Drinking Water State Revolving Fund Project Plan

City of St. Clair

Project No. 210443
May 19, 2021

Review Draft

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Prepared For:

St. Clair, Michigan

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List of Abbreviations/Acronyms

ADD	average day demand
AMP	asset management plan
CIP	capital improvement program
EGLE	Michigan Department of Environment, Great Lakes, and Energy
DWI	Drinking Water Infrastructure
DWSRF	Drinking Water State Revolving Fund
gph	gallons per hour
gpd	gallons per day
gpm	gallons per minute
i/o	input/output
MCC	main control center
MCP	main control panel
MDD	maximum day demand
mgd	million gallons per day
SEMCOG	Southeast Michigan Council of Governments
TDH	total dynamic head
VFD	variable frequency drive
WTP	water treatment plant

1.0 Introduction

In March 2021, the City of St. Clair retained Fishbeck to complete a Drinking Water State Revolving Fund (DWSRF) Project Plan for improvements to the City's water system. The purpose of this document is to present the Project Plan and meet the project planning requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

The City owns and operates a water supply, treatment, and distribution system that serves the City and a portion of St. Clair Township. There are approximately 8,300 customers connected to the system. The City's Water Treatment Plant (WTP) is a conventional water treatment plant with a rated capacity of 3.0 million gallons per day (mgd) that utilizes coagulation, flocculation, sedimentation, and filtration processes. Raw water is pumped using the Shorewell Pumping Station from the St. Clair River to the WTP. Both the WTP and the pump station were constructed in 1978 and have remained relatively unchanged since then. Many components of the treatment system are past their useful life and in need of upgrades. Expansion of the filtration process is also needed to comply with regulatory standards.

An asset management plan (*City of St. Clair Water System Asset Management Plan*) was completed in July 2018 by Anderson Eckstein and Westrick, Inc. The report identified needs for both the distribution system as well as the WTP. An additional assessment was completed by Fishbeck in February 2021 that evaluated the existing water treatment system condition and capacity. The report, *Water Treatment System Improvements Study*, identified areas of needed upgrades within the facilities. The recommended plant improvements from that report are included in this DWSRF Project Plan.

In preparing and submitting a Project Plan, the City is hoping to take advantage of a newly announced grant opportunity. Communities applying for a DWSRF loan may qualify for a Drinking Water Infrastructure (DWI) grant for drinking water infrastructure upgrades included in the community's asset management plan (AMP). A total of $35 million is available; communities may qualify for the lesser of 30% of project costs or $2 million.

2.0 Project Background

2.1 Delineation of Study Area

The City of St. Clair is in St. Clair County in eastern Michigan, along the US/Canadian border close to Ontario, Canada, and is about one hour northeast of downtown Detroit. The City water system also serves a portion of St. Clair Township just north of the City limits. The Study Area includes the developed areas of the City/Township as shown in Figure 1, with the focus being on the WTP. Figure 2 illustrates the existing distribution system within the City, and Figure 3 shows the water main in the Township. A map of the major surface waters is depicted in Map 1.

2.2 Land Use

The City's Master Plan was updated in 2020 and contains a detailed description of land use and zoning.

2.2.1 Existing Land Use

The City's land use is primarily residential, with the next largest land use being vacant, followed by recreation and/or open space, as well as industrial areas. There is no land dedicated to agriculture within the City. Map 2 depicts the City's existing land use.

Most of the current land use within the City is residential, with almost 43.9% of the City being single-family homes according to data from the Southeast Michigan Council of Governments (SEMCOG) from 2015. Multi-family homes comprise another 3.1%. About 13.3% of the current land is classified as vacant according SEMCOG, which is the next largest category after residential land use. This could provide an opportunity for potential growth of a future population. Approximately 8.5% of the land is considered open space or recreational areas, with trails along the St. Clair and Pine River frontage areas being popular public spaces. Another 8% of the land is industrial. The Cargill Salt Plant is located along the St. Clair River and occupies a large area. The BP Dome Petroleum Corporation is another major industry, located along Fred W Moore Hwy on the western side of the City. There are several vacant industrial buildings in the area as well.

2.2.2 Future Land Use

The City's 2020 Master Plan indicated that the City will retain much of the existing land use pattern, while further developing areas of the City. The planned land use, depicted in Map 3, identifies generalized preferred future land uses in the City. There is an initiative to promote public use of downtown for shopping, events, and housing, aiming to make the space more pedestrian-friendly through the Downtown Redevelopment District Zoning ordinance. Expansion of parks and open spaces in new residential areas is also encouraged.

The high percentage of currently vacant land offers potential for residential expansion. Zoning ordinances are in place to keep areas of low-density residential and traditional neighborhoods essentially the same as existing. Multi-family homes will continue to be confined to moderate density neighborhoods or other areas currently containing multi-family residential living spaces.

The City's Master Plan identified four areas where there are plans for redevelopment related to residential land use:

- The Pine River area, south of Fred Moore and north of St. Clair Highways.
- A central area near Clinton Avenue and Whiting Street.

- A small group of undeveloped parcels near Hugo Street between Jackson Street, N. Carney Drive, and Sinclair Street.
- A line of property from North 6th Street toward Carney, including a few closed school buildings: Riverview East High School, Eddy Elementary, and Gearing Elementary School.

Commercial land use is to be confined primarily to the area east of the City along Fred W Moore Hwy. Some commercial use is allowed in the downtown or mixed-use areas, but must be businesses related to serving the needs of the surrounding neighborhoods. Current industrial areas are planned to be maintained for industry as this is an important aspect to the economy and available jobs in the City.

The City is already mostly developed out, but some undeveloped areas have been identified that are expected to grow within the 20-year planning period:

- There is 25 acres in the St. Clair Industrial Park, located at the north end of the City, that are well-suited for industrial development. It has great potential for trade access to and from Canada; the land is cleared for development and has industrial utilities in place, and environmental studies and wetlands delineation have been completed on the site. It is likely this land will be developed for industrial use in the near future.
- Construction is underway on a new industrial development in Industrial Park near the corner of Range and Yankee Roads. Three phases of construction are planned for the next 10 years.
- There are current plans for a 50-home residential development within the City. Approximately 10 homes are expected to be developed in within the year, and the remaining homes are expected to be complete within the next 5 years.

Compared to the City, St. Clair Township has much more developable land for residential, commercial, and industrial use. For this reason, it is expected that the Township's population growth rate will exceed that of the City's over the next decade or so.

2.3 Population Projections

The City's 2020 Master Plan discusses the City's current population and population projections based on SEMCOG data. SEMCOG completes population projections for cities within their area of focus based on US Census data, and they provide projections in 5-year increments out to 25 years. According to data available on the SEMCOG webpage, the estimated population as of July 2019 was 5,518 people for the City of St. Clair. The St. Clair water distribution system also serves a portion of St. Clair Township. According to the City's Sanitary Survey from 2018, the connected population in St. Clair Township was 2,605; approximately 38% of the total population in St. Clair Township.

The City's 2020 Master Plan states that between 1900 and 2000, the City's population increased by a rate of at least 1% per decade, except for the decade from 1970 to 1980 when the growth rate was 0.21%. Between the years of 2000 and 2010, the population decreased at a rate of -5.5%. The City reports there has been minimal growth in the last decade, from 2010 to 2020. SEMCOG data forecasts that a low growth rate is expected to continue, predicting a total growth of 4.8% from 2010 to 2030. From 2030 to 2045, the population is expected to plateau, then decline slowly over the 15 years. The projected population for 2040 is 5,710 and for 2045 is 5,651. The anticipated decline is largely due to an aging population, as is common for many communities across the nation due to the baby boom generation. The City reports that approximately one in six residents is currently over the age of 65.

A portion of St. Clair Township was connected to the City's water system in 1992. There are an estimated 985 services in St. Clair Township that are supplied by City water. Population projections for St. Clair Township were also obtained from SEMCOG data. As previously mentioned, the 2018 Sanitary Survey estimated the connected population to be 2,605 equating to approximately 38% of the total Township population. The population forecast obtained from SEMCOG was used to estimate projections for the connected population in the Township, assuming 38% of the projected population is connected.

Table 1 shows the historical and projected population for the City of St. Clair and the estimated connected population for the Township. The data was obtained from population estimates developed by SEMCOG.

Table 1 – Historical and Projected Population for the City of St. Clair and St. Clair Township

Year	City Population	Township Connected Population**
1900	2,543	n/a
1910	2,633	n/a
1920	3,204	n/a
1930	3,389	n/a
1940	3,471	n/a
1950	4,098	n/a
1960	4,538	n/a
1970	4,770	n/a
1980	4,780	n/a
1990	5,116	n/a
2000	5,802	2,454
2010	5,485	2,605
2015*	5,481	2,667
2020*	5,597	2,704
2025*	5,770	2,741
2030*	5,746	2,796
2035*	5,765	2,800
2040*	5,710	2,767
2045*	5,651	2,781

*From SEMCOG 2045 Forecast
**Estimated based on data from SEMCOG for the total population and the estimated connected population for the Township.

The population projections in 5-year increments for the 20-year planning period, beginning in 2021, were estimated based on the data from SEMCOG. Table 2 summarizes the population projections.

Table 2 – Projected Population for the 20-year Planning Period

Year	City Population	Township Connected Population	Total Estimated Connected Population
2021	5,620	2,711	8,332
2026	5,805	2,748	8,553
2031	5,741	2,807	8,548
2036	5,769	2,800	8,569
2041	5,699	2,760	8,459

Population projections indicate that the connected population to the City's water system is expected to increase about 3% in the next five years, then plateau between the years of 2031 and 2036. The population is projected to decline about 1.3% between 2036 and 2041.

2.4 Water Demand

Current demand and demand projections were developed for the water system. The City provided daily operational data for the WTP for the years of 2016 through 2020, which was used to develop the projections. Average day demand (ADD) was determined by totaling the million gallons of treated water for the year and dividing by the number of days in the year. The highest water production day of each year was pulled from the data to determine the maximum day demand (MDD). Table 3 shows the demand from the past five years.

Table 3 – St. Clair WTP Historical Annual Pumpage

Year	ADD (mgd)	MDD (mgd)
2016	0.840	1.582
2017	0.793	1.567
2018	0.777	1.585
2019	0.751	1.467
2020	0.801	1.600
5-Year Average	**0.792**	**1.560**

The average ADD from the past five years is 0.792 mgd and the average MDD is 1.560 mgd, resulting in a typical peaking factor from ADD to MDD of about 2.0.

Some of the WTP pumpage is used to supply the demand in St. Clair Township. The City provided metered flow data for the Township from 2016 through 2020, which is totalized monthly. Demands for the City were determined by taking the difference between the total WTP pumpage and the metered data for the Township. The historical ADDs from the past five years for the Township and the City are presented in Table 4.

Table 4 – City of St. Clair and St. Clair Township Historical Demands

Year	City ADD (mgd)	Township ADD (mgd)
2016	0.655	0.184
2017	0.615	0.178
2018	0.606	0.172
2019*	0.546	0.205
2020*	0.509	0.292
5-Year Average	**0.586**	**0.206**

*Flow meter data for the Township was not available from Nov. 2019 to March 2020 or Aug. 2020.

Based on the water production and flow meter data, St. Clair Township uses about 25% of the total demand from the WTP, while the remaining 75% is delivered to users within the City. The City of St. Clair currently has a contractual obligation to supply St. Clair Township with 0.5 mgd of their 3.0 mgd capacity.

Although the projected population is expected to decline, as discussed in a previous section, it is not anticipated that the water usage will decrease at the same rate. This is expectation is based on the fact that there are many opportunities for industrial growth in both the City and the Township. Plans are currently underway for industrial development within the City, and it is expected that more industrial and commercial development will occur in the Township in years to come.

Construction is underway for the first of three phases for development at the northeast corner of Range and Yankee Roads. The first phase is expected to add a demand of 49,000 gallons per day (gpd) and is to be complete within the year. In the second phase, an additional demand of 50,000 gpd is expected and is planned to be complete by 2026. The third and final phase will add another 50,000 gpd, with completion anticipated before 2031.

In addition, construction of a development of 50 new homes is also underway within the City. It is expected that 10 homes will be added within the year, adding an anticipated 2,370 gallons per day of demand. The remaining 40 homes are expected to be complete by 2026, corresponding to an additional demand of 9,480 gallons per day.

There are no known or planned future connections within the Township at this time, but it is likely that future services will be needed as the Township continues to expand. It is expected that future residential, commercial, and industrial demands will be added by 2041.

ADD projections were initially based on population projections, then the anticipated demand from future development projects were added. The ADD was determined first, then the ADD to MDD peaking factor of 2.0, determined from historical pumpage data, was used to estimate the MDD projections. Table 5 shows the demand projections in 5-year increments for the 20-year planning period.

Table 5 – City of St. Clair and St. Clair Township Demand Projections

Year	ADD (mgd)	MDD (mgd)
2021	0.847	1.693
2026	0.927	1.855
2031	0.977	1.954
2036	1.029	2.058
2041	1.068	2.137

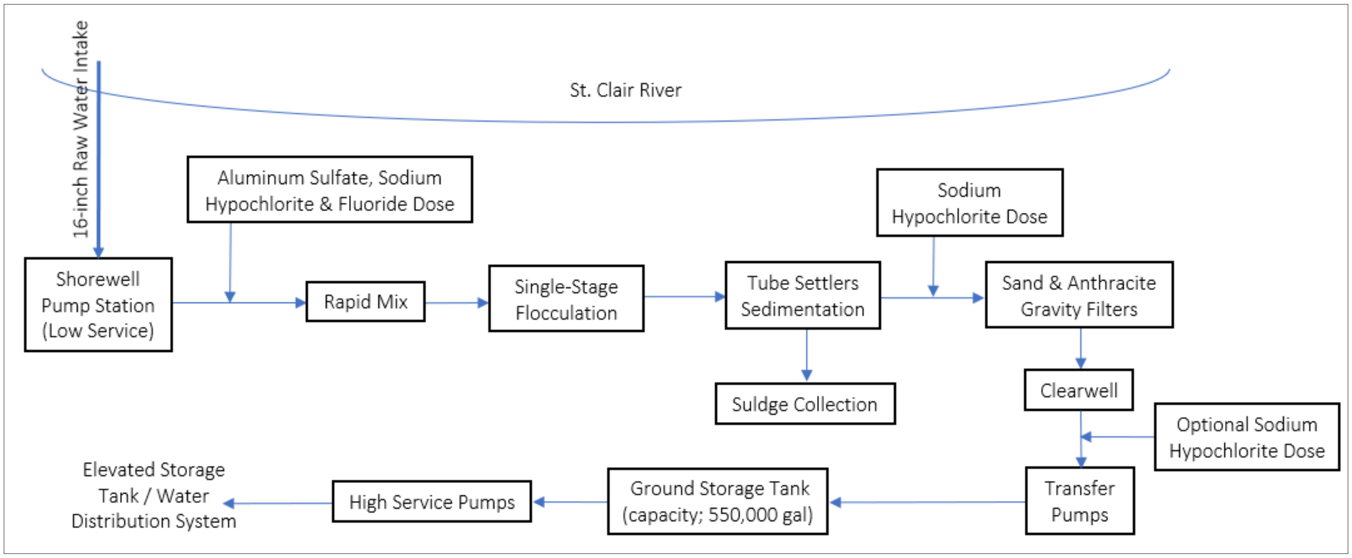
The water demand is expected to increase about 9.5% in the next five years, then continue to increase by approximately 3 to 5% for the next 15 years. The MDD is predicted to exceed 2.0 mgd sometime before the end of year 2034.

2.5 Existing Facilities

2.5.1 Water Treatment Plant

The City of St. Clair treats water from the St. Clair River at their WTP, located just west of the river at 1200 Adams Street. The Shorewell Pumping Station is located on the St. Clair River and is used to pump water from the river to the WTP. The intake is a 16-inch prestressed concrete subaqueous pipe that extends from the station approximately 200 feet into the river. The intake crib is a 15-foot by 14-foot wooden structure. The intake system is original to the plant but is in good condition. The WTP has a rated capacity of 3.0 mgd and currently operates at a maximum of two 8-hour shifts per day. It is a conventional water treatment plant that utilizes coagulation, flocculation, sedimentation, and filtration processes. Both the WTP and the pump station were constructed in 1978 and have remained relatively unchanged since that time. Figure 4 shows a flow diagram of the WTP.

Figure 4 - Water Treatment Plant Flow Diagram



In general, the water plant is very well maintained. However, due to the age of the plant and some outdated processes and equipment, both the City and EGLE have concerns about the long-term reliability of some portions of the water treatment system. EGLE completed a Sanitary Survey in 2018 that provided a list of items that were of concern regarding treatment plant processes and condition. The City also developed their own list of deficiencies at the WTP and the Shorewell Pumping Station. An evaluation of the water treatment system was completed by Fishbeck in February 2021. The evaluation and recommended improvements from that study are presented in the report from February 5, 2021 called *Water Treatment System Improvements Study*.

The most recent 2018 Sanitary Survey, plant drawings, and shop drawing information received from St. Clair were used as a basis for determining the existing capacities for the equipment at the plant. Design criteria from the Recommended Standards for Water Works (Ten States Standards) and additional water treatment plant design manuals were utilized to determine the current design capacities of the plant. Table 6 shows each of the WTP processes, the recommended design criteria, and the capacity of each process.

Table 6 – Existing WTP Capacity Analysis

Unit Process	Design Criteria	Capacity
Raw Water Intake		
Raw Water Intake	< 5 ft/sec	4.5 mgd
Raw Water Pumping		
No. of Pumps		3
Firm Capacity		3.0 mgd
Total Capacity		4.5 mgd
Coagulation/Rapid Mix		
No. of Units		1
Type	Inline Static Mixer	
Detention Time	< 30 sec	1.80 sec
Mixing Gradient	> 750 ft/sec/ft	1,260 ft/sec/ft
Capacity		3.0 mgd

Table 6 – Existing WTP Capacity Analysis

Unit Process	Design Criteria	Capacity
Flocculation		
No. of Trains		2
No. of Stages		1
Detention Time	> 30 min	30.2 min
Capacity		3.0 mgd
Sedimentation		
No. of Basins		2
Tube Settler Loading Rate	< 2 gpm/ft^2	2.20 gpm/ft^2
Tub Settler Area Covered	< 75%	50.3%
Settling Time	5 - 20 min	5.40 min
Capacity		3.0 mgd
Filtration		
Filtration		
No. of Units		3
Loading Rate	2 - 4 gpm/sf	3.0 gpm/sf
Capacity		3.0 mgd
Transfer Pumping		
No. of Pumps		3
Firm Capacity		3.0 mgd
Total Capacity		4.5 mgd
Ground Storage Reservoir		
No. of Compartments	2	1
High Service Pumping		
No. of Pumps		3
Firm Capacity		4.0 mgd
Total Capacity		6.0 mgd

Note: gpm/sf – gallons per minute per square foot

City staff and plant operators experience frequent issues regarding operation of the plant and general building maintenance. The HVAC system is outdated and experience reoccurring problems; the plant has lost heat at least once each year for the past six years. Generator issues have also persisted for the past several years. Radio communication connection between the plant and the Shorewell Pumping Station is lost almost daily. There are frequent issues regarding PLCs, with analog cards failing every three to four months. Chemical feed lines and pumps experience frequent breaks and leaks that must be repaired, and the chlorine monitor fails almost weekly. The plant has also experienced issues with their high service pumps, showing both electrical and operational issues, particularly with the motors. Specific plant deficiencies are discussed further in Section 2.6.

Plant staff make repairs as they occur. They also keep a maintenance schedule that includes pumping sludge and washing tube settlers weekly and changing oil in the electric motors annually. For many of the repairs and preventative maintenance, however, an outside contractor with the necessary technical skills is hired to perform the work due to a lack of staffing at the WTP.

system in St. Clair Township. The City's system is comprised of a single pressure district and consists of about 37 miles of water main, with sizes ranging from 3/4-inch to 16-inch diameter. About 41% of the water main is ductile iron pipe, 32% is asbestos cement, 17% is cast iron, and the remainder is comprised of copper, galvanized iron, HDPE, PVC, and steel. The install date of most of the water main, about 67%, is unknown but assumed to have been installed around 1960. According to the City's GIS, the system also includes over 310 hydrants and over 360 gate valves, varying in size from 1-inch to 16-inch.

