller
TYCO Marinette, WI
Z:\GISProjects_ENV\TYCO_Marinette_WI\MXD\2019-05\WaterWells_Highest.mxd 5/15/2019 11:53:39 AM

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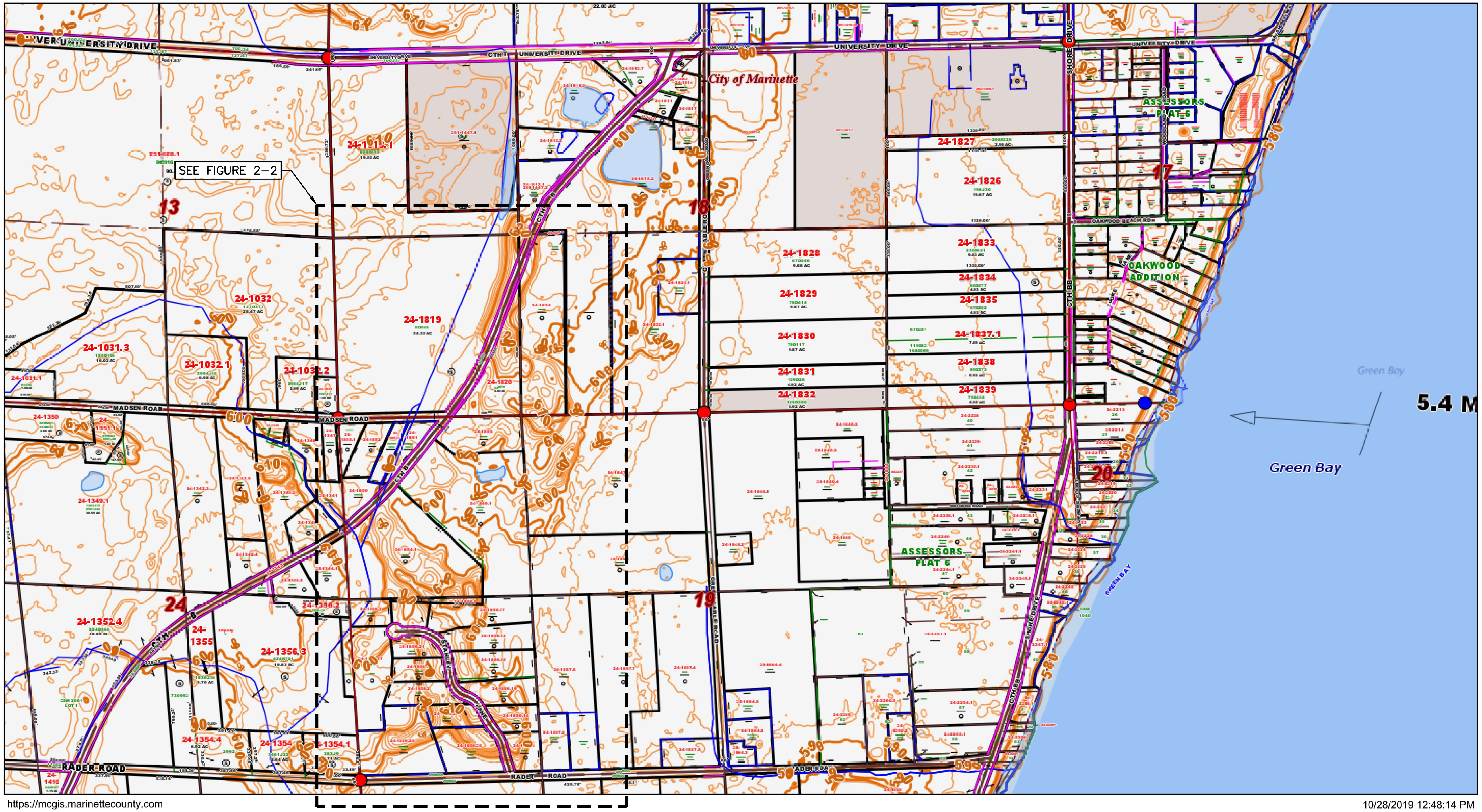

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TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
CONTOUR MAP – ENTIRE STUDY AREA

SHEET NO.
FIGURE 2–1

I:\Clients-GrBay\P\P6173 Peshtigo Town of\001 Consulting Services – GW-DW Contamination\100 Cad\DWG\Contour Maps.dwg 10/28/19 2:01:26 PM