The only pumps in the distribution system are the three high service pumps at the WTP, each with a capacity of about 2 mgd. Water is pumped from a ground storage tank with an effective size of 550,000 gallons located at the WTP. The distribution system also includes a 200,000-gallon elevated storage tank. The total storage capacity exceeds the current ADD. The high service pumps are controlled by the level in the elevated storage tank. When the tank level is at a hydraulic grade of 725.33 feet (USGS datum), then the lead high service pump turns on. If the tank level continues to drop to 715.33 feet, the lag pump turns on.

The system has three primary metering stations that supply St. Clair Township from the City of St. Clair water system. These meters are located at M-29 and Riverside, Braeburn and City Limit, and Yankee Road.

2.6 Summary of Project Need

The St. Clair WTP and its Shorewell Pumping Station were constructed in 1978, and both facilities have remained relatively unchanged since construction. Although the plant is well-maintained, improvements are needed to replace outdated equipment and processes. EGLE completed a Sanitary Survey dated April 2, 2018 that included a list of treatment plant processes that are of concern due to age and condition. This is one of the driving factors for the City to proceed with necessary plant improvements. The City also developed their own list of deficiencies that they regard as needed plant improvements.

The following items were identified by EGLE in the 2018 Sanitary Survey as recommendations for plant improvements:

- Gravity filter media core sampling to determine media characteristics.
- Consider coagulant aid for improved sedimentation and filter turbidites.
- Develop a protocol for intake and raw water transmission main roughness testing.
- Add a disinfectant feed point after the ground storage tank (prior to the high service pumps).
- Decrease the velocity through flocculation/sedimentation (floc/sed) baffle wall.
- Install a double-walled diesel fuel storage tank at the Shorewell Pumping Station.

Additional items identified were by the City's plant staff as potential deficiencies at the WTP and Shorewell Pumping Station. Needed improvements are listed below:

- Replacement of the Low Service Pumps.
- Addition of standby generator at the Shorewell Pumping Station.
- Hypochlorite containment at the Shorewell Pumping Station.
- HVAC improvements at the Shorewell Pumping Station.
- Roof replacement/repair at the WTP and Shorewell Pumping Station.

- Integrate filter control valve actuators into SCADA.
- Replace Venturi meters with magnetic flow meters.
- Chemical feed SCADA improvements.
- Improve rapid mix equipment.
- Improve pretreatment flocculation and sedimentation equipment.
- Replacement of sludge collection equipment.
- Replacement of the filter transfer pumps.
- Addition of a redundant backwash pump.
- SCADA system replacement.
- Replace electrical components.
- Arc-flash program certification for electrical distribution system components.
- Corrosion protection for HVAC and SCADA cabinet.
- Variable frequency drive (VFD) additions for High Service Pumps.
- Increasing filter capacity to meet the State of Michigan Administration Code 325.11006 (i.e., the "Four Filter Rule").

Many of the improvements listed above can be most efficiently and cost effectively made as part of a larger project, as opposed to small projects that only address a few items at a time. Efficiencies in engineering and administrative costs, contractor mobilization and overhead costs, and equipment packaging from vendors will allow for decreased costs. The improvements were categorized by the process that they address. There are eight categories of need:

1. Shorewell Pumping Station Improvements.
2. Pretreatment Improvements.
3. Filtration Improvements.
4. Chemical Feed Improvements.
5. Venturi Flow Meters.
6. Electrical, Instrumentation and Controls Improvements.
7. Water Treatment Plant Building Improvements.
8. Water Treatment Plant Capacity Expansion.

The following sections discuss the needed improvements in more detail.

2.6.1 Shorewell Pumping Station

2.6.1.1 Low Service Pumping

There are three low service pumps each with a capacity of 1,050 gallons per minute (gpm) or 1.5 mgd. The station has a firm capacity of 3.0 mgd. Table 7 presents a summary of the low service pumps.

Table 7 – Existing Low Service Pumps

Pump No.	Model	Size (hp)	Flow (gpm)	TDH (feet)	Control
1	Peerless 15MA	30	1,050	78	Constant Speed
2	Peerless 15MA	30	1,050	78	VFD
3	Peerless 15MA	30	1,050	78	VFD

Note: hp - horsepower
VFD – variable frequency drive

The low service pumps are original to the plant and are past their useful life. They have had increasing operational issues, so they should be replaced to improve reliability of the plant. Low Lift Pump No. 2 especially has required frequent maintenance as the packing cannot be kept tight and there is significant vibration in the shaft.

2.6.1.2 Sodium Hypochlorite Storage and Containment

A sodium hypochlorite chemical feed system is located at the Shorewell Pumping Station. The City currently doses sodium hypochlorite at the intake crib structure for control of zebra mussels. 55-gallon drums are utilized as storage for the sodium hypochlorite in the Shorewell Pumping Station. The drums are filled from the bulk storage tanks located at the WTP and transported to the Shorewell Pumping Station for use. The drums are placed near the chemical feed pump, the plugs are removed, and a suction tube is transferred into the drum. There is no secondary containment at the Shorewell Pumping Station for the drum storage.

There are various potential issues that can arise from this current practice. One of the issues is that filling and transport of the chemical from the WTP to the Shorewell Pumping Station can result in potential spills during handling of the drums. There are special MDOT requirements that need to be met to transport sodium hypochlorite. A second issue is the potential for a spill to enter the St. Clair River because the lack of secondary containment at the Shorewell Pumping Station. Improvements to the chemical storage system are needed at the Shorewell Pumping Station to mitigate these issues.

2.6.1.3 Diesel Fuel Containment at Shorewell Pumping Station

Standby power for the Shorewell Pumping Station does not exist. Rather, in the event of a power outage, the staff can operate an engine drive that can be coupled to one of the existing pumps. During an outage, it is assumed the plant staff will have no communications with or control over the Shorewell pumping operations, since there is no power or limited UPS power. There is a need for a backup generator for reliability of the pumping station.

An additional concern with the current engine drive is the diesel fuel storage. Currently, the diesel fuel for the engine does not have secondary containment, causing safety and regulatory concerns. If the existing diesel tank remains, it must either be contained or replaced with a double-walled tank. In 2018 Sanitary Survey, EGLE recommended the existing 200-gallon diesel storage tank at the Shorewell Pumping Station be replaced.

2.6.1.4 Electrical

The station receives a single utility service from DTE Energy. The medium-voltage service is stepped down via a utility owned 150kVA, 13.2kV-480V pad-mounted transformer located on the east side of the station. The utility meter and metering cabinet are located inside the station. The transformer feeds a 600A, 3 phase, 3 wire MCC (MCC-3) inside the plant. MCC-3 is a 3 section General Electric 7700 motor control center. MCC-3 contains the starters for two 30 hp pumps, P-2 and P-3, and one 40 hp pump, P-1. The starters for P-2 and P-3 feed VFDs located adjacent to MCC-3. In addition to feeding the pumps, MCC-3 feeds a low voltage transformer that serves LP-D, a

15kW unit heater, and the submersible pump control panel. LP-B is a 24 space, 100A, General Electric NLAB type panelboard. The transformer that feeds it is a 10kVA, 240/120V, single phase transformer.

The control panel at the station (SP-CP) is installed inside the station on the east wall. SP-CP contains a single I/O rack with a Direct Logic 06 PLC and a single analog input I/O module. SP-CP communicated to MCP via radio. The following information is communicated between the panels:

- Pump 1 – Start/Stop
- Pump 2 – Start/Stop
- Pump 2 – Speed Control
- Pump 3 – Start/Stop
- Pump 3 – Speed Control
- Sump Level
- Entry Alarm
- Pumps 1 and 2 – Indicator Lamps
- Pump 3 – Indicator Lamp and Screen Diff

The station should be considered a damp/wet location; standing water from one of the pumps has been observed on the floor causing water to pool around that batteries for the engine driven pump. Most of the electrical distribution equipment is the original equipment installed during the construction of the station in 1978 and there are a few instances of rusting or corrosion on devices and conduit throughout the station, so electrical upgrades are needed. In addition, the plant experiences issues regarding radio communications to the pumping station, with connection being lost almost daily. Alternative forms of communication are needed.

2.6.1.5 HVAC System

There are several needs regarding the HVAC system at the pumping station. The following is a list of items that need to be addressed:

1. In the Pump Station room, ventilation to prevent overheating is accomplished by a wall mounted thermostat starting a propeller wall exhaust fan and manually opening a wall louver damper. This is outdated and is in need of upgrades.
2. The original wall exhaust fan (EF-7) that served the Shorewell Pumping Station room is covered with plastic and is non-operational.
3. There is not cycle timer in the building that prevents the potential buildup of harmful vapors from the sodium hypochlorite.
4. The lower level is considered a confined space. Code requires that ventilation at a rate of 6 air changes per hour be provided when occupied.
5. There is a need to install equipment to limit the humidity level of the space during warm weather.

2.6.1.6 Plumbing System

The station contains an emergency shower that is provided with cold water. Code states that emergency showers are to be supplied with tepid water (60 ºF minimum), so this must be addressed.

2.6.1.7 Roof

The Shorewell Pumping Station perimeter walls are capped with a wood-framed steeply sloped mansard structure that is covered with asphalt shingles applied over roofing felts. The mansard structure extends above the main flat-roof area forming a perimeter parapet. On the main roof, a raised roof hatch is configured on one side of the roof for removal of equipment. A heavily rusted pipe-assembly is supported on a pipe frame with a pipe drip extending over the roof edge. The assembly does not appear to be in active use. The main roof area was originally constructed with a built-up roof membrane applied over 1-inch vent board and a vapor barrier. This roof assembly was applied directly over sloped insulating concrete fill supported by precast concrete roof plank. The building was subsequently reroofed with a white PVC mechanically attached roof membrane. It is unclear if this was the only time the building was reroofed and whether the new roof membrane was applied directly over the original membrane or if the original membrane was removed prior to reroofing. It is also unclear if insulation was added to the assembly when the building was re-roofed. PVC membranes have a history of plasticizer migration which, over time, can lead to embrittlement of the membrane and susceptibility to damage from hail and other shocks.

The asphalt shingles covering the mansard structure appear heavily weathered, the metal cap flashing and fascia are discolored, and the painted cement board soffit requires maintenance.

The existing PVC roof membrane and base flashing does not uniformly lay flat to the substrate. In some areas, it is stretched and rippled above the roof plane and sidewalls. The raised and stretched membrane makes it more susceptible to wind uplift and puts the membrane under further stress as the membrane is already stressed due to the stretching. In some areas of rippled roof membrane, debris has collected, and the membrane is discolored indicating that water has ponded and dried between the folds.

Debris has collected along one edge of the curbed hatch where drainage is interrupted, and vegetation is growing from the collected debris. Weathered boards are laying loose adjacent to the pipe assembly.

The roof membrane is flashed to the perimeter mansard structure and secured by a termination bar with a continuous bead of caulk along the top edge. The caulk exhibits aging and loss of bond in some areas which, over time, will compromise the water-tightness of the flashing. Currently though, there are no reports of leaks.

Roof drain dome strainers are missing at roof drain locations and there is significant discoloration of the membrane indicating ponding of water, potentially due to plugged roof drains or improper roof slope. There are no secondary overflow drains which are required by current codes.

2.6.2 Pretreatment

2.6.2.1 Rapid Mix

The City currently uses a static in-line mixer for rapid mixing. This type of mixer is inefficient, particularly with the mixing of a coagulant. This could be resulting in higher chemical use, poor coagulation, or both. The current static mixer consists of a 6-foot pipe segment with three baffled sections within the pipe. Static mixers are incapable of mixing rate adjustments depending on WTP treatment rates, influent water temperature, and water quality conditions. Ten States Standards indicate that the retention time through the mixer should be nearly instantaneous, but not longer than 30 seconds. Equipment should provide adequate mixing for all treatment flow rates; static mixing should only be considered where the flow is relatively constant and high enough to maintain the necessary turbulence for complete chemical reactions.

At the plant capacity of 3.0 mgd, the detention time in the mixer section is approximately 1 to 2 seconds, but at average treatment plant rates, the detention time is over 5 seconds. The water system maximum day to average day peaking factor is often around 2.0; the maximum day to minimum day pumpage ratio is around 3.0. This is a wide range of flow rates through the rapid mixing process without any process adjustments. Additionally, the City is a surface water treatment plant, so there can be significant variability in influent water temperature and turbidity, depending on seasonal environmental conditions. Utilizing an in-line static mixer does not provide capacity to adjust mixing rates for optimized coagulation, so alternative mixing technology is needed.

2.6.2.2 Flocculation

Plant staff are concerned with the performance of the flocculation equipment. The plant currently experiences higher than typical filter applied turbidity. It appears that floc is not easily settled in the sedimentation basin and makes it through to the top of the tube settlers. The City currently has two flocculation/sedimentation trains, each with a capacity of 1.5 mgd. The detention time at the rated capacity of each basin is 30.16 minutes, which is just above the 30-minute minimum detention time as recommended in Ten States Standards. The flow-through velocity at design capacity is 0.66 fps, which is between the range of 0.5 and 1.5 fps recommended again in Ten States Standards. Typical flocculation processes include multiple stages with a tapered or diminishing velocity gradient, which helps to form larger floc particles and prevent shearing of the floc. However, the City's flocculation process is a single-stage flocculator with a vertical, axial flow-type, variable speed mixer. This prevents the City from operating the mixer over a wide range of mixing gradients, making it more challenging to prevent the floc from shearing as it passes through the basin.

The existing flocculator mixer is driven by a 1.5 hp motor. Typical mixer operating speed is between 22.5 and 24 rpm, with the full speed range of the mixer between 15 to 45 rpm. At typical operating speeds, the impeller tip velocity is approximately 4.9 fps, which is greater the recommended maximum of 3.0 fps per Ten States Standards. Even at the minimum mixer speed, the tip velocity is 3.3 fps, which is still greater than the recommended range. The recommended mixing gradient through the flocculation process should be between 10 to 50 fps/ft. The City is currently operating at a mixing gradient of 17 fps/ft with the ability to adjust from 10 to 47 fps/ft. Although the City is operating at a low velocity gradient, the increased tip speed has the potential to shear apart the floc that is created during this process. Alternative equipment is needed to improve flocculation performance.

Another possible reason the flocculation process is showing poor performance is because of the design of the baffle wall between the flocculation and sedimentation basins. If the flow velocity through the baffle wall is too high, the risk of shearing the developed floc increases, which then results in poor sedimentation. Each of the two floc/sed basins has a baffle wall with nine 4-inch-diameter holes. The current arrangement of the orifice holes is in a 3 by 3 grid, with the columns spaced 80 inches apart on center, with the middle column centered in the middle of the wall; the rows are spaced 48 inches apart on center with the bottom row of orifices along the flocculation tank floor. Flow is perpendicular to the orifice wall.

At the design capacity of 1.5 mgd through each basin, the velocity through the baffle wall holes is approximately 2.9 fps on average. This is much higher than Ten States Standards, which notes the velocity of flocculated water through conduits to settling basins should be between 0.5 and 1.5 fps during normal operation. In conjunction with the velocity through the holes, headlosses across the baffle wall are recommended to be between 0.12 and 0.40 inches during normal flow conditions to prevent the developed floc from breaking apart as it enters the sedimentation basins. Some headloss through the orifice wall is desired to limit short circuiting through the tank, but too much headloss can result in the fragile floc shearing apart, which hinders sedimentation. Modifications to the baffle wall are needed to reduce the exit flow velocity and headloss.

2.6.2.3 Sedimentation

The plant currently utilizes tube settlers for high-rate sedimentation. The performance of the tube settlers was identified as a potential concern by the plant staff, as applied filter turbidities are higher than typical rates. Floc has also been observed to settled on top of the tubes, indicating poor performance. Shop drawings of the tube settlers at the plant indicate that the surface loading is slightly above Ten States Standards of a maximum of 2 gpm/ft^2 for tube settlers. Operational improvements or equipment upgrades are needed to address the issue of sedimentation performance.

Coagulants used at the WTP are related to settling performance. Evaluation of the existing coagulation process is a high priority for the City. The City currently uses aluminum sulfate (alum) as their primary coagulant and no coagulant aid is applied. The water quality data indicates that the filter applied turbidity is on average 0.6 NTU, but the plant can experience spikes up to 3.5 NTU. In comparison, Ten States Standards recommend that the 95th percentile of the maximum daily settled water turbidity values not exceed 1 NTU when the source water is below 10 NTU. These spikes are relatively high compared to similar surface water plants. In addition, the raw water pH has gradually risen over the years, which may contribute to a decline in the effectiveness of the alum for coagulation.

The monthly operating reports for the last few years were recently examined in the *Water Treatment System Improvements Study* report from February 5, 2021. Results of that evaluation show the finished water pH varied more than the raw water pH. The lowest finished water pH values were directly related to increase alum dosages, and increased alum dosing appeared to be a response to seasonal increases in raw water turbidity. This occurred in the months of March, April, and May. The limitations of the coagulation process, along with the performance of the sedimentation process, also resulted in these being the highest months of filter applied turbidities.

2.6.2.4 Sludge Collection Equipment

The existing sedimentation basins utilize 40-feet-long by 19-feet, 10 inches-wide chain and flight sludge collection equipment for removal of settled solids from the basins. The chain and flight collectors are activated to push the sludge to a sump on the north ends of the basins. The basins are sloped down towards the sumps at approximately a 1.1% slope to aid in sludge removal. Cross-collector augers move sludge to the low end of the sump, where a 3-inch cast-iron sludge blowdown pipe is located. A sludge blowdown pump pulls sludge through this pipe and conveys it to the existing 20-inch wash water pipe located in the filter pipe gallery. The 20-inch wash water pipe discharges into the wastewater storage tank, which discharges into the sanitary system.

The sludge collection equipment is original to the plant and was rebuilt in 1995 with new chains, flights, and hardware. However, even with the rebuild the equipment is nearing the end of its useful life. The various mechanical components of this type of collection system require a significant amount of maintenance. In addition, the equipment has caused turbidity spikes when operated because it tends to stir up the sludge. Equipment replacement is needed for these reasons.

2.6.3 Filtration

2.6.3.1 Filtration Capacity

The plant currently has three gravity media filters that are rated for 3.0 gallons per minute per square feet of area. This loading rate equates to a 1 mgd capacity for each filter, or a total capacity for all three the filters of 3.0 mgd. Ten States Standards indicate that for water treatment plants with more than two filters, the filters must be capable of meeting the plant design capacity at the approved filtration rate with the largest filter removed from service. The State of Michigan Administration Code 325.11006 or "Four Filter Rule" also rates the plant capacity with the largest filter out of service at plants where there are less than four filters. This rule was established in 1978 and has not been applied retroactively to St. Clair. However, if the "Four Filter Rule" were applied it would leave the plant at a 2.0 mgd rated capacity. To restore the plant rated capacity to 3.0 mgd, there is a need to add a fourth filter.

2.6.3.2 Filter Media and Equipment

There is a concern that filter media characteristics may have changed over time as there has been a notable loss of filter media. In the 2018 Sanitary Survey, EGLE recommended that each filter have a core sample collected from the existing media and analyzed to determine the media depth, effective size, and uniformity coefficient.

The WTP has three granular media filters that are dual media, meaning a combination of sand and anthracite. The filters have 18 inches of anthracite above 12 inches of filter sand. The filter media appears to be original to the plant constructed in 1978, but the plant has recently had to add anthracite to top off their filters due to media loss. The three filters are rated for a design filtration rate of 3 gpm/ft^2 and have a capacity of 1 mgd each, which gives the WTP a total capacity of 3 mgd. The filters are equipped with rotary surface wash mechanisms, which is an older technology that churns up the top portion of the media bed but does not scour the entire media bed. The filters also have their original underdrains. Filter performance still appears to be very good with average filtered water turbidity being 0.070 NTU, with a range of 0.04 to 0.19 NTU. This is acknowledged in the Sanitary Survey with the major concern being the yearly need to add media.

It is anticipated that a small percentage of filter media will be lost during filter backwashing. The media expands during backwashing which can lead to media being lost as it is carried by the backwash water. Variables that influence media loss such as backwash flow rates and trough depth were recently evaluated in the *Water Treatment System Improvements Study* report from February 5, 2021. Based on that analysis, it appears that neither the flow rates nor the trough depth is the cause of significant filter media loss.