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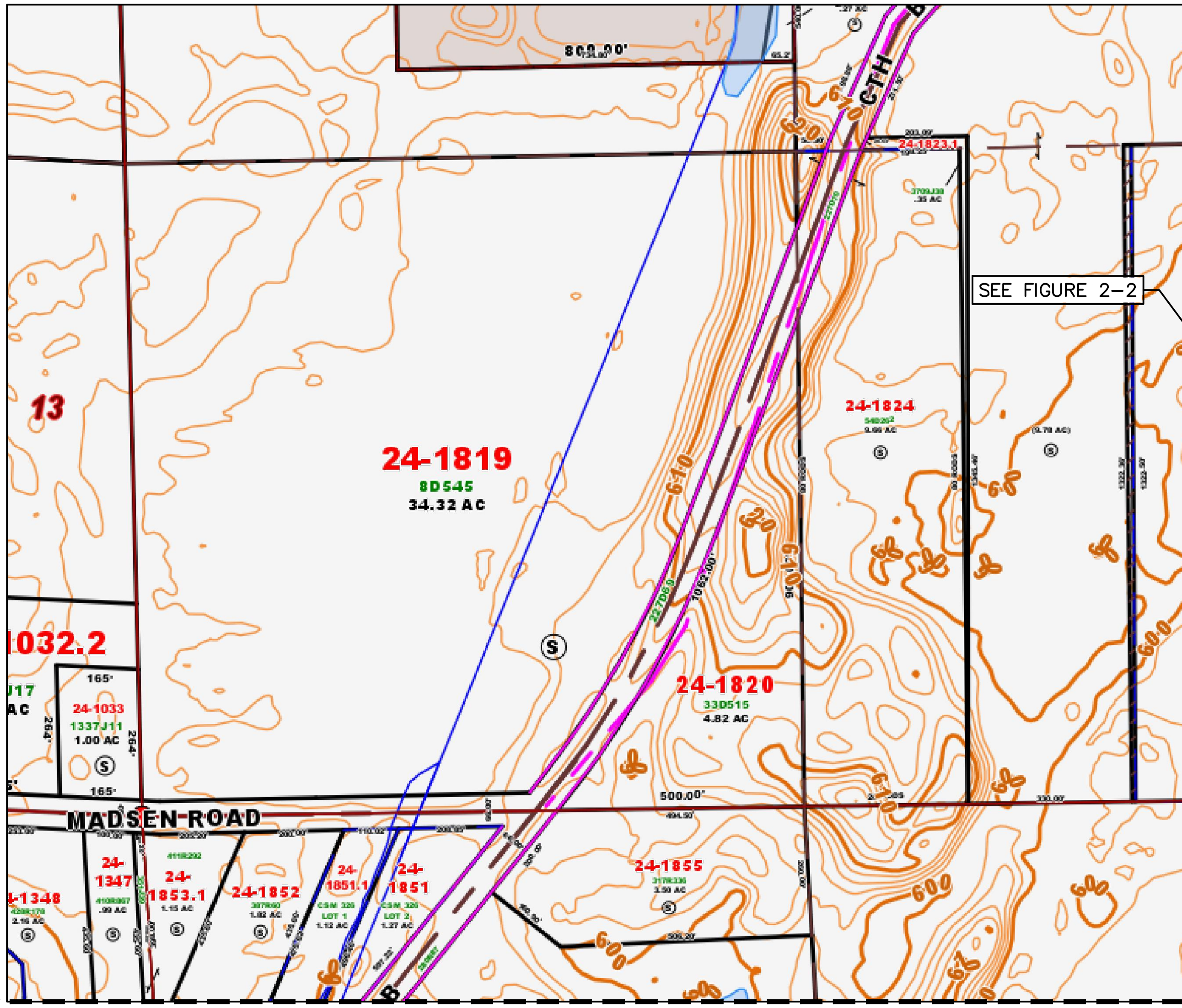
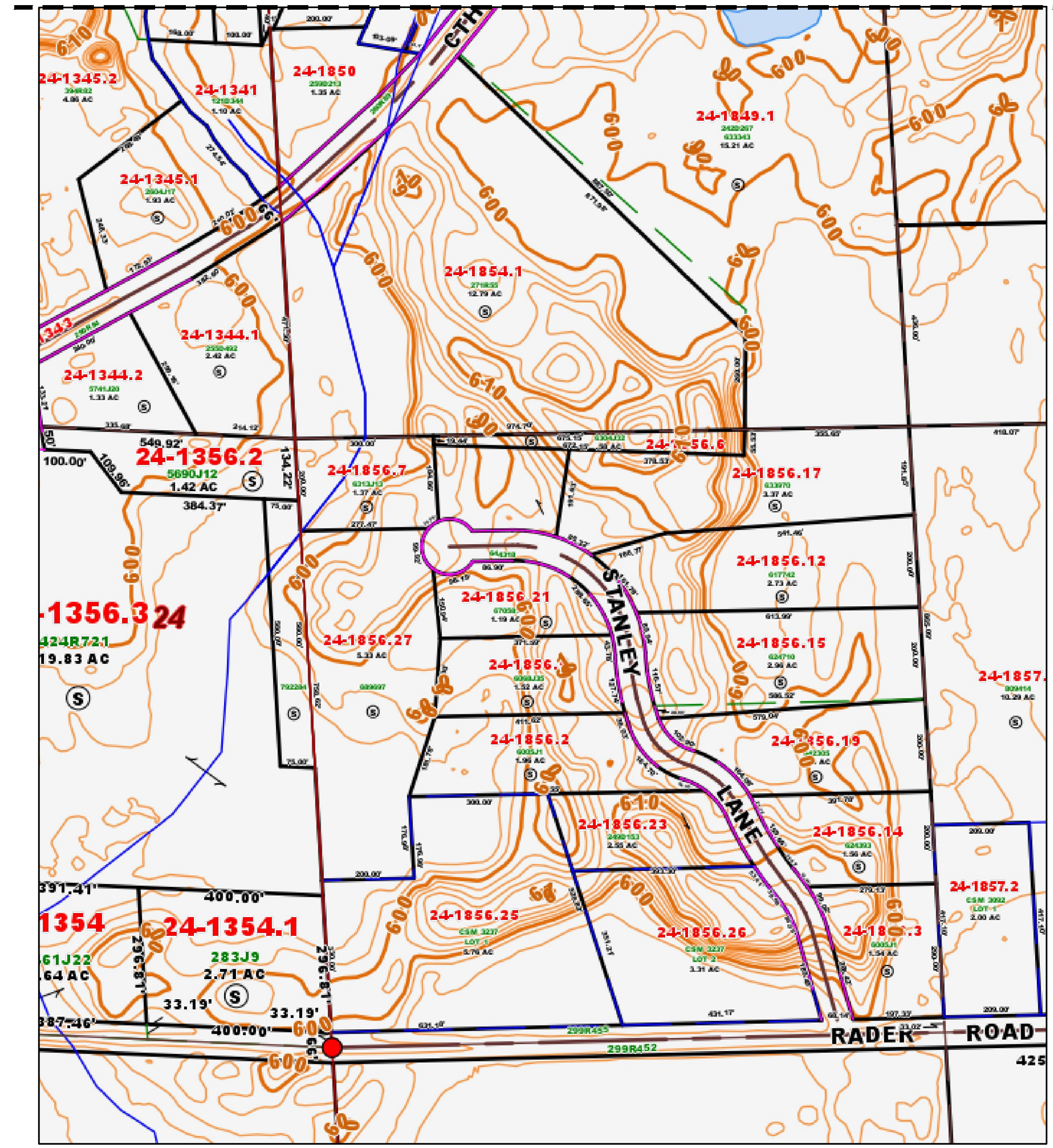


CONTOUR MAP AT COUNTY ROAD B AND MADSEN ROAD



CONTOUR MAP AT STANLEY LANE AND RADER ROAD

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Notice/Disclaimer: The land records site is intended to be a general guide to property and land information, and does not represent a survey of real property nor should it be used or referenced to for conveyance of real property, guaranteeing title thereto or making official determinations of building development, permitting or other activity. Contact the appropriate County Department to obtain original source documents or for official determinations. This information has been developed from various sources and although efforts have been made to ensure accuracy and reliability; errors, omissions and variable conditions originating from compilation and sources used to develop the information may be reflected herein. In addition, land information is constantly changing and the most current or accurate data might not be represented. The information accessible through this site is represented "as is" without warranty of any kind, either expressed or implied, or statutory, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose. No guarantee of accuracy, completeness or currentness is granted nor is any responsibility for reliance thereon assumed. The user assumes the entire risk as to the quality, use and reliability of the entire information. Marinette County does not accept any liability for damages or misrepresentation of any kind caused by inaccuracies in the information and in no event shall Marinette County, its elected or appointed officials or employees be liable for direct, indirect, incidental, consequential or special damages of any kind.