Another potential reason for filter media loss is that the media can degrade as it ages. Over time, the filter media can break down into finer particles the more times it is backwashed. If these particles become too fine, they can be carried more easily out of the filter during backwashing. Mudballs are also an issue with aged filter media, which are formed when coagulant and particles attach to filter media resulting in a mass that is difficult to remove or break up. Cracks in the media can also form over time. These issues can cause backwash non-uniformity resulting in localized high velocities that can increase the potential for loss of media.

Lastly, due to the age of the filters, the underdrains may also be a cause of media loss. It is possible that the underdrains are partially clogged, leading to backwash non-uniformity and increased head loss through the filter.

2.6.3.3 Backwashing Redundancy

The WTP has one backwash pump used for filter backwashing. Under normal operations, the backwash pump draws water from the filter clearwell and pumps it back through the wash water piping to the filter underdrains, through the filter media, over the wash water troughs, and to the filter drain. Wash water is then conveyed to the wastewater storage tank before being slowly discharged to the sanitary sewer. The plant initiates a low-wash rate for a few minutes to slowly begin the backwash process. The normal (or high) backwash rate is set to 20 gpm/ft^2 or 4,670 gpm and washes the filter for 15 minutes. This rate and duration meet the minimum requirements of Ten States Standards. There is a backwash rate control butterfly valve on the downstream side of the wash water meter to control the backwash rate. The backwash pump is a 50 hp, single speed, vertical turbine pump with a design operating point of 4,670 gpm at 26 feet total dynamic head (TDH).

St. Clair's plant is like many other water plants that only have one backwash pump. However, many other plants also have the redundant ability to backwash using system water. St. Clair's WTP does not currently have this capability, as the high-service pumps discharge directly to the elevated storage tank and distribution system.

To improve reliability, there is a need for providing some redundant alternative to the existing backwash pump for filter backwashing. As a surface water plant with a river as the source water, there is potential for turbidity spikes and decreased filtration capacity. If this occurs when the backwash pump is out of service for routine maintenance or emergency repair, the plant will not have standby backwash capability which could lead to diminished finished water quality.

2.6.3.4 Filter Control Valve Actuators

There is limited communication between the filter valves and the control system, so there is a need to integrate the valves into the SCADA system. The existing filter open/close control valves installed on Filters Nos. 1 through 3 are Pratt Positron electric actuators for the 12-inch filter influent butterfly valve, 16-inch wash water butterfly valve, and 20-inch filter drain butterfly valve. The surface wash valves are 4-inch plug valves with Pratt Positron electric actuators. These valve actuators are original to the plant built in 1978. The valves are controlled remotely through the existing SCADA system. A remote valve control panel is installed on the wall in the pipe gallery that has open and close indication lights and the ability to open and close the valves locally with switches. There is currently no position feedback for these valves to SCADA and position indication is only shown through the remote valve control panel or through the valve position indicator. The valve actuators are at the end of their useful life and need to be replaced.

The filter effluent valves and backwash rate control valve are modulating duty actuators that throttle to maintain an operator input flow rate for each filter, which is measured by the adjacent venturi flow meter. The existing modulating duty valve actuators (model number RCS MAR-250-60-4) are installed on flanged butterfly valves: 8-inch for the filter effluent valve and 14-inch for the backwash rate control valve. These actuators were provided with the venturi flow meters as a package and appear to be original to the plant from 1978.

The filter-to-waste valves are manually operated 3-inch plug valves. These valves can be opened after a filter is washed to prevent the initial turbidity spike normally experienced after backwashing. This process allows the filter to ripen prior to putting the filter back into service. Filter-to-waste is currently not utilized at the plant, due to the inability to control the valve remotely. The process typically floods the basement level floor due to not having adequate capacity in the basement sumps to pump the water to sanitary. There is a need to install a remote-controlled electric actuator on the filter-to-waste drain line to utilize this process.

An inventory list of the filter control valves and actuators is shown in Table 8.

Table 8 – Existing Filter Control Valve Inventory

Valve Function	Valve Size and Type	Actuator	Actuator Function	Valve Control Panel	Total Quantity
Filter Influent	12” Butterfly	Electric	Open/Close	Y	3
Filter Effluent	8” Butterfly	Electric	Modulating	Y	3
Drain	20” Butterfly	Electric	Open/Close	Y	3
Wash Water	16” Butterfly	Electric	Open/Close	Y	3
Surface Wash	4” Plug	Electric	Open/Close	Y	3
Filter to Waste	3” Plug	Manual	-	N	3
Backwash Rate Control	14” Butterfly	Electric	Modulating	Y	1

2.6.3.5 Filter Transfer Pumps

After filtration, filtered water is conveyed to the clearwell, where it is pumped via transfer pumps to the ground storage reservoir. The existing transfer pumps are listed in Table 9. The pumps have a firm capacity of 3.0 mgd, which assumes the largest pump out of service.

Table 9 – Existing Transfer Pumps

Pump No.	Model	Size (hp)	Flow (gpm)	TDH (feet)	Control
1	Peerless 14MC	20	1,050	57	Constant Speed
2	Peerless 14MC	20	1,050	57	Constant Speed
3	Peerless 14MC	20	1,050	57	Constant Speed

The transfer pumps are original to the plant, so they are past their useful life. They should be replaced to improve reliability of the plant.

2.6.4 Chemical Feed Systems

2.6.4.1 Disinfectant Feed Point Addition

The City has a post-filtration chlorine feed point in the filtered water transfer piping but does not currently have the capability to feed disinfectant to the process stream after the ground storage tank. A disinfectant feed point is needed for the tank discharge prior to the high service pump suction header. The Michigan Safe Drinking Water Act requires surface drinking water plants to provide a residual disinfectant concentration of 0.2 mg/L or higher to the distribution system. The City’s targeted WTP chlorine residual is 1.5 mg/L. Insufficient chlorine residual can occur if the residual diminishes while stored in the storage tank or an inadequate chlorine dose is applied at earlier states in the treatment process. Adding a feed point on the ground storage tank discharge (prior to the high service pumps) would ensure that there is sufficient disinfectant residual leaving the WTP to the distribution system, thus improving the system’s reliability.

2.6.4.2 Chemical Feed SCADA Improvements

Modern water treatment plants allow operators to monitor and adjust chemical doses through their SCADA control systems. Often chemical feed adjustments are done automatically based on changes in flow. The St. Clair WTP does not have this functionality as the chemical feed system is not currently connected to the plant SCADA system. The current operation requires that staff manually monitor and control the storage tanks and feed pumps.

St. Clair utilizes three different chemical feed systems for producing treated water: sodium hypochlorite for disinfection, aluminum sulfate for coagulation, and hydrofluorosilicic acid for fluoridation of finished water.

The sodium hypochlorite chemical feed system consists of three 400-gallon bulk storage tanks, one magnetic drive transfer pump, one 55-gallon day tank, and two peristaltic chemical feed pumps. The bulk tanks are filled through a quick connection located in the storage room. Each of the bulk tanks is monitored by observation of level through the tank wall. An operator transfers chemical from the bulk tanks to the day tank through a start/stop control station. The day tank is located on a weight scale for volume monitoring through an analog gauge. Two peristaltic pumps are manually controlled and feed three existing injection points; plant raw water upstream of the static mixer (pre-chlorination), settled water upstream of the filters (intermediate chlorination), and downstream of the transfer pumps (post-chlorination). The WTP can either dose at the intermediate chlorination point or the post-chlorination point but cannot dose both at the same time.

Aluminum sulfate is utilized as a coagulant and is feed in one location to the raw water at the rapid mixer. A 6,000-gallon bulk storage tank and magnetic drive transfer pump are located in the basement level. There is no ability to measure or observe the level in the bulk storage tank. An operator manually operates the transfer pump to fill the day tank located on the main level. A yardstick is used to monitor the level in the 100-gallon day tank. Two peristaltic pumps are used to feed alum to the rapid mixer. These pumps are monitored and adjusted manually as raw water quality changes.

Hydrofluorosilicic acid is fed upstream of the rapid mixer and utilizes 150-pound drums for storage. There is no bulk storage tank for this system. A single peristaltic feed pump is used to dose fluoride. The system is located in the Chemical Storage Room. The drums are placed on a weight scale for volume measurement and are manually monitored. The feed pumps are also manually monitored and controlled.

2.6.5 Venturi Flow Meters

The WTP uses venturi flow meters for the raw water flow, high service pumping, filter effluent, and filter wash water. Although venturi flow meter technology has existed for many decades, it is prone to inaccuracy if the pressure sensors are installed incorrectly or if the meter does not have the necessary distance from upstream or downstream disturbances (i.e., control valves, pumps, elbows, or other appurtenances). There is a need to replace the venturi flow meter with newer technology to improve raw water metering accuracy.

2.6.6 Electrical, Instrumentation and Controls

2.6.6.1 SCADA System

The City’s existing SCADA system is based on an industrial manufacturing platform. It predominantly monitors, rather than controls, the WTP. There is a need to upgrade the existing PLC and SCADA system to an industry standard to minimize both implementation and maintenance/repair costs.

The main control panel (MCP) for the plant is flush-mounted in the wall to the corridor adjacent to the Laboratory. The rear of the panel extends into the Laboratory. The MCP contains three input/output (I/O) racks. Each rack contains a Direct Logic 205 programmable logic controller and various I/O modules. The MCP communicates with remote sites via radio. An operator interface terminal is mounted to the MCP. A desktop workstation is located in the Laboratory and provides access to the SCADA system. The plant can control some operations through SCADA screens, but its primary function is for monitoring.

The DirectLogic PLC and I/O module line is still supported by Koyo Electronics Industries. The existing 205 PLC model, D2-09B-1, is a current model. The I/O modules are all also current and supported models. The PLCs and I/O modules are in good condition, as is the operator interface terminal.

The plant was recently struck by lightning and the resulting event deleted some of the stored SCADA settings. This revealed a need for a lightning protection system for the plant. Because the plant does not have a large roof area and there is limited equipment on the roof, adding a lightning protection system is relatively inexpensive and would prevent future similar events. The radio and telephone system would also be tied into the lighting protection system. A historian and/or application backup server for the SCADA system would help in rectifying issues like this.

2.6.6.2 Electrical Components at the WTP

The plant receives a single utility service from DTE Energy. The medium-voltage service is stepped down via a utility-owned 300kVA, 13.2kV-480/277V pad-mounted transformer located on the east side of the plant. The transformer feeds an 800A, 3 phase, 4 wire Main Switchboard (MSWB) inside the plant. MSWB contains four sections, including a utility metering and surge protection section, utility power switch section, generator power switch section, and a 480/277V distribution section (LDP-2) containing multiple fused switches. The utility and generator power switches are kirk-key interlocked to prevent paralleling.

480V power is further distributed in the plant via two motor control centers (MCCs). MCC-1 is located adjacent to MSWB. MCC-2 is located in the lower level of the plant. MCC-1 is a 600A, 3 phase, 3 wire, 3 section General Electric 7700 MCC. MCC-1 contains the across-the-line starters for the three 50 hp high service pumps located in front of it. MCC-2 is a 600A, 3 phase, 3 wire, 3 section General Electric 7700 motor control center. MCC-2 contains the across-the-line starters for the three 20 hp transfer pumps located in front of it. MCC-2 also feeds the wash water pump, surface wash pump, and other miscellaneous loads.

LDP-2 feeds a 400A, 120/208V lighting distribution panelboard (LDP-1) via a 480-120/208V, 75kVA low voltage transformer. LDP-1 and its associated low voltage transformer are located adjacent to MSWB. LDP-1 feeds additional 120/208V branch circuit panelboards: LP-A, LP-B, and LP-C. LP-A is located next to LDP-1 and is a 42 space, 225A, General Electric NLAB type panelboard. LP-B is located in the Laboratory and is a 30 space, 100A, General Electric NLAB type panelboard. LP-C is located on the lower level and is a 42 space, 100A, General Electric NLAB type panelboard.

An onsite 150kW diesel generator provides standby power to the plant. The generator is manufactured by Kohler and is a 150R0ZJ model. The generator feeds MSWB through the kirk-keyed generator power switch. This configuration allows the generator to power any load in the plant. The generator does not have sufficient capacity to power all loads in the plant at once; operators must determine which loads to operate while on generator power. A fuel tank is located adjacent to the generator.

The majority of the electrical distribution equipment is the original equipment installed during the construction of the plant in 1978. The equipment appears to be in moderate/poor condition, largely due to its age and where it is installed. External metal components of MSWB, MCC-1, MCC-2, and LDP-1 that are not painted are rusted or oxidized. It is likely that some internal components associated with this equipment have also started to rust, oxidize, or otherwise degrade.

The generator is a newer model manufactured around 2002 and appears to be in good condition. The HVAC associated with the generator requires manual operation when in use (i.e., opening/removing wooden board on exhaust louver). The fuel tank serving the generator is similar to the fuel tank at the Shorewell Pump Station and does not include measures for spill control.

Other electrical equipment, devices, and conduit throughout the plant are rusting, oxidizing, or otherwise degrading. These conditions are especially prevalent in the treatment area and lower level of the plant where the atmosphere is significantly more wet and corrosive compared to other areas in the upper level. Previous issues with chemicals being vented into the building also have caused corrosion issues, which has degraded the condition of the MCP. Some components have been replaced as a result.

The generator does not automatically provide power to the plant. This means that legally-required emergency systems must have an alternate power source (i.e., batteries). Egress lighting is the only legally-required emergency system at the plant. Some exit signs appear to have batteries, but the signs themselves do not appear to be operational. Remote lighting heads are found throughout the facility.

The electrical distribution equipment is beyond its recommended useful life. Multiple pieces of equipment are also rusting or oxidizing on the exterior and assumed to also be degrading on the interior.

Lastly, no steps have been taken toward complying with the NFPA 70E "Standard for Electrical Safety in the Workplace". This standard requires certain parts of the electrical distribution system to include arc flash hazard labels. Not having these labels can result in citations from OSHA and, more importantly, unsafe working conditions for those working on electrical equipment.

2.6.7 Water Treatment Plant Building

2.6.7.1 HVAC System

There are several needs regarding the HVAC system at the WTP. The following is a list of items that need to be addressed.

1. There are several hot water cabinet heaters, convectors, and unit heaters that are 43 years old and past their useful life.
2. The Laboratory exhaust hood roof mounted fan (EF-2) is up-blast, explosion-proof style per code, but it does not extend 10 feet above the roof as code requires.
3. The Laboratory is heated and ventilated by a 43-year-old air handling unit system (AHU-2) that is beyond its useful service life. The air handler draws outdoor air in through a roof-mounted intake hood. The air handler has a filter section, a pumped hot water heating coil section, and a fan section. Air is distributed through sheet metal ductwork and ceiling mounted diffusers.
4. The locker room is exhausted by a roof-mounted exhaust fan (EF-1) that is inoperable.
5. The chemical storage/truck bay room is not heated or ventilated. This is an issue because sodium hypochlorite is stored in this room, so the risk of corrosion of electrical and mechanical equipment is high.

6. The generator room has a wall-mounted motorized damper and louver likely interlocked with the generator to open when it runs. The wall louver for the fan and generator intake air is covered with wood on the exterior.
7. There are two 43-year-old hot water heating convectors on the exterior wall adjacent to the fan. The convectors are operated by a wall-mounted pneumatic thermostat. Control valves were not found, but may be present, out of ready sight.
8. The chemical storage/feed room has a 43-year-old hot water heating convector controlled by a pneumatic wall-mounted thermostat that appears to be corroded.
9. The janitor’s closet does not appear to have a code-required exhaust system.
10. The carbon room contains a PK gas-fired boiler that vents into the original chimney. The 12-year-old boiler is rated for 712mbh output, 200 F LWT, and appears to be in good condition. A wall-mounted Heat-Timer boiler controller controls the boiler firing rate. Combustion air is ducted to a boiler connection with PVC. There is an inline circulation pump and Spirotherm air separator. The boiler tank is constructed of aluminum, which requires chemical treatment that must consider aluminum, steel, and copper pipe in system. There is an emergency boiler gas shut off just outside the carbon room door. A wall-mounted pneumatic thermostat controls a hot water heating wall convector. The wall convector is 43-year-old and nearing its useful life.
11. The Office near the main entrance door is cooled by the wall air conditioner. The condensate from the AC unit spills to the floor in the filter gallery. The room is heated by a hot water heating cabinet heater located in the filter gallery. This unit is controlled by a pneumatic wall-mounted thermostat by the main building entrance door. The heater is about 43 years old and nearing its useful life. The heater’s supply air is ducted to four ceiling-mounted diffusers along the exterior wall of the office and entrance lobby. Two diffusers are in the office and two are above the building’s main entrance door. Return air is drawn back to the cabinet heater through a wall grille in the office.
12. The Filter Gallery houses a 43-year-old air handling unit system (AHU-1) that is beyond its useful service life. The air handler draws outdoor air in through a wall louver. It has a filter section, a pumped hot water heating coil section, and a fan section. This unit ventilates both the Filter Gallery and the lower level Pipe Gallery. A wall-mounted humidistat and thermostat in the Filter Gallery control the unit. Air is distributed through exposed sheet metal ductwork and sidewall duct-mounted diffusers. Return air is drawn back to the unit through a return duct-mounted grille in the lower level. There are two wall louvers with gravity backdraft dampers to relieve outdoor air that is drawn in. There are several issues with the system; the shaft on AHU-1 recently failed, one of the hot water pumps is leaking, the control switch is non-functional, and the ductwork is corroding as paint is peeling off.
13. The lower level Pipe Gallery supply duct from AHU-1 has a severely corroded short section of duct where a supply air diffuser used to be located. The remaining duct appears to be in good condition.
14. There are two 43-year-old hot water unit heaters in the lower level that are nearing their useful life.
15. There is significant evidence of high moisture and corrosion of bare metal in this space. Painted concrete wall coatings are peeling off.

2.6.7.2 Plumbing System

There are needed upgrades for the plumbing system at the WTP. The following is a list of items that need to be addressed.

1. The drinking fountain is very corroded.
2. The locker room sink is aged and does not have a mixing-valve style faucet.
3. The Peerless submersible sump pump in the lower level near the stairway has a corroded sump cover.
4. A second simplex sump pump in the lower level is heavily corroded.
5. There are emergency showers provided in the truck bay room and chemical storage/feed room that are piped with cold water. Code states that emergency showers are to be supplied with tepid water (60 F minimum).
6. There is a floor drain in the lower level chemical tank containment area that is not meant for chemical containment in the event of a spill.
7. The lower level Pipe Gallery has a ¾-hp tank-mounted air compressor that may be used for pneumatic temperature control air. This unit is heavily corroded.

2.6.7.3 Roof

The original roof of the WTP consists of a built-up roof membrane applied over 1-inch vent board and a vapor barrier. This roof assembly was applied directly over sloped insulating concrete fill supported by precast concrete roof plank. The building was subsequently reroofed with a white PVC mechanically-attached roof membrane. It is unclear if this was the only time the building was reroofed, whether the new roof membrane was applied directly over the original membrane, or if the original membrane was removed prior to reroofing. It is also unclear if insulation was added to the assembly when the building was re-roofed. PVC membranes have a history of plasticizer migration which, over time, can lead to embrittlement of the membrane and susceptibility to damage from hail and other shocks.

The existing roof membrane and base flashing does not uniformly lay flat onto the substrate. In many areas, it is stretched and rippled above the roof plane and sidewalls. The raised and stretched membrane makes it more susceptible to wind uplift and puts the membrane under further stress, as the membrane is stressed due to the stretching. In some areas of rippled roof membrane, debris has collected and the membrane is discolored, indicating that water has ponded and dried between the folds.

The roof membrane is flashed to an interior masonry sidewall and to perimeter parapets and secured by a termination bar with a continuous bead of caulk along the top edge. The caulk exhibits aging and loss of bond in some areas which, over time, will compromise the water-tightness of the flashing. However, there is currently a report of a leak at only one location, where a masonry “chimney” penetrates the low roof area.

Roof drain dome strainers are missing at roof drains. At several drains, there is significant discoloration of the membrane, indicating ponding of water, potentially due to plugged roof drains or improper roof slope. There are no secondary overflow drains, which are required by current codes.

2.6.8 Water Treatment Plant Capacity

The existing WTP must be expanded for the primary reason of restoring the plant to its existing 3.0 mgd capacity. Expansion of the filtration process is needed to comply with the “Four Filter Rule”, as discussed in Section 2.6.3. Secondarily, the plant should be expanded to meet future demands. There are current plans for industrial and residential development that are expected to increase the MDD to almost 2 mgd in the next 10 years. Additional growth and expansion within the 20-year planning period is expected to increase the demand to over 2 mgd. If the plant capacity is 3.0 mgd, and the current operating schedule of 16 hours a day is maintained, the plant capacity is effectively only 2.0 mgd. Overall plant expansion would be needed to meet future demands greater than 2 mgd.

2.7 Compliance with Drinking Water Standards

The Sanitary Survey completed by EGLE in 2018 evaluated the water system to determine if requirements of the Michigan Safe Drinking Water Act, Part 399 are being met. The evaluation determined the system and the water treatment plant are in compliance, although there were several recommendations for improvements as discussed in Section 2.6.

Orders of enforcements actions for the City were reviewed. There was one recent acute violation of a Maximum Contaminant Level. The City issued a Notice of Drinking Water Chemical Overfeed on January 12, 2020, included in Appendix 1. Severe weather on January 11 to 13 caused deteriorated raw water quality, which led to an alum dosage that exceeded certified levels in violation of the Michigan Safe Drinking Water Act. In response, the City made efforts to flush out the impacted water, performed lab testing for proper dosing, and performed additional sampling related to corrosion control in the system.

2.8 Orders of Enforcement Actions

There have been no court or enforcement orders against the City water supplier in recent years.

2.9 Drinking Water Quality Problems

One potential source of contamination is runoff into the St. Clair River, this being the City’s source water. Sewage runoff from both US and Canadian sources or chemical spills from industries in the area could lead of contamination. However, there are no major reoccurring issues related to drinking water quality for the City. In general, they have very low turbidity in their finished water, so aesthetic quality is typically very good.

2.10 Projected Needs for the Next 20 Years

There are additional capital improvement needs for the City beyond the funding being sought for in this DWSRF plan. Much of the distribution system piping is thought to have been installed around 1960 and is undersized in some areas. Dead ends also affect the reliability of the distribution system. A reliability study was completed for the City in 2016 by Anderson, Eckstein and Westrick, Inc. entitled *Water Distribution System Reliability and Master Plan for the City of St. Clair*. The study outlined projected needs for the 20-year period from 2016 to 2036 and recommended a capital improvement program (CIP). CIP #1 through #4 were recommended to be complete in the next five years (2016 to 2021) and CIP #5 through #16 were recommended for the next 20 years (to be complete by 2036). Necessary water supply improvements were prioritized based on their ability to improve reliability and address available fire flow deficiencies. One of the projects, CIP #1, has been complete, while the remaining 15 projects have not. A portion of CIP #2, from Palmer to Oak on Goffe St, is planned to be replaced in the summer of 2021. The improvements from the Reliability Study are listed below.

- CIP #1: Construct 8-inch water main on St. Clair Highway between M-29 and about 300 ft SW of Second St. (Total length is about 560 linear feet of 8-inch ductile iron)
- CIP #2: Replace existing 6-inch water main with 8-inch water main on Goffe St between Laura and Oak. (Total length is about 3,400 linear feet of 8-inch ductile iron)
- CIP #3: Construct 8-inch water main between South Riverside and Oakland in easement (to be acquired). (Total length is about 450 linear feet of 8-inch ductile iron)
- CIP #4: Replace existing 4-inch water main with 8-inch water main on Witherell St (from Seventh to Ninth), Seventh St (from Witherell to Thornapple) and Thornapple (from Sixth to Ninth). (Total length is about 2,500 linear feet of 8-inch ductile iron)
- CIP #5: Construct new 8-inch water main loop along St. Clair Highway from Mary to Oak (connect to existing 8-inch on Oak West of Edison). (Total length is about 4,800 linear feet)
- CIP #6: Replace existing 4-inch water main with about 625 feet of 8-inch water main on Glendale between Palmer and Maple.
- CIP #7: Construct new 8-inch water main loop on Fifth from Cedar to Vine. Connect to all East/West cross streets. (Total length is about 2,800 linear feet)
- CIP #8: Replace multiple existing ¾-inch to 1-inch water main with about 580 feet of 8-inch water main on Witherell between Fifth and Seventh.
- CIP #9: Replace multiple existing 1-inch water main with about 305 feet of 8-inch water main on Cass between Fifth and Sixth.
- CIP #10: Construct new 8-inch water main loop on Royal from Fifth to Sixth. Replaces existing ¾-inch dead end water main on Royal. (Total length is about 360 linear feet)
- CIP #11: Construct new 12-inch water main loop on Range Rd from Jordan Creek to Yankee and south to Christian B. Haas. (Total length is about 3,100 linear feet)
- CIP #12: Construct new 12-inch water main loop in easement (to be acquired) from Cross Country (from Highland to Range) 12-inch water main to Jordan Creek and Christian B. Haas. (Total length is about 1,600 linear feet)
- CIP #13: Construct about 1,500 feet of 16-inch water main extension north from current limit.
- CIP #14: New elevated storage tank at Christian B. Haas and Yankee Rd. Estimated 1,00,000-gallon volume and 60- foot diameter. Operating levels between 46.5 feet to 95 feet above grade. About 100 feet of 12-inch ductile iron pipe to connect to system. This improvement was recommended because of an anticipated increase in demand, especially in the Township. If demand is the driving factor for increasing the WTP capacity, then the available storage in the system must also be increased.

Apart from the needed upgrades to the WTP, the 2018 Sanitary Survey recommended two especially noteworthy improvements for the City, as discussed below.

- Tank venting standards have been updated in recent years to require a fine mesh screen on the tank vents. The original design for the type of elevated storage tank that St. Clair has does not conform to this requirement as there is a gap at the junction of the roof top and access tube/hatchway. This could result in a sanitary hazard. The Sanitary Survey stated the roof and access tube area was not visible, so it was uncertain if the gap existed or if it had already been sealed to meet the current requirements.
- Another deficiency identified in the Sanitary Survey was a need to improve the Cross-Connection Control Program. It was recommended that St. Clair's inspection staff attend training offered jointly by Michigan Section AWWA and EGLE.

The AMP completed in 2018 also identified needed improvements to the water distribution system, including the following.

- Replacement of 5,540 feet of water main (or about 3% of all of the City's water main) in the next 20 years because it is approaching the end of its useful life.
- Not all of the CIP items listed in the 2016 Reliability Study could be complete with available funds, so the AMP recommended only installing water main that would loop the existing system (CIP #3, 5, 7, 10, 11, and 12).
- It was recommended that all gate valves and fire hydrants be inspected and replaced as needed.
- Water main, gate valves, and hydrants with a criticality score of 16 or greater were recommended to be replaced in 1 to 10 years. This included five local water main and two major water mains.
- Water treatment plant components with a criticality score of 4 or greater were recommended to be replaced in 1 to 10 years. This included a list of 48 items throughout the plant.

3.0 Analysis of Alternatives

The following sections discuss alternatives for meeting the needs of the system. The alternatives that were evaluated include the no-action alternative, connection to a regional water utility, and optimizing the existing facility.

3.1 No-Action Alternative

The first alternative is the "no-action" alternative which evaluated whether no project at all is a viable option of the City. In the long term, the no-action alternative is not a viable option because most of the existing equipment is past its useful life and there are some components that are outside of industry or regulatory standards. To continue to provide quality water for years to come, action must be taken to address the existing facilities.

3.2 Regional Alternatives

The second alternative is to consider connecting the City's water distribution system to another regional water utility. The feasibility of connecting to two other water supplies was evaluated: The City of Marysville and East China / China Townships.

It is important to note that some of the deficiencies at the St. Clair water treatment plant are time-sensitive due to the age and condition of the existing equipment. In the short-term, some upgrades may be needed at the plant to continue operating adequately, even if consolidation happens in the long-term.

3.2.1 Connection to Marysville

A neighboring utility is the City of Marysville, located approximately three miles north of St. Clair. Water utility staff at Marysville were consulted to determine the feasibility of the conceptual plan.

The Marysville system has two intakes extending into the St. Clair River and a conventional water treatment plant rated at 9.0 mgd. The water distribution system in Marysville consists of about 50 miles of water main. The ADD for Marysville is about 2.5 mgd and the MDD is about 4.5 mgd.

This alternative assumed that if St. Clair were to connect to the Marysville system, St. Clair would become a retail customer of Marysville and the St. Clair WTP would be no longer be used. User water rates would be at the discretion of Marysville. Transmission capacity would need to supply a maximum demand of about 2.14 mgd to St. Clair based on demand projections in the 20-year planning period.

An important consideration for consolidating the systems is available water storage. The existing storage capacity in Marysville will need to be evaluated to determine if expansion is needed, and the cost and construction will need to be considered as part of the project. Another consideration for the Marysville system is water pressure. Marysville reportedly has pressures around 35 psi near its southern border, which is where St. Clair would connect. The pressure in Marysville would decline even further with the additional demand from St. Clair. A booster pump station and/or new watermain in Marysville would likely be needed to address this low-pressure issue.

At a minimum, this alternative would require the construction of two booster pumping stations and two transmission mains. Dual pump stations and transmission mains are needed to eliminate a single point of failure, to provide fully redundant water supply to St. Clair.

A likely tie-in location for the transmission mains would be at the corner of Davis Rd and River Rd in Marysville. The two routes for the dual supply system are below.

- Route 1: Follow M-29, extending south from St. Clair the Marysville.
- Route 2: Follow South Range Road.

Route 1 would begin at the corner of Davis Rd and River Rd in Marysville and connect to existing water main at St. Clair's city boundary along M-29. The route is about 2.6 miles. M-29 follows the St. Clair River and is a main traffic route between cities along the river. The entire route is lined with residential homes and several small businesses, and it includes a walking path for public use. The project could greatly disrupt local activity and may be a nuisance to residents. The cost of paving and restoration would also be high for this route.

Route 2 would begin at the corner of Davis and River Rd in Marysville, then head south on South Range Rd and end at the corner of South Range and Yankee Rd in St. Clair. The distance is about 3.3 miles. The majority of Route 2 extends through farmland, with some areas of industry. There are drainage ditches on either side of the road and the route is not intended for foot traffic. The social impact would be much less significant for this route compared to Route 1. However, there would be slightly more environmental impact as Route 2 would require crossing Bowman Drain and Brandywine Creek. This route would also need to cross the railroad owned by CSX Transportation. The cost of drain and railroad crossings would be high for this route.

The estimated project cost for the project with full redundancy is $26,840,000.

3.2.2 Connection to East China / China Township

The St. Clair River Sewer and Water Authority (SCRSWA) operates a water treatment plant in East China Township that serves East China and China Townships, using the St. Clair River as their water source. The plant was constructed in 2001 and uses membrane filtration for treatment. There are currently three filter trains with modular filter cassettes, and additional cassettes can be added to increase capacity. The filter capacity had been increased once since the original construction, providing a current rated capacity of 1.94 mgd. Six additional cassettes can be added to the existing trains, two per train, which would provide an increased filtration capacity of 3.0 mgd. There is an additional basin onsite that is currently used for reject-water, and piping modifications could be made to convert this into a filter train to provide an additional 1.0 mgd of capacity. However, the overall plant is also limited by its intake and low service pumping capacity, which is currently 3.0 mgd.

The treatment plant has three high service pumps with a design flow of 1,130 gpm each, providing a firm capacity with one pump out of service of about 3.25 mgd. The distribution system has a 500,000-gallon ground storage tank, a 350,000-gallon elevated storage tank, and a 500,000-gallon elevated storage tank.

The current ADD for the SCRSWA system is 0.45 mgd, and the current MDD is 0.85 mgd. For projected demands, the 2040 ADD is 0.48 mgd and the 2040 MDD is 0.91 mgd.

If St. Clair were to connect to the SCRSWA system, they would require a total of 2.14 mgd for a future MDD, bringing the total projected MDD that the plant would need to provide at the end of the 20-year planning period to 3.05 mgd. The SCRSWA water treatment plant would need to be expanded to accommodate the increased demand. The three existing filter trains would need to be utilized to full capacity, and the fourth additional basin would need to be converted to a filter train. In addition, a second intake and low service pump station would be needed to meet the projected demand.

Currently the SCRSWA plant is staffed only 10 hours each day, but operating hours would likely need to be increased. To supply at least the 3.05 mgd that is required to meet the future MDD, it is anticipated that the plant capacity would be increased to 5.0 mgd to allow it to be operated less than 24 hours a day. Expanding to 5.0 mgd capacity would allow for production of about 3.3 mgd when operating on a 16-hour a day schedule. To increase the capacity to 5.0 mgd, an additional membrane filtration basin would need to be constructed and the high service pumping capacity would need to be increased, in addition to the expansion discussed above.

Other projects would be needed in the distribution systems to allow for supply from SCRSWA to St. Clair. East China has plans to construct over 2 miles of 16-inch watermain in King Road from Springborn to Recor Road, which would likely need to be complete if St. Clair were to connect to increase capacity to the north. This alternative would also require the construction of two booster pumping stations and two transmission mains. Dual pump stations and transmission mains are needed to eliminate a single point of failure, to provide fully redundant water supply to St. Clair.

A likely tie-in location for one of the transmission mains would be at the corner of Fred W Moore Hwy and King Rd in China Township where there is an existing 16-inch dead-end. This would require about 2,700 feet of 16-inch watermain in Fred W Moore Hwy from Carney Dr to King Rd, which would cross the Pine River. A possible route for the second transmission main would be to connect to existing watermain in East China at the corner of St. Clair Hwy and Oak St and extend to the corner of St. Clair Hwy and Palmer Rd in St. Clair. Watermain sizes in East China need to be confirmed to determine if this is feasible. This would require about 1,700 feet of new 16-inch watermain and would cross the railroad owned by CSX Transportation.

Watermain improvements in St. Clair would also be needed to increase transmission capacity and connect dead-ends. At a minimum, it is anticipated that the following watermain would be needed.

- About 1,000 feet of 12-inch watermain in Carney Dr from Vine St to Adams St, to connect existing 12-inch watermain.
- About 2,000 feet of 12-inch watermain from the existing 12-inch dead-end in Carney Dr just north of Clinton Avenue, down to the existing 12-inch in Fred W Moore Hwy.

Other improvements would likely be needed to reduce headloss or boost water pressure to the north region of the City and to St. Clair Township. A hydraulic evaluation should be conducted to determine if this can be accomplished with additional watermain or if a booster pump station would be needed. As previously discussed, there is a new industrial user that will develop the area in the northern part of the City, so it will become very important to ensure adequate pressures are maintained in the north especially if water is supplied from SCRSWA to the south. St. Clair has reported that low-pressure issues already occur in St. Clair Township, so for this evaluation it was assumed a booster station within the City of St. Clair would be needed if supply is from SCRSWA. This is a third booster station, in addition to the two mentioned above.

Hydraulic modeling should be performed to confirm flows and pressures in both the SCRSWA and St. Clair systems. Additional watermain in both systems may be needed to adequately meet demands while maintaining pressures. In addition to increasing the capacity of the SCRSWA high service pumps, the pumps' design point would need to be evaluated to ensure efficient pumping to St. Clair. The pump sizes and design points for the booster stations should also be confirmed.

Based on this preliminary assessment, at a minimum consolidation would require two new booster stations and transmission mains for supply from SCRSWA, additional watermain in both St. Clair and SCRSWA, an additional booster station in St. Clair, and expansion of the SCRSWA water treatment plant, intake system, and high service pumps. The conceptual estimated project cost is $38,200,000.

A study titled *Water Distribution System Water Plant Consolidation Feasibility Study* was complete in August of 2020 for Marine City by Wade Trim Associated, Inc. that evaluated the potential of supplying Marine City from the SCRSWA system. The study concluded that from a technical standpoint, consolidation is feasible without needing to expand capacity or complete any capital improvements. The study does note that a disadvantage of consolidation is that redundancy is reduced. If both Marine City and St. Clair were to connect to the SCRSWA system, further water treatment plant expansion and distribution system improvements beyond what is discussed in this section would be needed.

3.3 Optimize the Performance of Existing Facilities Alternative

The existing WTP can be optimized by replacing and upgrading process equipment throughout the plant, as discussed in the following sections.

3.3.1 Shorewell Pumping Station Improvements

3.3.1.1 Low Service Pumping

The three low service pumps at the Shorewell Pumping Station should be replaced in kind with new pumps. The existing pumps are past their useful life and are experiencing operational issues, so replacing these pumps will improve reliability of the pumping station. The project would include new pumps and motors, VFDs, and any necessary electrical or piping modifications. The knife gate discharge control valves for the pumps were recently replaced, so these could potentially be reused.

3.3.1.2 Sodium Hypochlorite Storage and Containment

Typical dosage rates for zebra mussel control with 12.5% sodium hypochlorite is between 0.2 and 0.5 ppm. The 2021 ADD in the system is 0.85 mgd and the MDD is 1.69 mgd. The plant currently doses approximately 2.3 pounds per hour of sodium hypochlorite and this dosing rate typically remains unchanged throughout the year when the intake is being chlorinated. Based on this rate, the dosage rate is 0.81 ppm during average plant flows and 0.41 ppm during maximum plant flows. This dosage is at or above the typical rates utilized for zebra mussel control.

Dosing at a constant 2.3 lb/hr results in an average monthly use of 175 gallons of sodium hypochlorite at the Shorewell Pumping Station. The plant takes a sodium hypochlorite delivery every 1.5 months on average. Based on this analysis, storage capacity of 250 gallons or approximately 1.4 months should be adequate for sodium hypochlorite at the Shorewell Pumping Station. This will allow for storage to be replenished at the typical interval at which the plant receives a sodium hypochlorite delivery. The plant typically only doses chlorine at the crib when water temperature consistently rises above 52°F, which typically occurs between late May and early November. It is anticipated that this chemical feed system would only be used during this time.

It is recommended a building addition be constructed to house a new sodium hypochlorite chemical feed system, with anticipated dimensions of 12 feet by 14 feet. This could be constructed at the same time a building addition for a standby generator is built. A building addition is optimal because it would allow for proper secondary containment and ventilation, as required for a chemical room. Isolating the sodium hypochlorite system in a separate room eliminates the potential for corrosion of the existing pumps and electrical equipment because of sodium hypochlorite off-gassing. Secondary containment would be provided by constructing grating flush with the finished floor overtop a depressed area. The depressed area would include a pad with a weight scale for volume indication. The room would have an overhead door to allow for easy access to load and unload drums into the room. A pallet of 4 drums could be brought into the room with a pallet jack and be set on the scale. There would also be room for additional drum storage. A new chemical feed pump would be installed on a wall-mounted chemical feed shelf. New chemical feed piping would be extended to the existing injection point at the existing pump room. A hose and dip tube would allow for easily transitioning between drums for chemical feed.

It should be noted that due to the small amount of chemical being utilized in this location, having a bulk storage tank, transfer pump, and day tank is not a feasible alternative. It is recommended to continue to feed out of 55-gallon drums that are shipped directly to the Shorewell Pumping Station.

3.3.1.3 Standby Generator at Shorewell Pumping Station

To optimize the existing Shorewell Pumping Station, issues related to standby power must be addressed. The station currently does not have a secondary power source and maintains pumping during a power outage using a diesel engine.

A 150kW natural gas generator should be installed at the station for standby power. A generator of this size can potentially operate the full load of the Shorewell Pumping Station, but it would be recommended to limit operations to no more than two pumps and other equipment at the station. The existing heating at the station is 15kW of electric heat. This load combined with all three pumps running would push the generator to or over its 150kW limit. A service entrance rated automatic transfer switch with bypass would need to be installed ahead of the MCC for the station. This will allow the station to automatically switch between power sources as required. The generator could be installed outside in a soundproof enclosure; however this option may not be aesthetically pleasing for the surrounding area. For this reason, it is recommended an addition on the existing station be constructed to house the generator and any new electrical equipment.

3.3.1.4 Electrical Needs

The electrical distribution equipment is beyond its recommended useful life, so improvements are needed. The following improvements are needed to optimize the existing system.

1. The MCC-3, LP-D and associated transformer should be replaced. Replacements should be rated for the installed environment. HVAC upgrades may allow for dust-tight enclosures to be utilized. However, if the space remains damp/wet NEMA 4 enclosures should be used at a minimum.
2. All rusting and corroding conduits should be replaced with new conduits to match existing.
3. All existing exit signs and emergency lighting be replaced with battery backup units that are self-testing.
4. A short circuit current study, overcurrent coordination study, and arc flash hazard evaluation should be completed for the station. Arc flash hazard labels should be applied to all equipment requiring a label in accordance with the National Electrical Code and NFPA 70E. These items should be completed in conjunction with the studies and arc flash hazard labeling at the WTP.
5. All receptacles in the station should be GFI or protected by GFI breakers. While-in-use covers should also be installed for further protection. All light switches should have weatherproof covers/operators on them.