N

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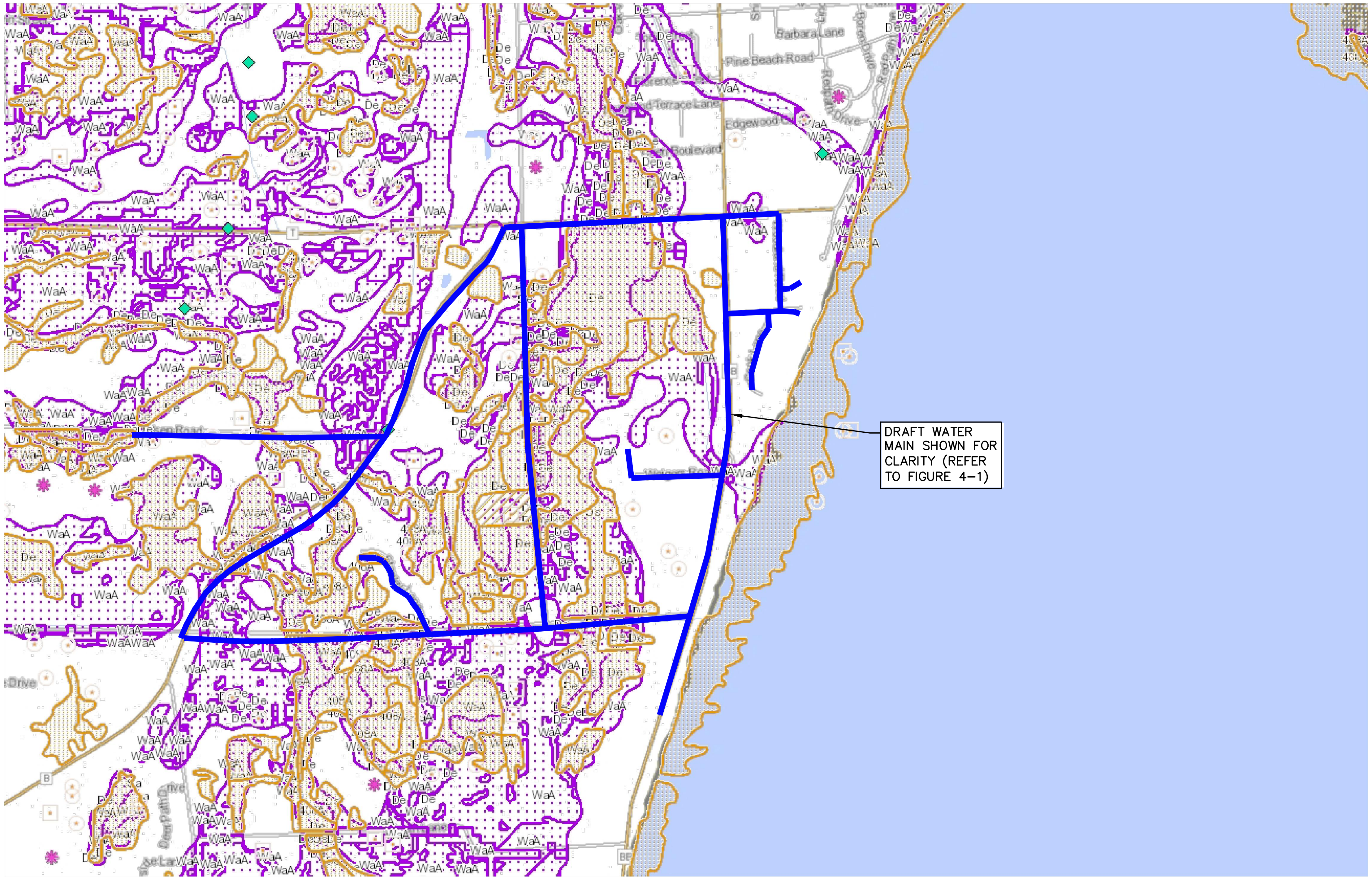
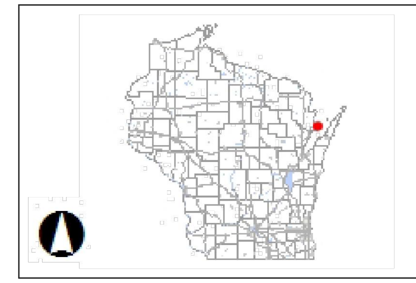
TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
CONTOUR MAP – WEST STUDY AREA

SHEET NO.
FIGURE 2-2

DRAWING NOT TO SCALE

Surface Water Data Viewer Map - Town of Peshtigo Study Area





Legend

- Wetland Identifications and Confirmations
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
- Filled Points
- Wetland Class Areas
  - Wetland
  - Upland
- Filled Areas
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
- Filled Points
- Wetland Class Areas
  - Wetland
  - Upland
- Filled Areas
- NRCS Wetspots
- Maximum Extent Wetland Indicators
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water

Source info: Wisconsin Department of Natural Resources (WDNR) Surface Water Data Viewer (including mapped wetland and wetland indicators & soils layers)

Notes

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TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
WDNR MAPPED WETLANDS – STUDY AREA

SHEET NO.
FIGURE 2-3

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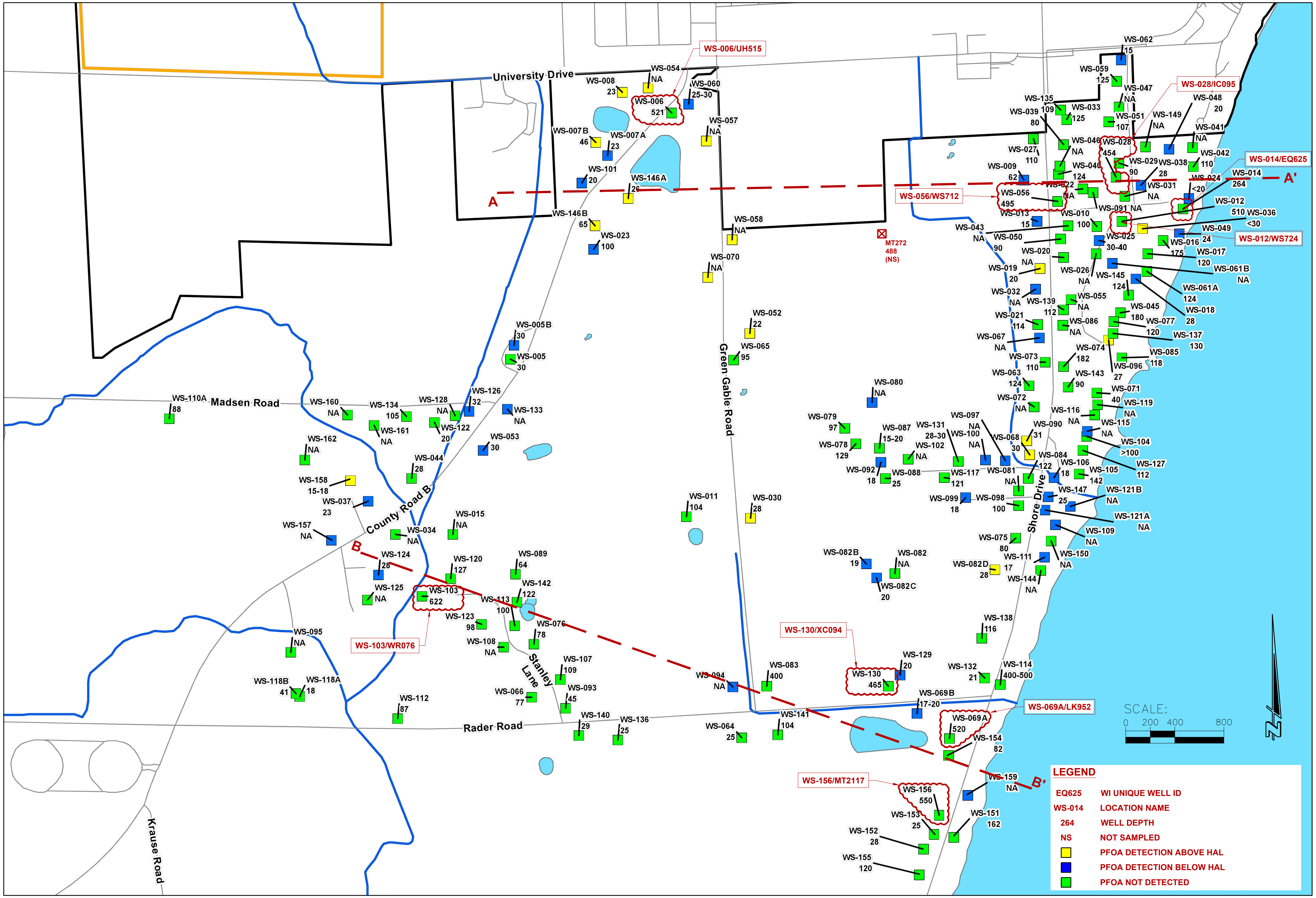

Source info: Wisconsin Department of Natural Resources (WDNR) Bureau for Remediation and Redevelopment Tracking System (BRRTS) website, Johnson Controls, Inc./Tyco Fire Products, LP, BRRTS No. 02-38-580694.