6. While the SCADA system PLC and I/O modules are still supported, it is recommended that they be upgraded to match upgrades made to the MPC. A MicroLogix PLC by Allen-Bradley can be installed. The MicroLogix will be compatible with the selected Allen-Bradley PLC installed in MPC. An operator interface terminal could be installed in the panel so that operators can see how the station is operating. To improve communication between the WTP and the pump station, either a cellular modem would be added or fiber-optic communication would be installed, if it is available in the road.

3.3.1.5 HVAC Needs

Some aspects of the HVAC system are outdated and need upgrades, as listed below.

1. In the Pump Station room, ventilation to prevent overheating is currently accomplished by a wall mounted thermostat starting a propeller wall exhaust fan and manually opening a wall louver damper. It is recommended that the wall louver damper be automatically opened by adding a motorized operator and wiring to interlock its operation with the fan.
2. The original wall exhaust fan (EF-7) that served the Shorewell Pumping Station room is covered with plastic and is non-operational and should be replaced.
3. To prevent the potential buildup of harmful vapors from the sodium hypochlorite, it is recommended that an intermittent cycle timer be added to the ventilation system. This will purge the buildings air with fresh air throughout the day. This is not required by code but is good practice where chemicals are stored.
4. The lower level is considered a confined space. Code requires that ventilation at a rate of 6 air changes per hour be provided when occupied. This can be accomplished by providing a temporary ventilation system prior to entering or a permanent system could be added. It is recommended a permanent system be installed, consisting of a fan with discharge and intake pipes to the outside. The fan could be interlocked with the lower level light switch.
5. To limit the humidity level of the space during warm weather, it is recommended that two commercial-grade portable plug-in style electric dehumidifiers be added.

3.3.1.6 Plumbing Needs

The station currently has an emergency shower that is provided with cold water. Code states that emergency showers are to be supplied with tepid water (60 ºF minimum). To meet code, it is recommended a water heating system and mixing valve be added.

3.3.1.7 Roof Replacement

The roof should be replaced, as described below:

- Remove and replace the asphalt shingles, roofing felts, metal cap flashing, metal fascia and cement board soffit at the perimeter mansard. Examine the underlying sheathing and replace if damaged prior to installation of the new roofing and flashings.
- The existing roof membrane should be removed down to the structural deck and the deck examined to confirm that the substrate is dry and sound and that all surfaces are sloped a minimum of ¼-inch per foot as required by code. Confirm that the roof slope on the high side of the curbed hatch is corrected to assure good drainage.

Remove and replace the existing PVC membrane roofing and insulation with a new single-ply system with a 30-year Total System Warranty. The new roof membrane should be applied over a vapor barrier and a minimum of R-30 insulation, or thicker as required by the energy codes at the time of the roof replacement. The vapor barrier and insulation should be adhesively attached to the deck prior to application of the roof membrane. A continuous two-piece prefinished metal counterflashing should be installed on the backside of the mansard over the membrane base flashing to facilitate future replacement of roof membranes.

- Install secondary (overflow) roof drains at each roof drain location to assure that all roof areas are properly drained should the primary roof drains become plugged.

3.3.2 Pretreatment Improvements

3.3.2.1 <u>Rapid Mix Evaluation</u>

The WTP staff can perform jar testing to determine the proper mixing velocity gradient to optimize coagulation across a range of plant conditions. However, the existing static mixer cannot achieve the minimum recommended mixing gradient of 750 fps/ft at lower WTP flows. To improve this, an in-line mechanical mixer is needed that can achieve the recommended mixing gradient.

Utilizing an in-line, mechanical mixer will allow mixing rates to be varied, dependent on treatment rates and coagulation performance. Replacing the existing static mixer with a shorter pipe section will reduce the detention time in the flash mixing process. The equipment with the mixer would include an approximately 2-foot-long flanged pipe body with a 3 hp motor driven mixer with dual axial flow impellers, internal flow baffles, and a chemical solution flow proportioning system.

It is recommended that two in-line mechanical mixers be installed for redundancy. Coagulation is a required process for treatment, and currently the WTP has a single rapid mixer. This is a single point of failure in the treatment system if the rapid mixer were to be taken offline for maintenance or replacement. It is not currently a requirement from EGLE to have a redundant mixer, but it is good practice to have a two units as the mixer will eventually require maintenance. Piping should be provided to install a second rapid mixer adjacent to the existing mixer.

Additional efficiencies and cost reductions can be realized if this project is completed concurrently with the raw water meter replacement, since these improvements would require similar electrical and instrumentation improvements alongside the piping modifications. Additionally, these could be completed with a single WTP shutdown, rather than multiple shutdowns. The WTP would need to have a short shutdown during installation as there is not a secondary raw water line.

3.3.2.2 <u>Flocculation Evaluation</u>

There are two components of the flocculation process that need modifications to optimize the flocculation performance: the current single-stage flocculator mixer and the current baffle wall configuration. Both components contribute to high velocities in the flocculation process, thus increasing the likelihood of floc shearing before entering the sedimentation basin.

The current flocculation process includes a single-stage flocculator which allows for only a single mixing gradient, making it very important to prevent shearing of the floc as it passes through the basin. The existing mixer has a tip speed that is higher than the recommended maximum, which increases the potential of shearing apart the floc. To resolve this, the axial flow flocculators should be replaced with a vertical paddle wheel flocculator. This type of flocculator combines the maintenance benefits of a vertical flocculator with the increased process performance of a paddle-style flocculator. It would reduce the tip speed of the mixer to less than 3.0 fps, as recommended. The lower tip speed and increased paddle surface area are expected to improve mixing efficiency. The quality of the flow would improve and enhance settling performance in the sedimentation basin.

A vertical paddle wheel flocculator would consist of a motor, gearbox, and thrust bearing installed above the water line on a maintenance platform above. The vertical shaft and paddles are the only items located below the water line. The motor would be installed with a VFD to optimize process control for flow rate and water temperature changes. Preliminary sizing of a vertical paddle wheel flocculation system is presented in Table 10.

Table 10 – Proposed Vertical Paddle Wheel Flocculator Preliminary Sizing

Parameter	Design value	Standard
Existing Basin No.	2	2 or more
Existing Basin Size	20’ W x 20’ L x 10.5’ D	NA
Paddle Diameter	16.0’	NA
No. of Paddles	12	NA
Paddle Speed	1.78 – 3.53 rpm (50 – 100% speed)	1 – 5 rpm
Velocity Gradient Range	17 – 63 sec^{-1}	10 – 50 sec^{-1}
Gt Value Range at Maximum Flow (1.5 mgd per basin)	41,000 – 114,000	10,000 – 100,000
Tip Speed Range	1.49 – 2.96 fps	< 3.0 fps (Ten States)
Detention Time at Maximum Flow (1.5 mgd per basin)	30.16 min	>= 30 min (Ten States)
Horizontal Velocity through Tank at Maximum Flow (1.5 mgd per basin)	0.66 fpm	0.5 – 1.5 fpm (Ten States)

A vertical paddle wheel flocculator would meet Ten States Standards and typical flocculation design standards. An evaluation of a vertical paddle wheel flocculator performance at different flocculator speeds and water temperature is shown in Table 11. This indicates that a vertical paddle wheel flocculator can be easily optimized for varying water flow rates and quality. At higher water temperatures, the paddle speed would need to be reduced to keep the velocity gradient below 50 $seconds^{-1}$.

Table 11 – Proposed Vertical Paddle Wheel Flocculator Performance Evaluation

	Mixing Gradient ($second^{-1}$)					
Flocculator Speed (rpm)	33°F	40°F	50°F	60°F	70°F	80°F
1.78 (50%)	17	18	19	21	22	24
2.12 (60%)	22	23	25	27	29	31
2.48 (70%)	28	29	32	34	37	39
2.83 (80%)	34	36	39	42	45	48
3.18 (90%)	40	43	46	50	54	57
3.53 (100%)	47	50	54	59	63	63

The work for this alternative includes removing the existing vertical flocculators and installing new vertical paddle wheel flocculators with associated electrical and controls.

To further optimize flocculation performance, the existing baffle wall between the flocculation and sedimentation basins should be modified. Several alternative baffle wall arrangements were evaluated that would add additional exit holes or enlarge existing holes between the flocculation and sedimentation basins to reduce the exit velocity and headloss through the baffle wall. The recommended alternative is to add six additional orifices to the baffle wall in two columns between the middle column and the outer columns, as illustrated in the image below. This alternative minimizes the number of new orifices that would need to be cored through the wall and maintains an even spacing of the orifices. This reduces the velocity through each orifice to 0.53 fps during average demands, 1.17 fps under MDD, and 1.75 fps at the current peak WTP design capacity (3.0 mgd). Each of these metrics is within the recommended ranges of exit velocities between the flocculation and sedimentation processes. Headloss through the orifices is slightly above the recommended design criteria at full plant design capacity but is significantly reduced from the existing configuration and will still meet the required hydraulic grade throughout the treatment process.

Flocculation/Sedimentation Baffle Wall Configuration

O	O	O	O	O
O	O	O	O	O
O	O	O	O	O

O – *existing 4" orifices*
O – *recommended new 4" orifices*

Each flocculation/sedimentation train will need to be taken out of service to complete these modifications, so efforts should be made to schedule the improvements for low demand periods of the year.

3.3.2.3 Sedimentation Evaluation

The existing tube settlers are a concern for plant performance as applied filter turbidities are high and floc has been observed to settle on top of the tubes. Settling improves with improved floc development, so it is expected that the proposed flocculation improvements discussed in the previous section would improve sedimentation performance as well.

To further optimize sedimentation performance an additional row of tube settlers should be installed. This will decrease the loading rate on the tube settlers, decrease the velocity through the tubes, and increase the detention time through the tubes. Table 12 indicates the potential effects on the performance of the tube settlers if an additional 3-foot-long tube settler module was added to the existing system, as well as optimizing the coagulation/flocculation process to achieve a medium sized floc, which has a typical settling velocity of 0.22 fpm.

Table 12 – Optimized Tube Settler Process Evaluation

Parameter	Design Value	Standard
No. of Basins	2	2 or more
Depth of Basins	13.75 feet	10 – 16 feet
Fraction of Basin Covered by Tube Settlers	56%	< 75%
Tube Settler Surface Loading	1.98 gpm/ft^2	< 2 gpm/ft^2 (Ten States)
Tube Settler Angle	60°	60°
Flow Velocity through Tubes	0.31 fpm	< 0.50 fpm

Table 12 – Optimized Tube Settler Process Evaluation

Parameter	Design Value	Standard
Detention Time through Tubes	11.15 min	> 4 min
Reynolds Number through Tubes	18	< 50
Froude Number through Tubes	0.00006	> 0.00001
Weir Overflow Rate	6.5 gpm/ft^2	5 – 20 gpm/ft^2
Horizontal Velocity in Basin	0.50 fpm	0.15 – 0.50 fpm

This evaluation shows that Ten States Standards can be met in the existing basin with the addition of additional tube settler modules. All other typical design standards would be met in this scenario.

3.3.2.4 Replacement of Sludge Collection Equipment

The existing chain and flight sludge collection equipment is at the end of its useful life and should be replaced with newer technology. It is recommended a traveling vacuum collector system be installed because of its low maintenance requirements and low capital cost.

A collector system would be installed in each of the two basins. The traveling vacuum collector equipment consists of a header pipe with bottom orifices and an electric actuated sludge blowdown valve. With the sludge blowdown valve open, sludge would be drawn through the collector either by operating the sludge blowdown pump or from the differential head in the basin if the pump is off. Sludge would then be conveyed through the blowdown piping to the existing 20-inch wash water pipe and ultimately to the wastewater storage tank. A flow meter would be installed in the sludge blowdown system to quantify the sludge flow. An electric motor-driven cable reel collector drive would be mounted above the sedimentation tank on the maintenance walkway above. This drive moves the collector across the basin floor at a constant speed. The sludge collection system operation can be modified by changing the collector speed, adjusting the pumping rate, and changing the frequency of sludge collection events to accommodate varying sludge production rates. The typical operational frequency would be 1 to 2 times per day.

This system would include the removal of the existing chain and flight collection system and cross collectors. The existing floor would be leveled, and the sump partially filled. A new sludge blowdown pipe header would be installed on the south end of the basins where each blowdown valve actuator and sludge collection system would be installed. The existing sludge blowdown piping, valves, and sludge pumps would be replaced. A new sludge control system which includes a control panel and flow meter would be installed.

3.3.3 Filtration Improvements

3.3.3.1 Filtration Capacity Expansion

An additional filter should be constructed to the west of the existing Filter No. 3. The fourth filter would allow for the plant to be comply with the “Four Filter Rule” requirements and provide a 4.0 mgd rated capacity for the filtration process. An additional 1.0 mgd filter would allow the plant to take down one of the other filters at a time and maintain plant capacity. This will be important during any planned filter rehabilitation project, such as media or underdrain replacement.

The new filter would replicate the existing filters with similar media levels and trough elevations. It would be constructed with the same floor levels and a size of 15 feet, four inches by 15 feet, four inches. The existing brick building would be extended to enclose the new filter. Filter piping inside the existing building, including the influent, wash water, wastewater, and surface wash pipes, was constructed with blind flanges to the west and can be extended to a new filter constructed in that direction. An existing overflow chamber that drains the basement during large floods would need to be relocated, as the new filter would be constructed in the same location.

3.3.3.2 Filter Media and Equipment

Filter media replacement would require removal of the existing sand and anthracite and installation of new media. It is possible to reuse the existing support gravel, but it is frequently disturbed during media removal which results in the need to screen and sort the gravel into appropriate layers and reinstall in its original placement. This replacement can be performed one filter at a time in to minimize disruption in the plant.

To optimize filter performance, the filter underdrains and surface wash system should be upgraded as part of the media replacement. One issue that can cause backwash uniformity issues is if the filter underdrains are causing increased head loss or are partially clogged. Replacing filter underdrains could provide more uniform backwashing across the filter bed.

If the underdrains are replaced, utilization of an air scour system during backwash would eliminate the need for a surface wash system, in addition to potentially reducing the required backwash flow rate. The existing filters are equipped with rotary surface wash mechanisms which do not clean the media as effectively as newer air scour technology. Surface washers only churn up the top portion of the media bed, whereas air washing can scour the entire media bed. The air-wash system would be incorporated into the new plastic nozzle underdrain system. Air washing would be used when the filter water level drains down below the backwash troughs and in conjunction with the low-rate wash. Two new positive displacement blowers (one used for standby) would be required for supplying the scour air to the filters.

3.3.3.3 Backwashing Redundancy

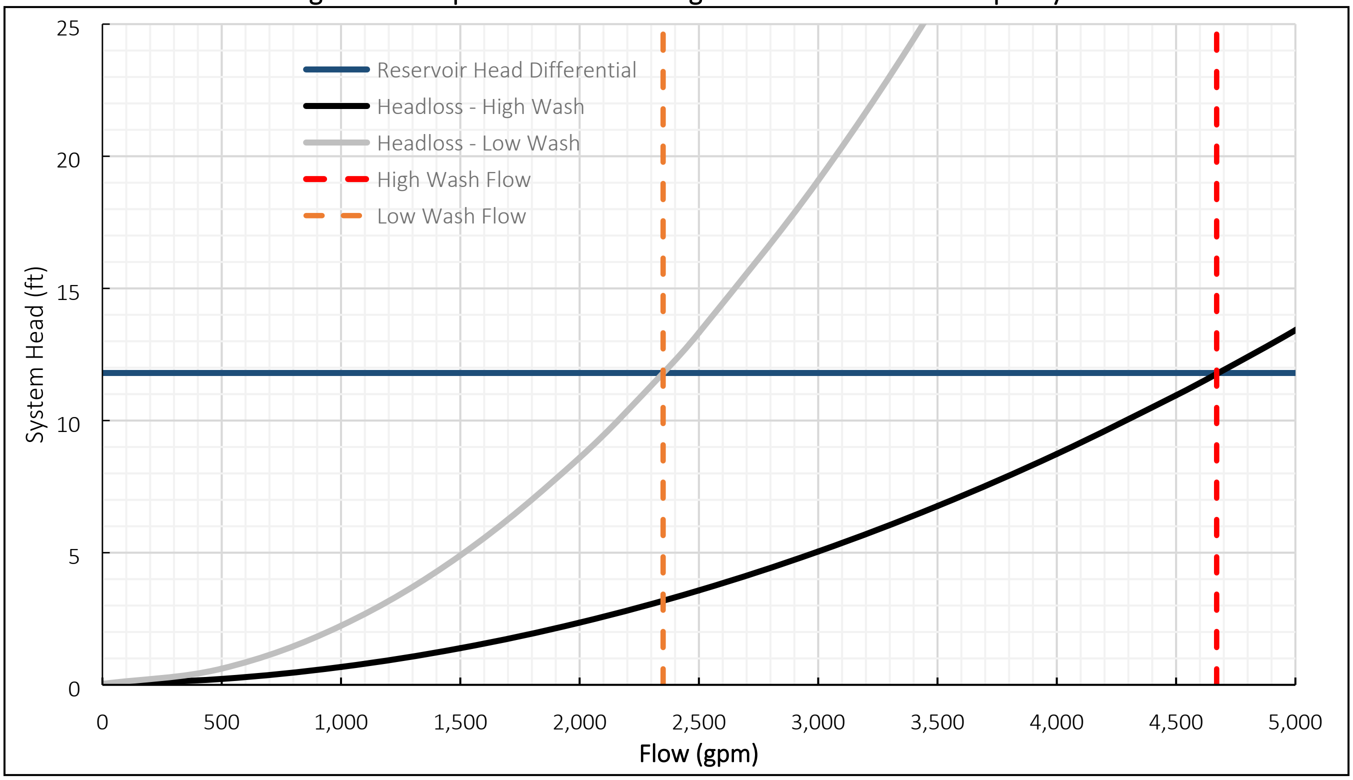
Some form of backwashing redundancy must be provided to optimize the existing system. Several alternatives for providing redundancy were evaluated, including using the transfer pumps or high service pumps for backwash supply, or installing piping to utilize the elevated storage tank or ground storage reservoir. The recommended alternative is to install piping to allow backwashing from the ground storage reservoir.

The normal reservoir water level is around 20 to 40 feet above the elevation of the wash water troughs. The discharge from the ground storage reservoir leads to the high-service suction header, but there is an emergency reservoir bypass that connects the high-service suction header to the transfer piping. This could be used to provide flow back to the filters. No additional valving is required for this alternative, as the invert of the ground storage reservoir fill pipe is at a higher elevation than the filter wash trough level. Flow from the ground storage reservoir would be directed to the filters by gravity. A butterfly valve could be installed on the transfer piping to ensure the reservoir fill pipe is isolated, if desired, but this is not hydraulically required. The isolation valve between the backwash pump and transfer pump must be opened to allow flow back through the transfer piping to the filters.

The base of the reservoir is at an elevation of 620 feet. The overflow elevation of the reservoir is at an elevation of 660 feet, and the normal low water level is at an elevation of 640 feet which equates to a reservoir level of 20 feet. As a conservative analysis, the evaluation was performed at the end of the backwash period with one high service pump also pumping out of the ground storage reservoir to the elevated storage tank and distribution system, resulting in an additional 700 gpm being drawn out of the reservoir. The total backwash volume is approximately

70,000 gallons based on a backwash rate of 20 gpm/ft^2 and a duration of 15 minutes. This would draw the reservoir level down an additional 3.7 feet. There is 11.8 feet of positive head in the system between the reservoir (636.3') and the hydraulic grade needed to backwash the filter beds (624.5') at the end of the backwash. This hydraulic grade differential is constant across a variety of flow rates. Figure 5 shows the system curve and headlosses through the WTP piping between the ground storage reservoir and Filter 3 during a backwash. The low-wash rate backwash can be achieved with the wash water rate control valve approximately 40% open; the high-rate backwash can be achieved with the wash water rate control valve approximately 78% open.

Figure 5 – Proposed Ground Storage Reservoir Backwash Capacity



The primary limitation of this alternative is that water levels in the clearwell, ground storage reservoir, and elevated storage tank must be carefully managed by operators to ensure levels are within the desired ranges when the backwash is initiated. In the worst-case scenario, all three filters could be blinded off by a turbidity spike and all need to be backwashed while the backwash pump is out of service. The filters would not be able to continue producing high quality filtered water if this situation occurred. The following list outlines the parameters that must be satisfied to utilize the reservoir for backwashing.

- The transfer pumps cannot be run during the backwash process:
  - If the clearwell level is too high, the transfer pumps should be run before the backwash is initiated to bring the level down to the minimum level and fill the ground storage reservoir as much as possible.
  - The other online filters could be producing filtered water into the clearwell.
  - The transfer pumps cannot be used to pump water from the clearwell to the reservoir, since the piping will be used to provide flow in opposite direction.

  - Clearwell level must be initially low enough to be able to fill with filtered water from the online filters while the backwash occurs.
- If the elevated tank levels drop too low, high-service pumps will turn on and draw additional volume from the reservoir that may impact the backwash rate.
  - A single high-service pump pumping at its normal capacity of 700 gpm (1.0 mgd) will decrease the level in the reservoir by 0.6 feet over a 15-minute backwash.
- The ground storage reservoir level must be at or above 20 feet.
  - If the reservoir water level is below 20 feet when a backwash is initiated, the high-rate backwash rate will not exceed the desired 20 gpm/ft^2 over the entire backwash duration.
  - Each filter backwash will decrease the level in the reservoir by approximately 3.7 feet.
  - If backwashes on all three filters are performed sequentially, the initial reservoir level must be at or above 27.4 feet. An initial level of 29.2 feet would allow one high-service pump to run continuously while all three filters are backwashed.
- If the filters will be washed consecutively, Filter 3 should be washed first, then Filter 2, and finally Filter 1, in decreasing order of the hydraulic grade requirements needed to complete the backwash.
- There are currently several valves that are actuated with a manual handwheel that must be changed from their normal position to perform a backwash under this scenario. If the actuators are replaced and controlled through SCADA, this redundant backwash alternative will become more operationally efficient.
- It is assumed that additional SCADA programming would need to be performed to allow for selecting the ground storage reservoir as the backwash supply. This would allow the wash water rate control valve to be controlled in the event that the backwash pump is not operating.

If all these parameters cannot be met for approximately an hour while the three filter backwashes are completed, the filters can be backwashed with greater time separating the backwashes. In this scenario, after the first filter is washed, it can be returned to service and produce filtered water to the clearwell while the other two filters remain offline. As the clearwell fills from the operating filter, the transfer pumps would fill the ground storage reservoir again. At the rated capacity of a single filter, it would take 100 minutes to produce enough water to complete the next filter backwash, plus additional time to produce any volume that is needed to satisfy demands of the distribution system and fill the elevated tank again. Once the ground storage reservoir level exceeded 20 feet again, the second backwash could be initiated from the reservoir; then this process would be repeated until the reservoir level was high enough to complete the third backwash. This would be more labor intensive, as the operators must return each isolation valve to its normal position while the tanks are refilled and then reopen the valves again when the next backwash is initiated.

All these factors and the level of all three water storage units should be considered together before attempting to initiate a backwash from the ground storage reservoir. This method for backwashing should be tested and a detailed operating procedure should be developed if this option is needed for emergency backwashing.

Additional construction is not necessarily required for this option to be utilized now. However, additional piping and valving could be installed to allow for backwashing without needing to cease transfer pump operations. Providing a pipe bypass loop from the discharge header of the backwash and transfer pumps and the suction header of the high service pumps would add this additional reliability. Two additional 16-inch butterfly valves, approximately 4 feet of 16-inch piping, two 16-inch by 16-inch by 16-inch, pressure reducing valves and the supporting fittings would be needed to optimize the process of backwashing from the ground storage reservoir.

3.3.3.4 Filter Control Valve Actuators

The filter control valve actuators are at the end of their useful life and need to be replaced to optimize the existing facility. New electric actuators that serve similar functions but allow for increased feedback to the SCADA system should be installed to allow operators better remote control and observation of the control valves. Rotork is a popular electric actuator manufacturer whose IQ3 actuators should be installed on the existing butterfly and plug valves. The modulating duty version of the IQ3 actuator should be installed on the filter effluent and backwash rate control valves. The open/close duty version of the IQ3 actuator should be installed at the filter influent, drain, wash water, surface wash, and filter-to-waste valves. The IQ3 series valves allow for multiple contacts for feedback to the SCADA system, which includes fully open, fully closed, remote/local status, valve moving, and position (%) indication. A local valve control panel should be installed for local control and open/close indication of the valves. Rotork IQ3 series valves have a standard IP66/68 rating, which allows them to be temporarily submerged to a depth of up to 20 meters (65.6 feet) for 10 days. This will protect the valve actuators in the event of a basement flood event.

Additional improvements, listed below, are needed to optimize the filter piping and should be completed along with the replacement of the electrical actuators.

- The existing butterfly valves and plug valves should be replaced during replacement of the electrical actuators. This improvement would include replacing the existing valves; three 3-inch eccentric plug valves, three 4-inch eccentric plug valves, three 8-inch butterfly valves, three 12-inch butterfly valves, one 14-inch butterfly valve, three 16-inch butterfly valves, and three 20-inch butterfly valves.
- A new contained duplex sump pump system should be installed to eliminate the flooding issue in the basement when filter-to-waste is utilized. The new sump pump system would be only for capturing the filter-to-waste stream and could then be pumped back into the head of the plant for treatment. This water would not need to be wasted.

3.3.3.5 Filter Transfer Pumps

The three filter transfer pumps should be replaced in kind with new pumps. The existing pumps are past their useful life, so replacing these pumps will improve reliability of the plant. The project would include new pumps and motors, and any necessary electrical or piping modifications.

3.3.4 Chemical Feed Systems Improvements

3.3.4.1 Disinfectant Feed Point Addition

A new disinfectant feed point is needed downstream of the ground storage tank (prior to the high service pumps) to provide backup chlorination. A backup pump should be added to supply this additional chlorine feed point. A new peristaltic pump can be designed specifically for the purpose of emergency feed, rather than attempting to repurpose the existing peristaltic pumps to supply the new feed point. In addition, if the normal hypochlorite pumps or piping were to malfunction or fail, there would be no potential for emergency disinfectant feed.

The new pump would be installed in the chlorine room and would only be connected to the new feed point at the high service pump suction. This chlorine feed would be routed from the chlorine room through the floor to the lower level, above the raw water piping, through the wall into the lower level of the high service pump room, and to the north where it could be dosed into the high service suction header before the pumps. Applying chlorine before the high service pumps would help ensure that the chlorine is mixed throughout all the water pumped to the distribution system. This routing would follow a similar path as the filter feed piping. The route would require approximately 70 feet of new PVC piping between the chlorine room and the feed point.

Under the worst-case scenario with no chlorine residual remaining in the ground storage reservoir, a flow rate of 1.5 gallons per hour (gph) of chlorine would be required to achieve a dose of 1.5 ppm while the WTP is operating at its design capacity. There is an elevation differential of approximately 47 feet between the ground storage reservoir and the high service pump suction, which equates to a required minimum pressure of 20.4 psi that must be overcome by the pump to feed chlorine into the filtered water stream. There will be additional energy losses due to pipe friction, fittings, and valves, but many peristaltic style pumps can pump over a wide range of flow rates with rated discharge pressures of 100 to 125 psi. The requirements for this application scenario can easily be met with a single pump, even if the applied residual must be higher than the typical 1.5 ppm.

3.3.4.2 Chemical Feed SCADA Improvements

3.3.4.2.1 Sodium Hypochlorite Feed System

The sodium hypochlorite chemical feed system has some manual components that should be upgraded. The level of the three 400-gallon bulk storage tanks is monitored by observation through the tank wall. Operators manually operate a single magnetic drive transfer pump using start/stop controls to transfer the chemical from the bulk tanks to the single 55-gallon day tank. The day tank is located on a weight scale for volume monitoring through an analog gauge. Two peristaltic pumps are manually controlled and feed three existing injection points; plant raw water, settled water upstream of the filters, and ground storage reservoir discharge. The existing chemical feed pumps should be connected to the SCADA system via hardwire contacts. Additional instrumentation that should be considered for the sodium hypochlorite chemical feed system includes:

- Bulk Storage Tank Volume Measurement: this can either be in the form of a weight scale or ultrasonic level transmitter.
- Day Tank Weight Scale: monitors volume in the day tank and sends to SCADA.
- Discharge Pressure Switch: monitors feed system pressure by alarming to SCADA when the pressure is low.
- Raw Water Flow Meter: monitors flow rate to main chlorine feed point to the rapid mixer.
- Bulk Storage Eye Wash Flow Switch: alarms to SCADA when the eye wash station is being utilized in an emergency. This includes switches for the two eye wash stations at the WTP.

3.3.4.2.2 Aluminum Sulfate Feed System

The current chemical feed process for aluminum sulfate is all manual; operators manually operate the transfer pump to fill the 100-gallon day tank, a yardstick is used to monitor the level, and the two peristaltic pumps used to feed alum to the rapid mixer must be monitored and adjusted manually based on raw water quality. In addition, there is no way to measure or observe the level in the bulk storage tank. To improve safety measures, the existing chemical feed pumps should be connected to the SCADA system via hardwire contacts. Additional instrumentation that should be considered for the aluminum sulfate chemical feed system includes:

- Bulk Storage Tank Ultrasonic Level Sensor: monitors level in the bulk storage tank and sends to SCADA.
- Day Tank Weight Scale: monitors volume in the day tank and sends to SCADA.
- Discharge Pressure Switch: monitors feed system pressure by alarming to SCADA when the pressure is low.
- Raw Water Flow Meter: monitors flow rate feed to the rapid mixer. This will allow plant staff to monitor if there is an overfeed.

3.3.4.2.3 Hydrofluorosilicic Acid Feed System

Hydrofluorosilicic acid for fluoridation is fed upstream of the rapid mixer. There is no bulk storage tank for the system, rather 150-pound drums are used for storage. The current system requires manual monitoring and control; the volume of the drums is manually measured by placing them on a weight scale, and a single peristaltic feed pump that is manually monitored and controlled is used to dose fluoride. The existing feed pump should be connected to the SCADA system via hardwire contacts. Additional instrumentation that should be considered for the hydrofluorosilicic acid chemical feed system includes:

- Drum Weight Scale: monitors volume in the day tank and sends to SCADA.

3.3.4.2.4 Chemical Feed SCADA Improvements Summary

The existing chemical feed system can be integrated into the existing SCADA system via hardwiring to the existing control panel. If the SCADA system is upgraded in the future, the wiring can be extended to the new control panel with minimal effort. Instrumentation and I/O contacts that should be connected to SCADA for a fully functioning control and feedback chemical feed system include:

- Sodium Hypochlorite Chemical Feed System:
    - Feed Pump No. 1 and No. 2 (Existing)
        - START/STOP CALL
        - SPEED CONTROL
        - SPEED FEEDBACK
        - PUMP RUNNING
        - IN REMOTE STATUS
        - PUMP FAULT
        - PUMP LEAK
    - Day Tank Level **(New)**
        - WEIGHT
    - Bulk Storage Tote Level **(New)**
        - LEVEL
    - Discharge Pressure Switch – Low **(New)**
        - LOW PRESSURE ALARM
    - Raw Water Flow Meter **(New)**
        - FLOW RATE
    - Bulk Storage Area Eye Wash Flow Switch **(New)**
        - FLOW ALARM
- Aluminum Sulfate Chemical Feed System
    - Feed Pump No. 1 and No. 2 (Existing)

    - START/STOP CALL
    - SPEED CONTROL
    - SPEED FEEDBACK
    - PUMP RUNNING
    - IN REMOTE STATUS
    - PUMP FAULT
    - PUMP LEAK
  - Day Tank Level **(New)**
    - WEIGHT
  - Bulk Storage Tote Level **(New)**
    - WEIGHT
  - Discharge Pressure Switch – Low **(New)**
    - LOW PRESSURE ALARM
  - Alum to Rapid Mix Flow Meter **(New)**
    - FLOW RATE
- Hydrofluorosilicic Acid Chemical Feed System
  - Chemical Feed Pump No. 1 (Existing)
    - START/STOP CALL
    - SPEED CONTROL
    - SPEED FEEDBACK
    - PUMP RUNNING
    - IN REMOTE STATUS
    - PUMP FAULT
    - PUMP LEAK
  - Storage Drum Level **(New)**
    - WEIGHT

The work for this alternative includes installation of the new instrumentation as recommended, electrical wiring, and programming costs associated with incorporating the system into SCADA. There may be additional programmed interlocks associated with this improvement that the plant staff would prefer to have installed. This could include interlocks on the chemical feed pumps that prevent chemical addition when flow is stopped through the plant.

3.3.5 Venturi Flow Meters Replacement

The WTP currently uses venturi flow meters for flow monitoring of the raw water, high service pumping, filter effluent, and filter backwash. These should be upgraded to optimize the current facility by providing more accurate flow metering. Magnetic flow meters (mag meters) are an alternative to venturis. Mag meters have the same diameter as the surrounding piping, so they do not interrupt the flow stream. The technology uses electrodes on opposite sides of the pipe, sending a current through the fluid stream and measuring the changes in conductivity, which is proportional to the flow rate through the meter. This technology has 1% accuracy across a wide range of flows with resistance to disturbances.

For installation of mag meters, it is recommended to have an upstream distance of straight piping without any disturbances of at least five pipe diameters, though three pipe diameters can be sufficient to provide 1% accuracy depending on the piping configuration. Downstream of the meter, two pipe diameters of straight piping are recommended, although one pipe diameter is often sufficient. An additional parameter impacting the accuracy and sizing of mag meters is the velocity through the meter. Typically, velocities of 1.0 fps are recommended at minimum flows to ensure accuracy is maintained during low flow conditions. Full-bore mag meters are accurate up to velocities of 39.0 fps with most manufacturers recommending a max velocity of 10 fps at maximum flow conditions. In some cases, this requires reducing the line size down to accommodate the best meter size for the application.

The raw water meter and high service meter are currently installed on a 16-inch pipe with enough upstream and downstream straight piping to utilize a mag meter without concern of disturbances. Each of these pipe segments is designed to convey the rated capacity of the WTP (3.0 mgd) at maximum flow, but normal flows through these sections are only around 1.0 mgd. If a 16-inch mag meter is installed, the normal velocity through the meter will be 1.27 fps and the minimum velocity will be 0.64 fps, which are below the recommendations for best accuracy. As a result, installing a 12-inch mag meter will increase the velocities through the meter to 2.0 fps under normal conditions, 5.9 fps under maximum plant flows, and 1.0 fps under minimum plant flows. To accommodate this, two 16-inch by 12-inch reducers and approximately 10 feet of 12-inch piping are required for each meter replacement.

The backwash water meter is currently installed on a 16-inch pipe with enough upstream and downstream straight piping to utilize a mag meter without concern for disturbances; there are six upstream and 2.5 downstream lengths of straight pipe around the new mag meter. This pipe segment is designed to convey the rated backwash capacity of 4,670 gpm for each filter, which corresponds to a 20 gpm per square foot (gpm/ft^2) backwash rate. At maximum plant flow, only a single filter is designed to be washed at a time. If a 16-inch mag meter is installed, the normal velocity through the meter will be 8.5 fps and the minimum velocity will be 1.8 fps, which is within the recommendations for best accuracy. A full line size, 16-inch diameter mag meter is recommended for the backwash water meter.

There are currently three filter effluent water meters, one for each filter, to measure the filter effluent flow rate between the filter and the clearwell. These meters are currently installed on a 10-inch pipe that reduces to an 8-inch pipe into the clearwell. These meters do not have enough upstream and downstream straight piping to utilize a mag meter, as the configuration currently exists, since there is a rate control valve immediately downstream of where the meter currently is installed. Each filter is designed to filter a maximum of 1.0 mgd, or 694 gpm. Observed filtration rates are closer to 200 gpm but can be as low as low as 100 gpm. All three filters typically operate together unless one is being backwashed or taken out of service for maintenance or repairs. If a 6-inch mag meter is installed, the normal velocity through the meter will be 2.2 fps and the minimum velocity will be 1.1 fps, which is within the recommendations for best accuracy.

To allow mag meters to be installed to measure filter effluent flow, piping reconfiguration is required between the filter and clearwell. Currently, the water leaves the filter underdrain to a 16-inch tee, flows down to the left through a reducing elbow, through the existing venturi meter and rate control valve, and finally around a bend and into the filter clearwell. The proposed arrangement would replace the 16-inch tee with a 16-inch by 16-inch by 16-inch side outlet elbow and approximately 1- to 2- foot length of 6-inch-diameter spool piece to fill the space between the elbow and new mag meter. The 6-inch mag meter would be installed on that pipe spool with a 6-inch by 8-inch reducing elbow turned downward. The 8-inch butterfly rate control valve would then be installed with another elbow to connect to the existing clearwell. The existing effluent valve could be reused or be replaced as part of the actuator replacement improvement project. This improvement assumes that the existing valve is reused. Though there is only about three upstream and one downstream length of straight piping, it is adequate to achieve 1% or better accuracy for these meters based on the fittings and spacing of this proposed arrangement.

3.3.6 Electrical, Instrumentation and Controls Improvements

3.3.6.1 SCADA System Replacement

While the SCADA system PLC and I/O modules are still supported and in working condition, the plant should upgrade this equipment to a more widely used and supported manufacturer. The equipment should be replaced with Allen-Bradley Logix products, which are widely used throughout the water and wastewater industry. They can be integrated into various human machine interface SCADA solutions such as Wonderware or VTScada. Logix products also seamlessly integrate with other Allen-Bradley products such as their operator interface terminals and VFDs. The existing PLC cabinet should be replaced with a new, properly sized cabinet, including a panel-mounted operator interface terminal. The cabinet can be installed to open into the Laboratory. Installing the control panel in the Laboratory will ensure the air it uses for cooling is conditioned. The wall where the existing panel is currently flush mounted could be filled in. Depending on existing control conductor lengths and what will or will not be replaced, a junction box may need to be placed on the wall, below the floor or above the ceiling, for extension of existing conductors to the new control panel.

3.3.6.2 Electrical Component Replacement at WTP

To optimize the electrical components at the WTP, several upgrades should be made as listed below.

1. The following equipment should be replaced; MSWB, MCC-1, MCC-2, LDP-2 and associated transformers; LP-A, LP-B, and LP-C. It is suggested that the utility meter be removed from the existing lineup and installed outside. DTE may require a metering cabinet to be installed near their transformer outside. Relocating the utility meter would allow the existing main switchboard to be replaced with a new MCC. The new MCC could incorporate all elements of MSWB and MCC-1, including the kirk-key interlock of the generator and utility. Combining MSWB and MCC-1 into a single MCC would open wall space for installation of VFDs for the high service pumps. VFDs would need to be integrated into the SCADA system for start/stop and speed control.
2. Adding VFDs to the high service pumps would allow for increased pumping flexibility to meet lower demands. This improvement can be performed easily during an electrical distribution equipment replacement project.
3. All exit signs and emergency lighting should be replaced with new fixtures that include battery backup and are self-testing.
4. Equipment, conduit, and conductors that have been exposed to corrosive environments and show corrosive damage should be replaced. The extent of all corrosive damage is not readily visible and would require further disconnecting of equipment and inspection of components. PVC or PVC-coated rigid steel conduit should be utilized in corrosive locations. PVC conduit or rigid steel conduit can be installed in dry, damp, and wet locations.
5. Steps should be taken toward complying with the NFPA 70E “Standard for Electrical Safety in the Workplace” which could result in citations from OSHA due to unsafe working conditions for those working on electrical equipment.