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TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
CROSS SECTION LOCATION MAP

SHEET NO.
FIGURE 3-1

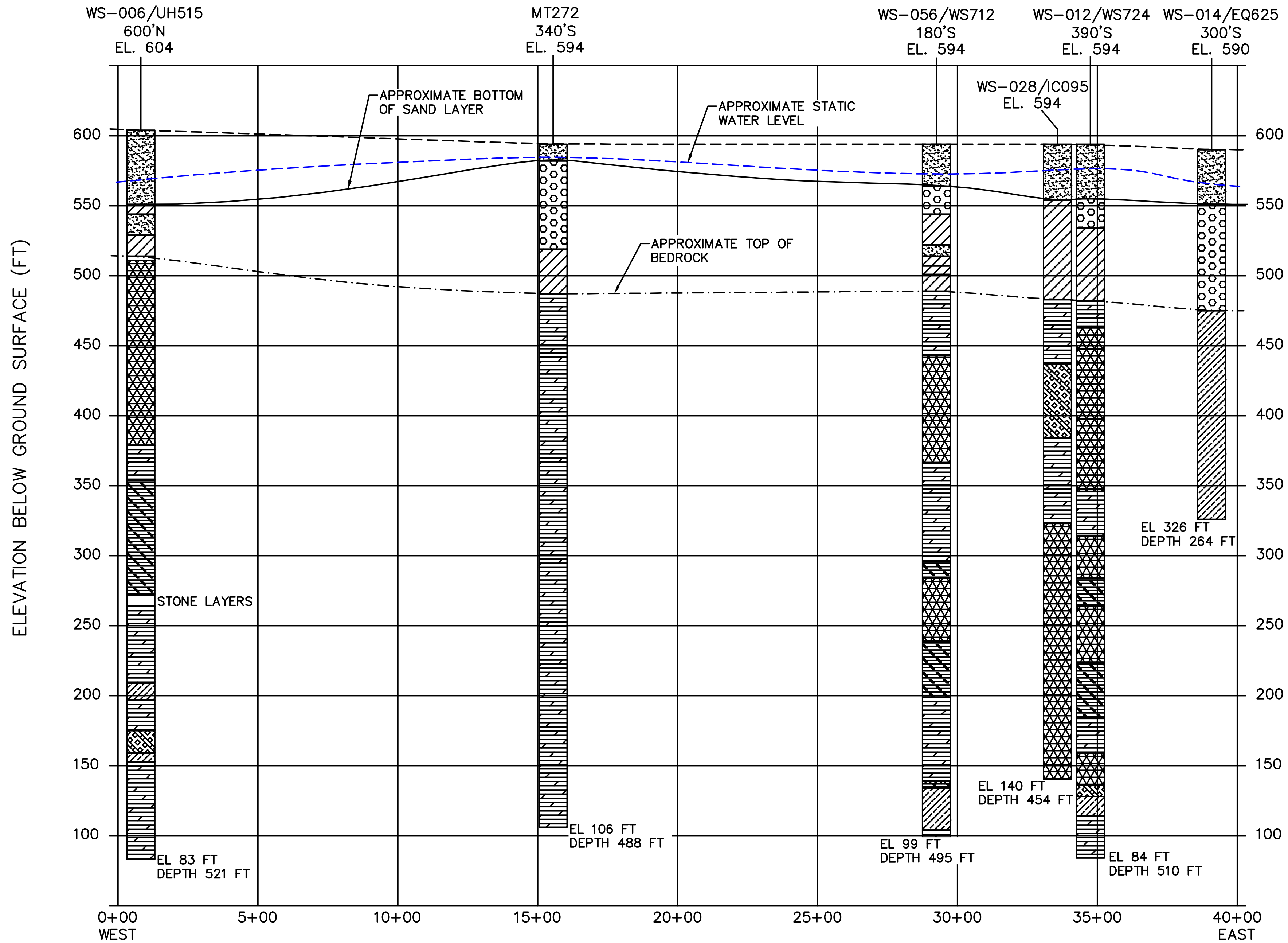
LEGEND

- - - - - EXISTING GROUND
- - - - - APPROXIMATE GROUNDWATER TABLE SURFACE
——— APPROXIMATE BOTTOM OF SAND LAYER
—·—·— APPROXIMATE TOP OF BEDROCK

SAND, FINE SAND, FINE SILTY SAND
SANDY CLAY, CLAY W/ FINE SAND, SANDY SILTY CLAY
CLAY, STICKY CLAY, CLAY AND STONE
LIMESTONE, TAN & GRAY LIMESTONE
LIMESTONE W/ SHALE LAYERS, GRAY SHALEY LIMESTONE, SHALEY LIMESTONE
SHALE, RED SHALE, BLUE SHALE
LIMESTONE, SANDSTONE, SHALE LAYERS
LIMESTONE, SANDSTONE LAYERS
SANDSTONE

WS-006/UH515	ARCADIS ID/WI UNIQUE WELL ID
600'N	OFFSET FROM SECTION LINE
EL. 604	APPROXIMATE GROUND SURFACE ELEVATION

NOTES:
1. GROUND SURFACE ELEVATIONS ARE ESTIMATED FROM THE MARINETTE COUNTY LAND INFORMATION PORTAL.
2. WELL WIDTH EXAGGERATED FOR CLARITY.