3.3.7 Water Treatment Plant Building Improvements

3.3.7.1 <u>HVAC Needs</u>

Several aspects of the HVAC system are outdated and in need of upgrades. Many of the needs are related to ventilation and should be addressed for safety reasons and for protection of mechanical and electrical equipment. The following is a list of all necessary improvements to the HVAC system at the WTP:

1. There are several hot water cabinet heaters, convectors, and unit heaters that are 43 years old. Wherever these are still needed, they should be replaced.
2. The Laboratory exhaust hood roof mounted fan (EF-2) should be replaced with one that includes extension of the exhaust outlet to 10 feet above the roof to meet code.
3. The Laboratory is heated and ventilated by a 43-year-old air handling unit system (AHU-2) that should be replaced with one having a hot water heating coil and a refrigerant cooling coil. A new air-cooled condensing unit would provide cooling and could be roof- or grade-mounted.
4. The locker room is exhausted by a roof-mounted exhaust fan (EF-1) that is inoperable and should be replaced.
5. The chemical storage/truck bay room is not heated or ventilated. Due to sodium hypochlorite being stored here, a corrosion-resistant electric unit heater and a code-required ventilation system consisting of a corrosion-resistant exhaust fan and motorized intake damper and louver should be added.
6. The generator room has a wall-mounted motorized damper and louver likely interlocked with the generator to open when it runs. The wall louver for the fan and generator intake air is covered with wood on the exterior. An insulated sheet metal blank of panel on the back side of the louver should be provided.
7. There are two 43-year-old hot water heating convectors on the exterior wall adjacent to the fan that should be replaced.
8. The chemical storage/feed room has a 43-year-old hot water heating convector controlled by a pneumatic wall-mounted thermostat that should be replaced due to corrosion.
9. The janitor's closet does not appear to have a code-required exhaust system. An exhaust system should be added.
10. The Wessels expansion tank and shot feeder in the lower level of the carbon room should be replaced. The 43-year-old wall convector in the carbon room should also be replaced if still needed for heat.
11. The Office near the main entrance door is heated by a hot water heating cabinet heater located in the filter gallery. This unit is controlled by a pneumatic wall-mounted thermostat by the main building entrance door. The heater is about 43 years old and should be replaced. The wall mounted air conditioner should also be replaced with a split system for cooling.
12. The Filter Gallery houses a 43-year-old air handling unit system (AHU-1) that is beyond its useful service life and requires frequent maintenance. The air handler, controls, coil pump and relief dampers should all be replaced. The ductwork should have all flaking paint removed and be repainted.
13. The lower level Pipe Gallery supply duct from AHU-1 has a severely corroded short section of duct where a supply air diffuser used to be located. This section should be replaced.

14. There are two 43-year-old hot water unit heaters in the lower level that should be replaced.
15. There is significant evidence of high moisture and corrosion of bare metal in this space. Painted concrete wall coatings are peeling off. Industrial grade refrigerant-based dehumidifiers should be added in strategic locations in the lower level.

3.3.7.2 Plumbing Needs

There are plumbing-related needs at the WTP due to outdated components. The following is a list of all necessary improvements to the plumbing system at the WTP:

1. The corroded drinking fountain should be replaced.
2. The locker room sink faucet should be replaced with a code-compliant mixing valve.
3. The Peerless submersible sump pump in the lower level near the stairway has a corroded sump cover that should be replaced.
4. A second simplex sump pump in the lower level is heavily corroded and should be entirely replaced.
5. There are emergency showers provided in the truck bay room and chemical storage/feed room that are piped with cold water. A water heating system and mixing valve to the emergency showers should be added to meet code.
6. The floor drain in the lower level chemical tank containment area should be filled, and a chemical sump should be installed in the containment area to be able to pump out of in event of a spill.
7. The lower level Pipe Gallery has a ¾ hp tank-mounted air compressor that is heavily corroded. If pneumatic controls will remain, this should be replaced.

3.3.7.3 Roof Replacement

The roof should be replaced, as described below:

- The existing roof membrane should be removed down to the structural deck, and the deck examined to confirm that the substrate is dry and sound, and that all surfaces are sloped a minimum of ¼-inch per foot as required by code. Remove and replace the existing roofing and insulation with a new single-ply system with a 30-year Total System Warranty. The new roof membrane should be applied over a vapor barrier and a minimum of R-30 insulation, or thicker, as required by the energy codes at the time of the roof replacement. The vapor barrier and insulation should be attached adhesively to the deck prior to application of the roof membrane.
- Remove and replace all perimeter copings and sidewall counter-flashings. The new roof membrane should be extended up and over parapets at all copings in accordance with the requirements of the roof membrane manufacturer. Two-piece prefinished metal counter-flashings should be installed at sidewalls areas to facilitate future replacement of roof membranes.
- Install secondary (overflow) roof drains at each roof drain location to assure that all roof areas are properly drained should the primary roof drains be plugged.

3.3.8 Water Treatment Plant Capacity Expansion

The plant rated capacity would be de-rated to 2.0 mgd if the "Four Filter Rule" were applied (discussed in Section 2.6.3), so the filtration process must be expanded to maintain the existing rated capacity of 3.0 mgd. By adding a fourth filter, the filtration process would have a total capacity of 4.0 mgd, while the remainder of the plant would remain 3.0 mgd. The plant currently operates on a 16-hour a day schedule. If the plant retains its rated capacity of 3.0 mgd, the daily water production capacity would be 2.0 mgd by operating the plant for a maximum of 16 hours per day. The projected 2041 MDD is above 2.0 mgd, so it is possible that the entire plant may need to be expanded to meet future demands within the 20-year planning period. If the entire plant was expanded to 4.0 mgd, then a daily water production rate of 2.67 mgd could be achieved, assuming the 16-hour a day operating schedule is maintained.

Table 6 found in Section 2.5.1 summarizes the current treatment processes and their capacities. Based on the information in that table, the limiting unit processes that currently cannot meet a 4.0 mgd flow rate are as follows: low lift pumping; coagulation/rapid mixing; flocculation; sedimentation; filtration; and transfer pumping.

The recommended improvements for the coagulation/rapid mixing process discussed in Section 3.3.2 will achieve a capacity of 4.0 mgd, although the primary reason for this improvement is to improve redundancy rather than to meet future demands. The primary reason for the filtration expansion is also not because of future demands, but to comply with regulatory standards as previous discussed.

The primary reason for replacing the low lift pumps and the transfer pumps is because they are original to the plant, so they are past their useful life and some have had operational issues. This is discussed in Sections 3.3.1 and 3.3.3. The pumps could be replaced in kind; however, it may be prudent to upsize the pumps as part of the replacement project in anticipation of the future demands. The additional cost to upsize the pumps is expected to be marginal to the overall project cost, but this cost is not included in this DWSRF project plan.

If all other expansion items discussed above were complete, the flocculation and sedimentation process would be the final limiting process of the plant. The primary reason for expansion of this process would be to bring the entire plant to a capacity of 4.0 mgd. The existing flocculation basins have no more additional capacity as the detention time through these basins is already at 30 minutes when operating at a flow of 1.5 mgd in each basin. Ten States Standards require the detention time to be a minimum 30 minutes. Therefore, there is a need for expanding or adding to the flocculation basins if the plant capacity was increased to 4.0 mgd.

The third flocculation/sedimentation basin would be constructed directly west of the existing two floc/sed basins, sharing a wall with the existing west basin. The original site piping that feeds these basins was constructed with the ability to expand to an additional basin to the west. The additional basin would have a similar configuration as the existing basins and provide an additional 1.5 mgd capacity to the floc/sed process, increasing the total process capacity to 4.5 mgd. This basin could be constructed while the existing plant remains in service. Then, during a short shutdown, the basin could be tied into the raw water site piping and settled water piping in the basement.

It should be noted that the existing sedimentation tank does have some capacity to expand the tube settler system by adding additional rows of tube settlers. This was analyzed in the Section 3.3.2.3. By maximizing the allowable basin area with tube settlers (75% covered) and maintaining a loading rate of 2 gpm/ft^2, the sedimentation capacity can be increased to 4.0 mgd. This does not address the flocculation capacity, which is the limiting factor, so there is still a need to construct an additional floc/sed basin.

4.0 Principal Alternatives

The two alternatives that carry over from the previous evaluation are (1) connecting to the Marysville water system for supply, and (2) optimizing the performance of the existing facilities. Of the two Regional Alternatives, the option to consolidate with the Marysville water system carries over from the previous evaluation because the overall estimated project cost is less than the estimated cost of connecting to the SCRSWA system. The two Principal Alternatives are evaluated further in the following sections to predict the impact each would have on users and the environment.

4.1 Regional Alternative – Connection to Marysville

4.1.1 Monetary Evaluation

A monetary evaluation was performed for connecting St. Clair to the City of Marysville water system. The estimated project cost was evaluated for the pump station and transmission main system with full redundancy. Table 13 shows the estimated budgetary cost summaries and Table 14 shows the present worth evaluation.

Table 13 – Estimated Project Cost Summary for Connection to Marysville, Redundant Routes

Item	Initial Capital Cost	Design Life (years)	Salvage Value
16-inch Ductile Iron Pipe	$9,400,000	50	$5,640,000
Site Restoration and Paving	$5,300,000	permanent	
Connections to Existing Water Main	$20,000	permanent	
16-inch Gate Valve Vaults	$710,000	50	$426,000
Air/Vacuum Relief Valve and Blowoff Vaults	$320,000	50	$192,000
Pump/Metering Station	$4,000,000	50	$2,400,000
Drain/Creek Crossing	$80,000	permanent	
Directional Drill for Railroad Crossing	$40,000	permanent	
Subtotal - Estimated Construction Cost	$19,870,000		
Administration (10%)	$1,990,000		
Contingency (10%)	$1,990,000		
Design and Construction Engineering (15%)	$2,990,000		
Subtotal - Estimated Project Budget	$26,840,000		

Table 14 – 20-Year Present Worth Analysis: Connection to Marysville, Redundant Routes

	Cost/Value	20-Year Present Worth
Initial Capital Cost	$26,840,000	$26,840,000
Annual OM&R Cost	$0	$0
Marysville Water Rate/Year	$1,680,000	$31,900,000
Salvage Value	$0	$0
Total Worth		$58,740,000

The evaluations assume that St. Clair would become a retail customer of Marysville. As such, there are no operation and maintenance costs for St. Clair as these would be assumed by Marysville. Likewise, the salvage value was not included in the 20-year present worth evaluations because the assets would not be owned by St. Clair. The total cost to purchase water for customers in St. Clair was estimated based on current demands and current user water rates for Marysville customers.

4.1.2 Environmental Evaluation

4.1.2.1 Cultural Resources

There are no historical sites along the proposed transmission main routes.

4.1.2.2 Natural Environment

The construction of the transmission mains impacts about 3 miles of road along each of the two routes, which could result in disturbances to the environment. The project schedule will be somewhat weather-dependent, with more delays likely occurring during winter months. Based on information from the US Fish and Wildlife Service, some areas of freshwater forested or shrubbed wetlands must be crossed by the transmission main routes. Maps provided by FEMA also indicate a portion of the project near the northern border of the City of St. Clair may be within Flood Zone AH, however because no buildings will be constructed in this region this will not impact construction. The project may have some impact on wildlife as natural plant or animal habitat could be disturbed by construction activities. Once the project and proper site restoration is complete, however, long-term impacts to plant or animal life are not anticipated. Other impacts may include temporary decrease in air quality or increase in noise due to construction.

4.1.3 Mitigation

Mitigation of environmental impacts will include best construction practices such as soil erosion prevention techniques, maintenance of construction equipment, and limiting construction to regular working hours during the week.

4.1.4 Implementability and Public Participation

There are some potential issues regarding implementability of the project. The water main routes cross jurisdictional boundaries, which could make construction permitting challenging. There may be a financial burden placed on St. Clair residents if Marysville water rates increase over time. Being in the position of a retail customer could more restrictive than owning and operating the City’s own facility. Obtaining and implementing intermunicipal agreements could also be burdensome or restrictive. In addition, this alternative would mean that St. Clair no longer has water production as a potential revenue source. Water system equipment and components that are currently owned by the City would not be retained as assets. Lastly, there is a potential for reduced reliability and redundancy as a water-related emergency in Marysville would also impact St. Clair.

4.1.5 Technical Considerations

The project would be designed to meet regulatory standards and would require approval and proper permitting from the State in accordance with Act 399.

The booster stations and transmission mains would also be designed according to Ten States Standards. To comply with recommended standards, the booster station would include two pumps and a bypass line, and the station would have a flow rate indicator and totalizer meter. The design of the pumps must consider maintaining a suction and discharge pressure of at least 20 psi, with a normal working pressure between 60 and 80 psi. Each pump would be designed to meet the projected 20-year MDD at a minimum. Lastly, the station would be equipped with standby power to avoid interruptions in operation.

The transmission main, including pipes, fittings, and valves, would be constructed of ductile iron and conform to current ASTM, AWWA, and ANSI/NSF standards. Where stream crossing is needed, a minimum of five feet cover would be required. To mitigate surge and water hammer in the pipeline, the transmission main would include air-release valves at high points in the line and vacuum breaker valves at low points. Blowoff valves would also be provided to allow for flushing the pipeline. 16-inch gate valves would also be included to isolate segments of the transmission main. All valves would be located inside valve vaults. Upon installation, the pipeline would be pressure tested and leakage tested in according with AWWA standards. Prior to commissioning, the transmission main would be disinfected according to AWWA Standard C651.

4.1.6 Residuals

The volume of residuals generated correlates to the amount of water produced to meet the demand. The Marysville water treatment plant would likely produce more residuals because of the increased demand on the plant. Their residuals handling process would need to be evaluated to determine if the existing facility is adequately sized for the increase demand. The evaluation may show that modifications would be needed.

4.1.7 Industrial/Commercial/Institutional Users and Growth Capacity

The booster stations and the transmission mains would be designed with a capacity of 2.5 mgd, which is slightly more than the projected 20-year MDD of St. Clair. The stations would also have room for a future third pump. This would allow for future growth and expansion of the water system in the City and/or Township, both of which are anticipated to grow in industrial and residential water usage within the 20-year planning period. The project would account for anticipated water usage of these high-volume users by ensuring the booster stations and transmission mains are designed with adequate capacity.

4.1.8 Contamination

There are no known contaminated sites that would impact the project site.

4.1.9 New/Increased Water Withdrawals

Marysville may need to complete an Adverse Resource Impact assessment and registration if connection with St. Clair causes their water withdrawal limit to be exceeded.

4.2 Optimize the Performance of Existing Facilities Alternative

4.2.1 Monetary Evaluation

A monetary evaluation was performed for each of the proposed improvements for the WTP and Shorewell Pumping Station. The following tables (Tables 15 through 34) show the estimated budgetary cost summary for each improvement. A present worth analysis of all proposed improvements is also included in this section in Table 35.

4.2.1.1 **Shorewell Pumping Station Improvements**

4.2.1.1.1 Low Service Pumping

Table 15 – Estimated Project Cost Summary for Low Service Pumps Replacement

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$10,000	permanent	
Low Service Pumps	$80,000	20	$0
Process Piping and Valves	$50,000	50	$30,000
Concrete Modifications	$10,000	50	$6,000
VFDs	$70,000	20	$0
Electrical/Controls	$50,000	20	$0
Subtotal - Estimated Construction Cost	$270,000		
Administration (10%)	$27,000		
Contingency (10%)	$27,000		
Design and Construction Engineering (15%)	$41,000		
Subtotal - Estimated Project Budget	$365,000		

4.2.1.1.2 Sodium Hypochlorite Storage and Containment

Table 16 – Estimated Project Cost Summary for Sodium Hypochlorite Storage and Containment

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Building Addition	$102,000	50	$61,200
Schedule 80 PVC Piping	$4,000	50	$2,400
Metering Pump	$3,500	20	$0
Valves, Fittings, Appurtenances	$1,500	50	$900
Instrumentation	$7,000	20	$0
Hangers and Supports	$1,000	50	$600
Installation	$9,000	permanent	
Electrical	$5,000	20	$0
Programming	$3,000	permanent	
Subtotal - Estimated Construction Cost	$136,000		
Administration (10%)	$14,000		
Contingency (10%)	$14,000		
Design and Construction Engineering (15%)	$21,000		
Subtotal - Estimated Project Budget	$185,000		

4.2.1.1.3 Standby Generator

Table 17 – Estimated Project Cost Summary for Shorewell Pumping Station Standby Generator

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Standby Generator	$81,000	20	$0
Building Addition	$102,000	50	$61,200
Gas Service	$2,000	50	$1,200
Installation	$74,000	permanent	
Subtotal - Estimated Construction Cost	$259,000		
Administration (10%)	$26,000		
Contingency (10%)	$26,000		
Design and Construction Engineering (15%)	$39,000		
Subtotal - Estimated Project Budget	$350,000		

4.2.1.1.4 Building Improvements (Electrical, HVAC, Plumbing, Roof)

Table 18 – Estimated Project Cost Summary for Shorewell Pumping Station Building Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Electrical System Replacement	$112,000	20	$0
HVAC Systems Improvements	$22,000	50	$13,200
Plumbing Systems Improvements	$8,000	50	$4,800
Roof Replacement	$29,000	50	$17,400
Subtotal - Estimated Construction Cost	$171,000		
Administration (10%)	$18,000		
Contingency (10%)	$18,000		
Design and Construction Engineering (15%)	$26,000		
Subtotal - Estimated Project Budget	$233,000		

4.2.1.2 Pretreatment Improvements

4.2.1.2.1 Rapid Mix Evaluation

Table 19 – Estimated Project Cost Summary for Rapid Mix Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
16" In-line Mechanical Mixers, VFD	$92,000	20	$0
Piping & Valves	$38,000	50	$22,800
Pipe Support Allowance	$1,500	50	$900
Installation	$39,000	permanent	
Electrical Improvements	$3,500	20	$0
Instrumentation/SCADA	$3,000	permanent	
Subtotal - Estimated Construction Cost	$177,000		
Administration (10%)	$18,000		
Contingency (10%)	$18,000		
Design and Construction Engineering (15%)	$27,000		
Subtotal - Estimated Project Budget	$240,000		

4.2.1.2.2 Flocculation and Baffle Wall Evaluation

Table 20 – Estimated Project Cost Summary for Flocculation Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Vertical Paddle Wheel Flocculators	$80,000	20	$0
Installation	$32,000	permanent	
Electrical	$18,000	20	$0
Controls	$6,000	permanent	
Subtotal - Estimated Construction Cost	$136,000		
Administration (10%)	$14,000		
Contingency (10%)	$14,000		
Design and Construction Engineering (15%)	$21,000		
Subtotal - Estimated Project Budget	$185,000		

Table 21 – Estimated Project Cost Summary for Baffle Wall Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
4" Cored Openings	$3,000	permanent	
Mobilization	$12,000	permanent	
Disposal	$3,000	permanent	
Subtotal - Estimated Construction Cost	$18,000		
Administration (10%)	$2,000		
Contingency (10%)	$2,000		
Design and Construction Engineering (15%)	$3,000		
Subtotal - Estimated Project Budget	$25,000		

4.2.1.2.3 Sedimentation Evaluation

Table 22 – Estimated Project Cost Summary for Sedimentation Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Tube Settler Modules	$89,000	20	$0
Installation	$36,000	permanent	
Subtotal - Estimated Construction Cost	$125,000		
Administration (10%)	$13,000		
Contingency (10%)	$13,000		
Design and Construction Engineering (15%)	$19,000		
Subtotal - Estimated Project Budget	$170,000		

4.2.1.2.4 Replacement of Sludge Collection Equipment

Table 23 – Estimated Project Cost Summary for Sludge Collection Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Sludge Blowdown Piping and Valves	$30,000	50	$18,000
Sludge Blowdown Pumps	$32,000	20	$0
Sludge Collection System	$100,000	20	$0
Installation	$65,000	permanent	
Electrical	$16,000	20	$0
Controls	$30,000	permanent	
Subtotal - Estimated Construction Cost	$273,000		
Administration (10%)	$28,000		
Contingency (10%)	$28,000		
Design and Construction Engineering (15%)	$41,000		
Subtotal - Estimated Project Budget	$370,000		

4.2.1.3 Filtration Improvements

4.2.1.3.1 Filtration Capacity Expansion

Table 24 – Estimated Project Cost Summary for Filtration Capacity Expansion

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$20,000	permanent	
Filter Equipment and Media	$100,000	20	$0
Building Addition	$230,000	50	$138,000
Process Piping	$230,000	50	$138,000
Concrete/Excavation	$250,000	permanent	
Electrical/Controls	$50,000	20	$0
Subtotal - Estimated Construction Cost	$880,000		
Administration (10%)	$90,000		
Contingency (10%)	$90,000		
Design and Construction Engineering (15%)	$140,000		
Subtotal - Estimated Project Budget	$1,200,000		

4.2.1.3.2 Filter Media and Equipment

Table 25 – Estimated Project Cost Summary for Filter Media and Equipment

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$36,000	permanent	
Concrete/Crack Repair	$11,000	50	$6,600
Air Scour System	$48,000	20	$0
Underdrain	$138,000	20	$0
Media	$55,000	15	$36,667
Subtotal - Estimated Construction Cost	$288,000		
Administration (10%)	$29,000		
Contingency (10%)	$29,000		
Design and Construction Engineering (15%)	$44,000		
Subtotal - Estimated Project Budget	$390,000		