CROSS SECTION DETAIL A-A'

WS-006/UH515, MT272, WS-056/WS712, WS-028/IC095, WS-012/WS724, WS-014/EQ625

HOR: 1"=500'
VERT: 1"=100'

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TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
CROSS SECTION A-A'

SHEET NO.
FIGURE 3-2

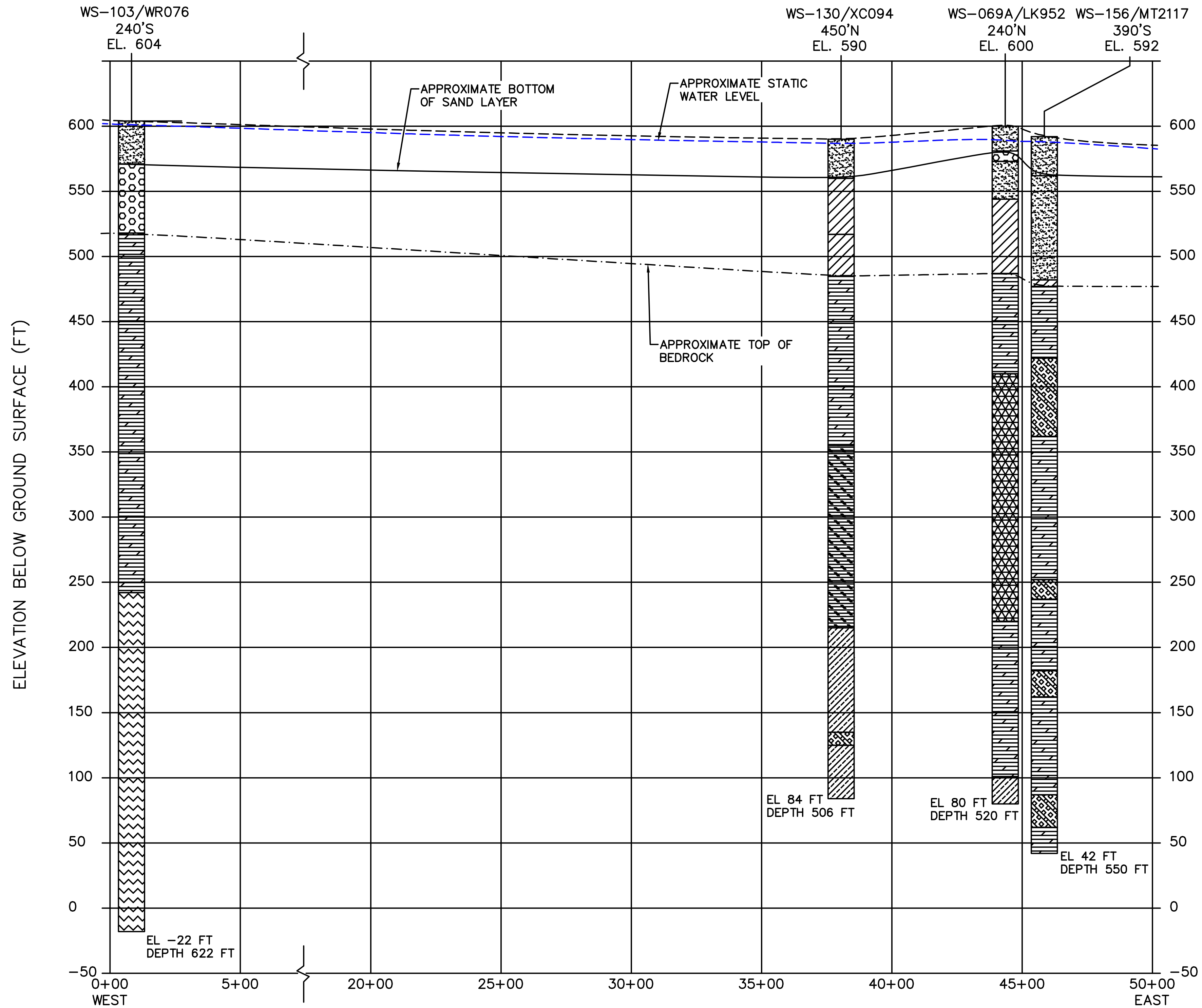
LEGEND

- - - - - EXISTING GROUND
- - - - - (blue) APPROXIMATE GROUNDWATER TABLE SURFACE
——— APPROXIMATE BOTTOM OF SAND LAYER
—·—·— APPROXIMATE TOP OF BEDROCK

- SAND, FINE SAND, FINE SILTY SAND
- SANDY CLAY, CLAY W/ FINE SAND, SANDY SILTY CLAY
- CLAY, STICKY CLAY, CLAY AND STONE
- LIMESTONE, TAN & GRAY LIMESTONE
- LIMESTONE W/ SHALE LAYERS, GRAY SHALEY LIMESTONE, SHALEY LIMESTONE
- SHALE, RED SHALE, BLUE SHALE
- LIMESTONE, SANDSTONE, SHALE LAYERS
- LIMESTONE, SANDSTONE LAYERS
- SANDSTONE

WS-006/UH515	ARCADIS ID/WI UNIQUE WELL ID
600'N	OFFSET FROM SECTION LINE
EL. 604	APPROXIMATE GROUND SURFACE ELEVATION

NOTES:
1. GROUND SURFACE ELEVATIONS ARE ESTIMATED FROM THE MARINETTE COUNTY LAND INFORMATION PORTAL.
2. WELL WIDTH EXAGGERATED FOR CLARITY.



CROSS SECTION DETAIL B-B'

WS-103/WR076, WS-130/XC094, WS-069A/LK952, WS-156/MT2117

HOR: 1"=500'
VERT: 1"=100'

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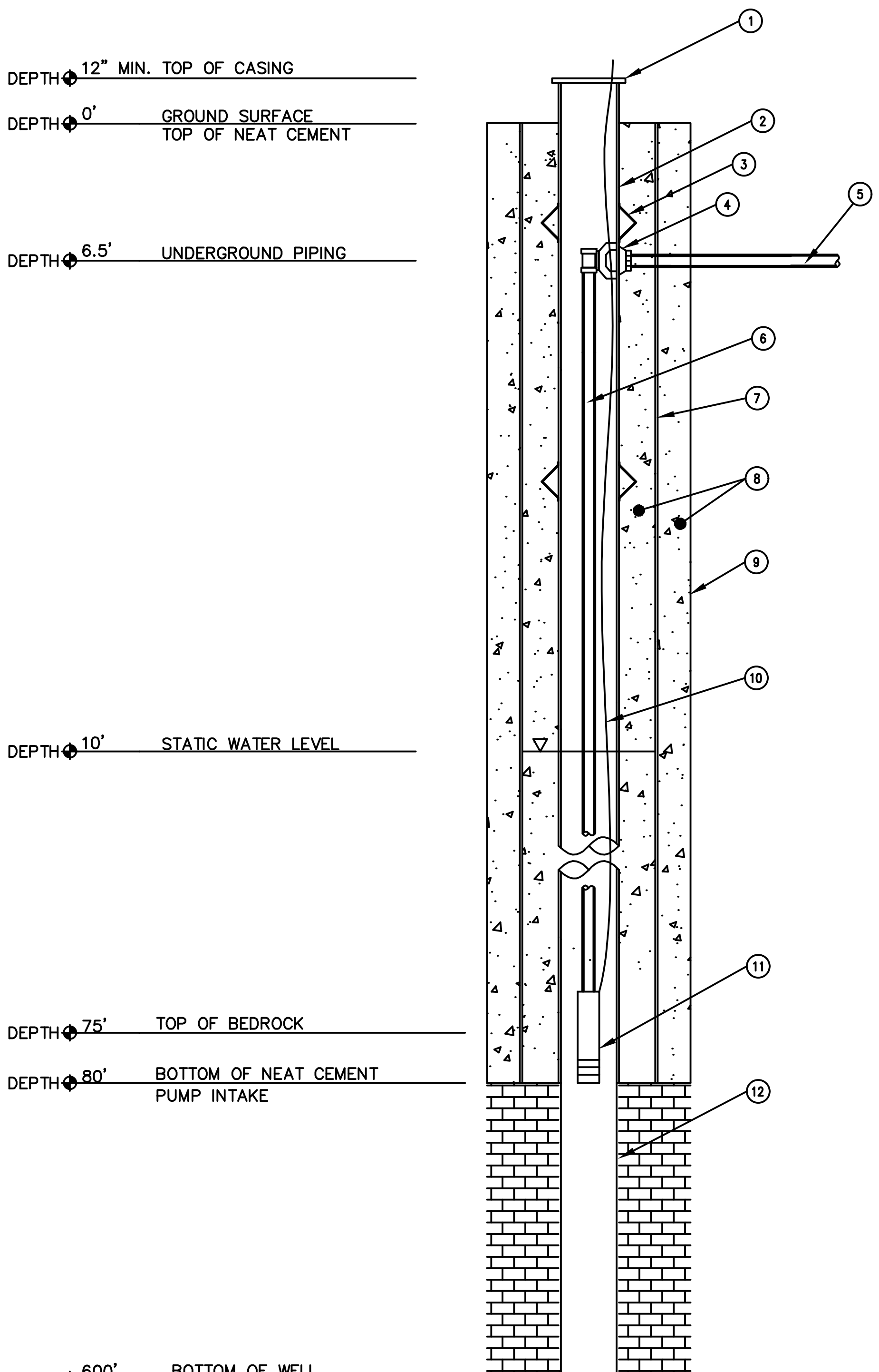
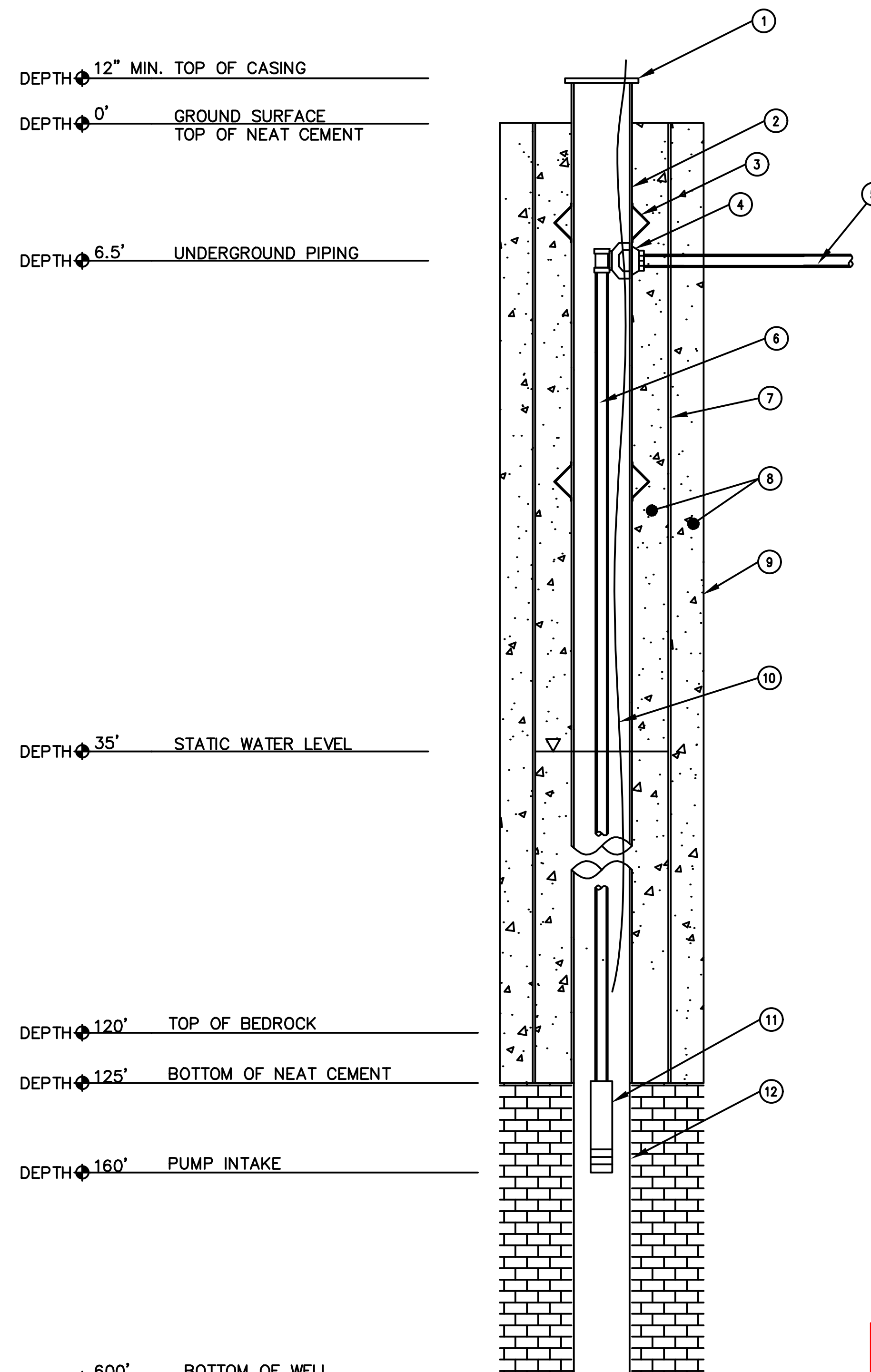
TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
CROSS SECTION B-B'

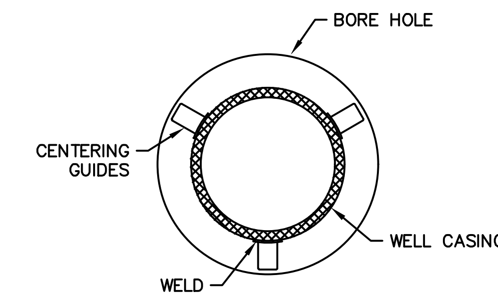
SHEET NO.
FIGURE 3-3



TOP OF BEDROCK 75 FEET



TOP OF BEDROCK 120 FEET



CENTERING GUIDE DETAIL

DESIGN NOTES:

1. PROVIDE WELLS IN ACCORDANCE WITH WDNR CHAPTER NR 812 – WELL CONSTRUCTION AND PUMP INSTALLATION.

2. LOCATE WELL AT THE HIGHEST POINT ON THE PROPERTY.

3. LOCATE WELL ACCORDING TO MINIMUM SEPARATION REQUIREMENTS IN NR 812.08

4. EXISTING DRINKING WATER WELL DEPTHS RANGE FROM 24 FEET TO 622 FEET BELOW GROUND SURFACE, AVERAGE DEPTH IS 149 FEET.

5. PROPOSED PUMP INTAKE DEPTH AND TOTAL DEPTH ARE APPROXIMATE. VERIFY ACTUAL DEPTHS IN THE FIELD DURING INSTALLATION.

KEY

1	SANITARY WELL SEAL (WITH VENT AND ELECTRICAL CONDUIT PENETRATIONS)
2	MIN. 6" DIAMETER STEEL INNER WELL CASING
3	CENTERING GUIDE (TYP.)
4	PITLESS ADAPTOR
5	UNDERGROUND PIPING CONNECTION TO RESIDENCE
6	2" DIAMETER STEEL DROP PIPE
7	MIN. 10" DIAMETER STEEL OUTER WELL CASING
8	2" ANNULAR SPACE, NEAT CEMENT
9	MIN. 14" DIAMETER OUTER BOREHOLE
10	ELECTRIC WIRING
11	SUBMERSIBLE PUMP
12	MIN. 6" DIAMETER OPEN BOREHOLE INTO BEDROCK

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DISCUSSION PURPOSES ONLY

TYPICAL DOUBLE-CASED WELL CONSTRUCTION DETAIL

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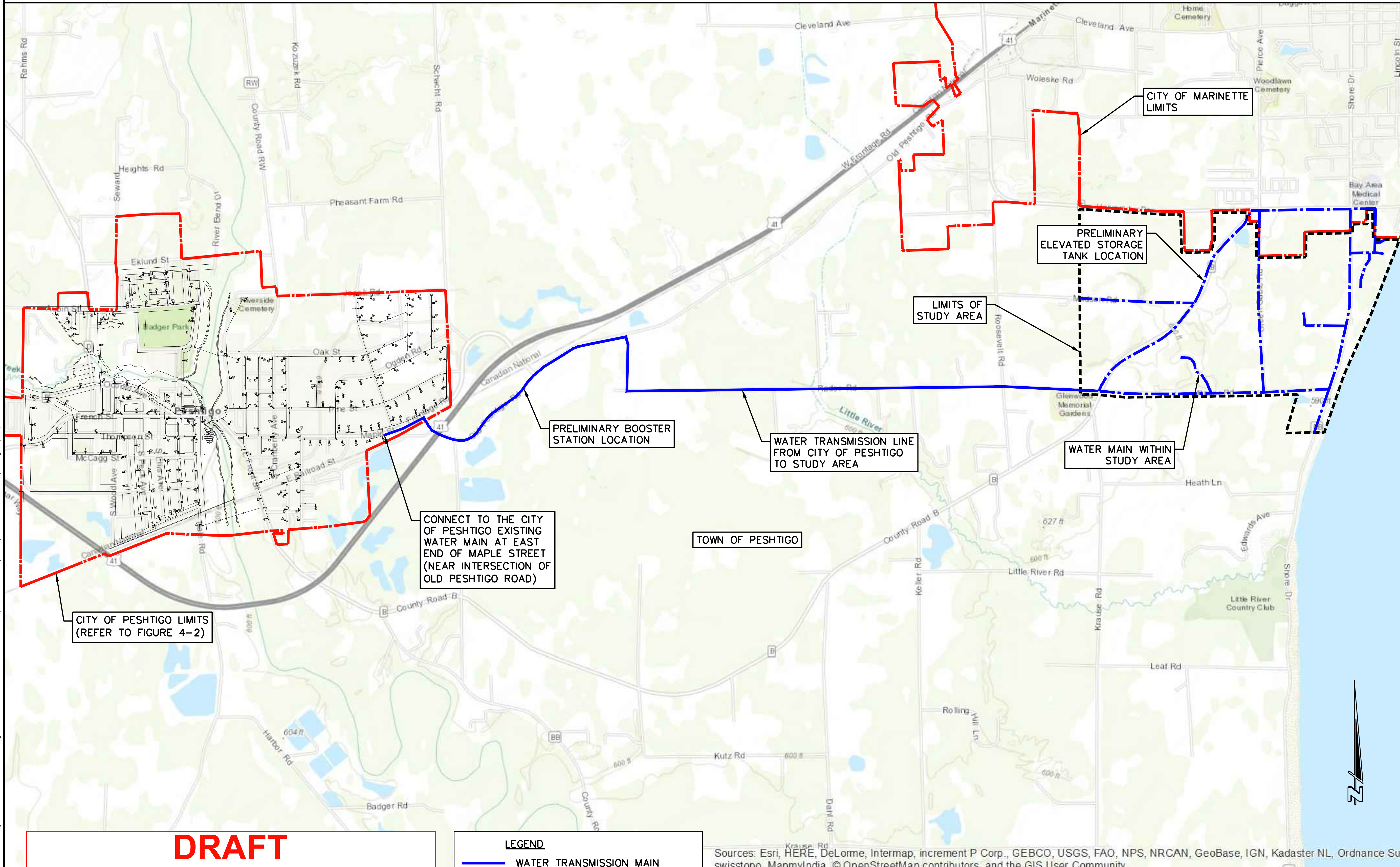
TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
PRELIMINARY WELL CONSTRUCTION DETAIL

SHEET NO. FIGURE 3-4

SCALE:
0 100 200 400



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LEGEND

(solid blue line)	WATER TRANSMISSION MAIN
(dash-dot blue line)	WATER MAIN WITHIN STUDY AREA

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TOWN OF PESHTIGO
WATER SUPPLY ALTERNATIVES
MARINETTE COUNTY, WISCONSIN
PRELIMINARY ROUTING OF WATER MAIN

SHEET NO.
FIGURE
4–1

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APPENDICES

List of Appendices:

Appendix A: Luisier Well Drilling Quote

Luisier Well Drilling, Inc. provided the attached quotation dated August 28, 2019.

LUISIER DRILLING, INC.
220 HANK MARKS DRIVE
OCONTO FALLS, WI 54154
TEL: (920) 848-5239
FAX: (920) 848-5535
TOLL FREE: 1-800-662-0940
E-MAIL: info@luisierdrilling.com
www.luisierdrilling.com

August 28, 2019

CEDAR CORP
DENNIS STEIGENBERGER, P.E.
1695 BELLEVUE ST.
GREEN BAY, WI 54311

DOUBLE CASED WELL ESTIMATE WITH 80' CASING

Dear Dennis,

We have worked up the following estimated cost for drilling a well for the property located in the township of PESHTIGO in MARINETTE county. These costs are based on other wells drilled in this area. You must remember that this is an estimate and that you will be billed for the actual cost per item to complete the well.

The costs are as follows: (600' Well)

14"	Drill Hole	80	feet @	$84.00	per foot	$6,720.00
10"	Casing	80	feet @	$65.00	per foot	$5,200.00
6"/10"	Cementing Casing In Place	90	bags @	$42.00	per bag	$3,780.00
6"	Drilling (80' to 600')	520	feet @	$15.00	per foot	$7,800.00
6"	Casing	80	feet @	$19.25	per foot	$1,540.00
Mob-Demob						$3,300.00
Well Development						$1,000.00
(2) Well Caps and Bacteria & Nitrate Samples						$525.00
Estimated Cost of Double Cased Well						**$29,865.00**
Pump: 1/2 HP V80 w/ $400.00 digging allowance						$2,750.00
Estimated Cost of Well & Pump						***$32,615.00***

If a signed contract and a $5,000.00 down payment are received within 30 days, prices on this estimate will be valid until all the work is completed.

If you have any questions, please don't hesitate to contact us at 1-800-662-0940. We are looking forward to working with you!

Respectfully Submitted,

Luisier Well Drilling, Inc.

LUISIER DRILLING, INC.
220 HANK MARKS DRIVE
OCONTO FALLS, WI 54154
TEL: (920) 848-5239
FAX: (920) 848-5535
TOLL FREE: 1-800-662-0940
E-MAIL: info@luisierdrilling.com
www.luisierdrilling.com

August 28, 2019

CEDAR CORP
DENNIS STEIGENBERGER, P.E.
1695 BELLEVUE ST.
GREEN BAY, WI 54311

DOUBLE CASED WELL ESTIMATE WITH 125' CASING

Dear Dennis,

We have worked up the following estimated cost for drilling a well for the property located in the township of PESHTIGO in MARINETTE county. These costs are based on other wells drilled in this area. You must remember that this is an estimate and that you will be billed for the actual cost per item to complete the well.

The costs are as follows: (600' Well)

14"	Drill Hole	125	feet @	$84.00	per foot	$10,500.00
10"	Casing	125	feet @	$65.00	per foot	$8,125.00
6"/10"	Cementing Casing In Place	130	bags @	$42.00	per bag	$5,460.00
6"	Drilling (125' to 600')	475	feet @	$15.00	per foot	$7,125.00
6"	Casing	125	feet @	$19.25	per foot	$2,406.25
Mob-Demob						$3,300.00
Well Development						$1,000.00
(2) Well Caps and Bacteria & Nitrate Samples						$525.00
Estimated Cost of Double Cased Well						**$38,441.25**
Pump: 1/2 HP V80 w/ $400.00 digging allowance						$2,750.00
Estimated Cost of Well & Pump						***$41,191.25***

If a signed contract and a $5,000.00 down payment are received within 30 days, prices on this estimate will be valid until all the work is completed.

If you have any questions, please don't hesitate to contact us at 1-800-662-0940. We are looking forward to working with you!

Respectfully Submitted,

Luisier Well Drilling, Inc.

Appendix B: Summary of Residential Water Supply Alternatives

Residential water supply alternatives are summarized on attachment.

Town of Peshtigo
Appendix B - Summary of Residential Water Supply Alternatives
December 2019

Alternative	Advantages	Disadvantages	Comments
Installation of Private Deep Wells			
--The Study Area is an approximately 1 square mile area that is generally bordered by County Rd B to the west, University Dr to the north, Rader Rd to the south and the bay of Green Bay to the east. --Private wells at approximately 168 residences within the Study Area will be replaced with wells drilled into the deeper bedrock aquifer. --Wells will be drilled to approximately 600 feet below ground surface and will be double cased to reduce spread of contamination from the upper sand aquifer to the deeper bedrock aquifer. --A submersible pump will be installed in each well including connection to the existing water service between the well and home. --Optional water treatment may include a softening system, iron and manganese filtration system and/or reverse osmosis system depending on water quality. --The existing well will be abandoned.	--This alternative is consistent with the existing type of water service at each residence. --Lower overall cost for installation at each residence. --Lower annual operating costs even if water treatment is required. --No required regulatory permitting; therefore, implementation of this option would not take as long. --No monthly municipal water bills or utility fees. --No need to create, operate and maintain a Sanitary District within the Study Area.	--Greater risk as a long term clean water supply considering double-cased wells do not guarantee that contamination will not be transferred from the upper sand aquifer to the deeper bedrock aquifer. --The transport and mobility of PFAS compounds are not yet well known so there is no guarantee that contamination won't reach the deeper bedrock aquifer over time. --The water quality and quantity in the deeper aquifer in the Study Area location is unknown; there is the risk of drilling to 600 feet and not finding sufficient water to operate a well. --No regulatory testing of private well water is required so monitoring of potential contamination would not happen. --The DNR has concerns regarding the long term effectiveness and safety of a deep well water supply within the Study Area. --Wells do not provide for a backup water supply; therefore, if something happens to the well bottled water or individual treatment systems would be required.	--There may be a potential affect to Town growth or existing home sales if future home owners are required to install a more expensive deep well. --Sample collection and analysis of water quality parameters (radioactivity, iron, manganese, sulfur, hardness, nitrates and bacteria levels) and PFAS compounds prior to using new wells, including periodic sampling over the life of the well is recommended. --Access agreements/easements from property owners will be required to complete work on private property. --Agreements and negotiations between the Town and JCI/Tyco will be required prior to any construction. --Water from deep wells often require treatment for removal of radium, iron and manganese; therefore, individual water treatment may be required at each residence depending on resulting water quality. --In addition, deep well water may contain compounds that are not hazardous but do cause issues with taste, odor or cloudiness that may require treatment.
Municipal Water Supply from the City of Peshtigo			
--Approximately 215 parcels are located within the Study Area; each parcel may be connected to a new municipal water supply system. --It was assumed that water will be supplied from the City of Peshtigo to a new Sanitary District established for affected Study Area residents and will include a master water meter to monitor wholesale distribution to the Town. --Approximately 5 miles of water main will be required to transfer water from the City to the Study Area. --A booster station with redundant pumps will be required to provide adequate pressure to transfer water from the City to the Study Area. --Approximately 7 miles of water main, including flushing hydrants and optional fire hydrants, will be required to distribute water to parcels within the Study Area and maintain the distribution system. --An elevated water storage tank will be required to provide water storage and optional pressure for fire protection. --Service connections and individual water meters for connection within the Study Area will be required. --A chlorination system to provide disinfection and maintain chlorine residual within the distribution system will be required.	--The City of Peshtigo water supply is a regulated and treated drinking water source with known water safe quality. --The City of Peshtigo has a sustainable and redundant water supply, with adequate supply to provide water to the Town. --A municipal water supply represents the least overall risk for a long term supply of drinking water. --The City currently treats their water for removal of radium, iron and manganese so no additional treatment would be required for homes within the Sanitary District. --A municipal water supply will provide the option for fire protection flow, which may potentially increase property values and/or reduce home insurance costs. --Groundwater flow direction is generally east-southeast towards Lake Michigan so the potential for PFAS contamination from the Tyco Site in Marinette reaching the City of Peshtigo water supply wells is minimal.	--Installation and capital costs are higher for each parcel and will require a longer schedule for implementation. --Multiple agencies (WDNR, Public Service Commission) will require design review and permit approvals which may affect installation schedule. --Horizontal boring will be required for the water main to cross the existing railroad and Highway 41 overpasses in the City of Peshtigo. --Coordination with the railroad and WDOT for these crossings may take 6 months or more. --Provision of a municipal water supply may require potential changes to Town Ordinances. --Negotiation with City of Peshtigo regarding the possibility of extending the City water supply, wholesale costs of water, operation and maintenance of distribution system, flushing requirements, etc., will be required. --Operating costs for a municipal water supply will be higher. --Customers will receive water bills.	--A Sanitary District for all affected areas will need to be established and staffed. --Operation of the approximately 12 miles of water distribution system will require a licensed operator to provide routine maintenance, flushing of the water mains, maintaining chlorine residual, and meter reading, etc.; and administrative staff to provide billing/invoicing, customer service and routine report preparation for multiple state agencies. --Customer use rates will need to be established based on wholesale water costs from the City; and operation, maintenance and administrative costs associated with operating a Sanitary District. --Access agreements/easements from property owners will be required to complete work on private property. --Agreements and negotiations between the City, Town and JCI/Tyco will be required prior to any construction. --A wetland delineation will be required and potential wetland disturbance permitting with the Army Corps of Engineers for installation of water main may be required. --Survey of water main routing will be required to identify all structure locations for ease of maintenance.