4.2.1.3.3 Backwashing Redundancy

Table 26 – Estimated Project Cost Summary for Backwashing Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Piping & Valves	$92,000	50	$55,200
Supports	$7,000	50	$4,200
Electrical	$6,000	20	$0
Instrumentation/Control	$6,000	permanent	
Subtotal - Estimated Construction Cost	$111,000		
Administration (10%)	$11,000		
Contingency (10%)	$11,000		
Design and Construction Engineering (15%)	$17,000		
Subtotal - Estimated Project Budget	$150,000		

4.2.1.3.4 Filter Control Valve Actuators

Table 27 – Estimated Project Cost Summary for Filter Control Valve Actuators

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Filter Control Valve Actuator Replacement			
Actuators	$123,500	20	$0
Remote Valve Control Station	$47,500	20	$0
Installation	$52,000	permanent	
Programming	$20,000	permanent	
Filter Control Valves Replacement			
Eccentric Plug Valves	$9,000	20	$0
AWWA Butterfly Valves	$58,700	20	$0
Installation	$20,300	permanent	
Floor Sump Replacement			
Duplex Sump System	$26,000	20	$0
4" Pipe	$4,000	50	$2,400
Sump Improvements	$15,000	20	$0
Installation	$14,000	permanent	
Subtotal - Estimated Construction Cost	$390,000		
Administration (10%)	$40,000		
Contingency (10%)	$40,000		
Design and Construction Engineering (15%)	$60,000		
Subtotal - Estimated Project Budget	$530,000		

4.2.1.3.5 Filter Transfer Pumps

Table 28 – Estimated Project Cost Summary for Filter Transfer Pumps Replacement

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$7,000	permanent	
Transfer Pumps	$60,000	20	$0
Process Piping and Valves	$45,000	50	$27,000
Concrete Modifications	$9,000	50	$5,400
Electrical/Controls	$45,000	20	$0
Subtotal - Estimated Construction Cost	$166,000		
Administration (10%)	$17,000		
Contingency (10%)	$17,000		
Design and Construction Engineering (15%)	$25,000		
Subtotal - Estimated Project Budget	$225,000		

4.2.1.4 Chemical Feed Systems Improvements

4.2.1.4.1 Disinfectant Feed Point Addition

Table 29 – Estimated Project Cost Summary for Disinfectant Feed Point Addition

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Schedule 80 PVC Piping	$4,500	50	$2,700
Metering Pump	$3,700	20	$0
Hangers and Supports	$2,100	50	$1,260
Valves, Fittings, Appurtenances	$3,100	50	$1,860
Installation	$5,400	permanent	
Instrumentation/Control	$3,100	permanent	
Electrical	$3,100	20	$0
Subtotal - Estimated Construction Cost	$25,000		
Administration (10%)	$3,000		
Contingency (10%)	$3,000		
Design and Construction Engineering (15%)	$4,000		
Subtotal - Estimated Project Budget	$35,000		

4.2.1.4.2 Chemical Feed SCADA Improvements

Table 30 – Estimated Project Cost Summary for Chemical Feed SCADA Improvements

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Pressure Switch	$4,000	20	$0
Flow Meter	$3,000	20	$0
Ultrasonic Level Transmitter	$10,000	20	$0
Weight Scale	$6,000	20	$0
Instrument Installation Costs	$10,000	permanent	
Electrical Wiring and Installation	$34,000	50	$20,400
Programming	$21,000	permanent	
Subtotal - Estimated Construction Cost	$88,000		
Administration (10%)	$9,000		
Contingency (10%)	$9,000		
Design and Construction Engineering (15%)	$14,000		
Subtotal - Estimated Project Budget	$120,000		

4.2.1.5 Venturi Flow Meters Replacement

Table 31 – Estimated Project Cost Summary for Venturi Meter Replacement

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$4,000	permanent	
12" Mag Meter	$9,400	20	$0
16" Mag Meter	$6,900	20	$0
6" Mag Meter	$9,000	20	$0
Piping	$20,700	50	$12,420
Installation	$19,000	permanent	
Pipe Support Allowance	$4,000	50	$2,400
Subtotal - Estimated Construction Cost	$73,000		
Administration (10%)	$8,000		
Contingency (10%)	$8,000		
Design and Construction Engineering (15%)	$11,000		
Subtotal - Estimated Project Budget	$100,000		

4.2.1.6 Electrical, Instrumentation and Controls Improvements

Table 32 – Estimated Project Cost Summary for SCADA System and Electrical Component Replacement

Item	Initial Capital Cost	Design Life (years)	Salvage Value
SCADA System	$315,000	permanent	
Electrical Upgrades	$426,000	20	$0
Subtotal - Estimated Construction Cost	$741,000		
Administration (10%)	$75,000		
Contingency (10%)	$75,000		
Design and Construction Engineering (15%)	$112,000		
Subtotal - Estimated Project Budget	$1,003,000		

4.2.1.7 Water Treatment Plant Building Improvements

Table 33 – Estimated Project Cost Summary for WTP Building Improvements (HVAC, Plumbing, and Roof)

Item	Initial Capital Cost	Design Life (years)	Salvage Value
HVAC Systems Improvements	$150,000	50	$90,000
Plumbing Systems Improvements	$20,000	50	$12,000
Roof Replacement	$148,000	50	$88,800
Subtotal - Estimated Construction Cost	$318,000		
Administration (10%)	$32,000		
Contingency (10%)	$32,000		
Design and Construction Engineering (15%)	$48,000		
Subtotal - Estimated Project Budget	$430,000		

4.2.1.8 Water Treatment Plant Capacity Expansion

4.2.1.8.1 Flocculation/Sedimentation

Table 34 – Estimated Project Cost Summary for Flocculation/Sedimentation Basin Expansion

Item	Initial Capital Cost	Design Life (years)	Salvage Value
Demolition	$40,000	permanent	
Flocculation Equipment	$80,000	20	$0
Sedimentation Equipment	$400,000	20	$0
Building Addition	$850,000	50	$510,000
Process Piping	$110,000	50	$66,000
Concrete/Excavation	$400,000	permanent	
Electrical/Controls	$70,000	20	$0
Subtotal - Estimated Construction Cost	$1,950,000		
Administration (10%)	$200,000		
Contingency (10%)	$200,000		
Design and Construction Engineering (15%)	$300,000		
Subtotal - Estimated Project Budget	$2,650,000		

4.2.1.9 Summary of Project Costs and Present Worth Analysis

Table 35 summarizes the project costs for each area of improvement, showing construction, associated planning and design, and total estimated project costs. The estimated salvage value of equipment after the 20-year planning period is also shown.

Table 35 – Summary of Project Costs for Optimizing Existing Facilities

Item	Subtotal - Estimated Construction Cost	Admin. (10%)	Contingency (10%)	Design and Construction Engineering (15%)	Estimated Project Budget	Estimated Salvage Value
Shorewell Pumping Station	$836,000	$85,000	$85,000	$127,000	$1,133,000	$198,900
Pretreatment Improvements	$729,000	$75,000	$75,000	$111,000	$990,000	$41,700
Filtration Improvements	$1,835,000	$187,000	$187,000	$286,000	$2,495,000	$413,467
Chemical Feed Systems Improvements	$113,000	$12,000	$12,000	$18,000	$155,000	$26,220
Venturi Flow Meters Replacement	$73,000	$8,000	$8,000	$11,000	$100,000	$14,820
Electrical, Instrumentation & Controls	$741,000	$75,000	$75,000	$112,000	$1,003,000	$0
WTP Building Improvements	$318,000	$32,000	$32,000	$48,000	$430,000	$190,800
WTP Capacity Expansion	$1,950,000	$200,000	$200,000	$300,000	$2,650,000	$576,000
TOTAL	**$6,595,000**	**$674,000**	**$674,000**	**$1,013,000**	**$8,956,000**	**$1,461,907**

Table 36 includes a 20-year present worth analysis for the overall project cost of optimizing the existing facilities. The current annual operation, maintenance, and replacement (OM&R) costs was determined to be roughly $770,000 based on the City's recent water fund budget and activity. This includes salaries and benefits, which makes up most of the total OM&R costs, as well as costs for utilities and chemicals, preventative maintenance, and equipment repair/replacement at the WTP. Costs associated with repair/replacement are expected to reduce with the proposed improvements. This is reflected in the annual OM&R cost shown in the table.

Table 36 – 20-Year Present Worth Analysis: Optimize the Existing Facilities

	Cost/Value	20-Year Present Worth
Initial Capital Cost	$8,956,000	$8,956,000
Annual OM&R Cost	$740,000	$14,050,000
Salvage Value	$1,461,907	($1,320,000)
Total Worth		$21,690,000

4.2.2 Environmental Evaluation

4.2.2.1 Cultural Resources

There are no historical sites in the vicinity of the proposed project.

4.2.2.2 Natural Environment

Most of the work would occur inside the existing buildings at the WTP property, with limited work occurring outside of the building in the proximity of the building footprints. Because much of the work is indoors, delays due to weather are not likely. The only anticipated impact to the natural environment is a temporary decrease in air quality or increase in noise due to construction. This is discussed further in Section 6.0.

4.2.3 Mitigation

Mitigation of environmental impacts will include best construction practices such as soil erosion prevention techniques, maintenance of construction equipment, and limiting construction to regular working hours during the week.

4.2.4 Implementability and Public Participation

The project plan will be available for public review. If at that time it becomes apparent that an alternative is not acceptable to the public, the alternatives will be reevaluated.

Implementability of the proposed projects was evaluated. The proposed improvements may create new operation and maintenance requirements, but many maintenance issues that the plant is currently managing will be eliminated. Many of the improvements involve upgrading equipment and automating processes. The WTP staff will need to be trained in the new operation and maintenance of the proposed equipment, but several labor-intensive and outdated processes that are currently used will no longer be needed.

4.2.5 Technical Considerations

The proposed improvements meet regulatory standards as well as improve the reliability and increase the capacity of the existing facility. With the proposed improvements, the plant will be able to maintain compliance with water quality standards in the long-term.

Overall reliability is improved with upgraded processes and new equipment because the risk of failure is reduced. Reliability is specifically addressed by the following:

- The addition of a standby generator at the Pumping Station is to provide backup power in the event of emergencies.
- The rapid mix improvements involve the installation of two mechanical mixers, providing redundancy.
- The project to provide a means for backwashing the filters from the ground water storage tank improves reliability and redundancy of the filtration system.

Compliance or safety concerns are addressed with the following improvements:

- The sodium hypochlorite storage project at the Shorewell Pumping Station improves the handling and transport of chemicals, thus improving safety concerns.
- The proposed fourth filter is needed to meet EGLE's "Four Filter Rule" requirements, providing a 4.0 mgd rated capacity for the filtration process.

4.2.6 Residuals

Currently, filter backwash water, settling basin sludge, and floc/sed basin drainage is directed to a 75,000-gallon wastewater storage tank, which slowly drains by gravity to the sanitary sewer. No capacity issues have been noted with this system. The volume of residuals generated correlates to the amount of water produced to meet the demand. Because demand projections are not anticipated to increase significantly, no significant impact is expected on residual production.

4.2.7 Industrial/Commercial/Institutional Users and Growth Capacity

New service areas that are currently in construction and are to be complete within the next ten years include a residential development and a new industrial user. Additional high-volume users are expected to be added to the system within the 20-year planning period. The projected 2041 MDD is greater than 2 mgd. Currently, the maximum water production is 2.0 mgd with the plant's existing 16-hour a day operating schedule. The plant may need to be expanded in the future to meet future demands.

4.2.8 Contamination

Map 4 shows contaminated sites within the City of St. Clair, including Part 213 closed and active leaking underground storage tanks, and Part 201 environmental contamination sites. There are no contaminated sites located near the project site.

5.0 Selected Alternative

The selected alternative is to optimize the existing facilities by expanding the system and upgrading equipment. This is preferred over the regional alternatives of connecting to the Marysville or SCRSWA water systems. The overall estimated project cost to improve the existing facilities is less than the estimated cost to connect to neighboring utilities. In addition, there are many advantages for the City to continue producing its own water, including maintaining water production as a revenue source and having ownership of the assets.

5.1 Design Parameters

The proposed improvements will meet regulatory capacity requirements. Figure 6 shows a flow schematic of the existing processes and proposed improvements at the water treatment plant facilities.

Several components of the existing WTP will be brought into compliance with drinking water standards or best practices with the completion of the proposed improvements, as listed below.

- Disinfection: It is good practice to have a second feed point after the ground storage tank discharge (prior to the high service pumps), which is addressed by the proposed project. This reduces the potential risk of failing to supply a residual disinfectant concentration of 0.2 mg/L or higher to the distribution system, as required by the Michigan Safe Drinking Water Act.
- Rapid Mix: Ten States Standards indicate that the retention time through the mixer should be nearly instantaneous, but not longer than 30 seconds. Static mixers should only be used where the flow is relatively constant and high enough to maintain the necessary turbulence for complete chemical reactions. The proposed project addresses this by adding an inline mechanical mixer, with a second unit for redundancy.
- Flocculation: The current flocculator tip speed is 4.9 fps at typical operating speeds and 3.3 fps at the minimum speed, which are both greater the recommended maximum of 3.0 fps per Ten States Standards. The proposed vertical paddle wheel flocculator reduces the tip speed to between 1.46 and 2.96 fps.
- Baffle Wall: The current velocity through the holes in the baffle wall between the flocculation and sedimentation basins is 2.9 fps at basin capacity, which is higher than the industry recommended 1.2 to 1.8 fps. The proposed baffle wall modifications reduce the velocity to 1.75 fps.
- Sedimentation: Shop drawings of the tube settlers at the plant indicate that the surface loading is slightly above Ten States Standards of a maximum of 2 gpm/ft^2 for tube settlers. The recommended improvements will reduce the loading to 1.98 gpm/ft^2. This, along with improvements to the flocculation process, will likely reduce the filter applied turbidity of the plant, which is currently on average 0.6 NTU with spikes up to 3.5 NTU. Ten States Standards recommend that the 95th percentile of the maximum daily settled water turbidity values not exceed 1 NTU when the source water is below 10 NTU.
- Filtration: Ten States Standards indicate that for WTPs with more than two filters, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with the largest filter removed from service. The State of Michigan Administration Code 325.11006 or “Four Filter Rule” also rates the plant capacity with the largest filter out of service at plants where there are less than four filters. Although this rule has not been applied retroactively to St. Clair, if it were applied it would leave the plant at a 2.0 mgd rated capacity. The proposed improvements for expanding the facilities will restore plant capacity to 3.0 mgd.

The preliminary basis of design for parameters that are impacted by the proposed improvements are listed below. The design parameters shown assume that the filtration and flocculation/sedimentation process has been expanded to an increased capacity of 4.0 mgd.

- Low Service Pumping (replace in kind): Three vertical turbine pumps, 30 hp each, design points of 1,050 gpm and 78 TDH, VFD controlled.
- Sodium Hypochlorite Storage: A storage capacity of 250 gallons (1.4 months).
- Shorewell Pumping Station Standby Generator: 150kW natural gas generator.
- Rapid Mix: Two inline mechanical mixers, each with a 3 hp motor.
- Flocculator (at a total max capacity of 4.5 mgd):
  - Max Capacity per Basin: 1.5 mgd
  - Paddle Speed: 1.78 – 3.53 rpm (50 – 100% speed)
  - Velocity Gradient Range: 17 – 63 sec^{-1}
  - Gt Value Range at Maximum Capacity: 41,000 – 114,000
  - Tip Speed Range: 1.46 – 2.96 fps
  - Detention Time at Max Capacity: 30.16 min
  - Horizontal Velocity through Tank at Max Capacity: 0.66 fpm
- Baffle Wall: velocity through each orifice 1.75 fps at peak WTP design capacity (4.0 mgd). Total of 15 holes in each wall.
- Sedimentation (at a total max capacity of 4.5 mgd):
  - Max Capacity per Basin: 1.5 mgd
  - Tube Settler Surface Loading: 1.98 gpm/ft^2
  - Flow Velocity through Tube: 0.31 fpm
  - Detention Time through Tubes: 11.15 min
  - Weir Overflow Rate: 6.5 gpm/ft^2
  - Horizontal Velocity in Basin: 0.50 fpm
- Filter Transfer Pumps (replace in kind): Three vertical turbine pumps, 20 hp each, design points of 1,050 gpm and 57 TDH, constant speed.
- Backwashing Redundancy:
  - Ground Storage Reservoir must be at or above 20 feet.
  - Conservative available backwash volume is about 70,000 gallons at a rate of 20 gpm/ft^2 and a duration of 15 minutes.
- Disinfectant Feed Point: pump must overcome a minimum of 20.4 psi pumping at a maximum of 1.5 gallons per hour.
- Flocculation/Sedimentation: Increase capacity to 4.5 mgd by adding a third basin.
- Filtration: Increase rated capacity to 4.0 mgd by adding a fourth basin.

Table 37 summarizes the WTP capacity with the proposed improvements and indicates the design parameters that would be modified by the improvements. The table shows the designed parameters assuming both the filtration and flocculation/sedimentation processes are expanded.

Table 37 – Proposed WTP Capacity Analysis

Unit Process	Design Criteria	Capacity
Raw Water Intake		
Raw Water Intake	< 5 ft/sec	4.5 mgd
Raw Water Pumping		
No. of Pumps		3
Firm Capacity		3.0 mgd
Total Capacity		4.5 mgd
Coagulation/Rapid Mix		
No. of Units*		2
Type*	In-line Mechanical Mixer	
Detention Time	< 30 sec	0.19 sec
Mixing Gradient	> 750 ft/sec/ft	7,442 ft/sec/ft
Capacity		4.0 mgd
Flocculation		
No. of Trains*		3
No. of Stages		1
Detention Time	> 30 min	30.2 min
Capacity*		4.5 mgd
Sedimentation		
No. of Basins*		3
Tube Settler Loading Rate*	< 2 gpm/ft^2	1.98 gpm/ft^2
Tub Settler Area Covered*	< 75%	56%
Settling Time*	5-20 min	11.15 min
Capacity*		4.5 mgd
Filtration		
Filtration		
No. of Units*		4
Loading Rate*	2 - 4 gpm/sf	3.0 gpm/sf
Capacity*		4.0 mgd
Transfer Pumping		
No. of Pumps		3
Firm Capacity		3.0 mgd
Total Capacity		4.5 mgd
Ground Storage Reservoir		
No. of Compartments	> 2	1
High Service Pumping		
No. of Pumps		3
Firm Capacity		4.0 mgd
Total Capacity		6.0 mgd

Note: gpm/sf – gallons per minute per square foot
*Design parameter has been updated because of the proposed improvements.

5.2 Schedule for Design and Construction

Projects looking to take advantage of the proposed DWI Grant funds must have a loan closing within EGLE's Fiscal Year 2022, which begins October 1, 2021 and ends September 30, 2022. The tentative schedule for the proposed projects is presented in Table 38 below.

Table 38 – Proposed Project Schedule

Activity	Estimated Date
Design Begins	May 2021
Submit to EGLE	Jan./Feb. 2022
Out to Bid	May 2022
Approval / Loan Closing	Aug. 2022
Notice to Proceed	Oct. 2022
Construction Start	Oct. 2022
Construction End	Oct. 2024

5.3 Cost Estimate

This section summarizes the estimated project cost including engineering design, administrative and legal costs, and construction. Engineering costs include preparation of the project plan, design, and construction and inspection services. The cost estimates presented here reflect November 2020 costs. These cost estimates were prepared to determine approximate project costs to aid the City in its planning and budgeting process. There are a number of factors that could cause the actual project costs to deviate from these estimates. These include the competitive bidding climate at the time that the construction bids are received, inflation, and additions to or changes in the scope of the project that may occur during the design process. Table 39 below breaks down the cost between estimated capital cost, contingencies, and administration and legal fees.

Table 39 – Breakdown of Estimated Project Costs

Category	Cost
Estimated Capital Cost	$6,595,000
Project Contingency	$674,000
Engineering, Administration, Legal	$1,687,000
Total	$8,956,000

5.4 User Costs

The project is considered an integrated cost because it benefits all users in both the City of St. Clair and the Township. The cost is distributed proportionately among users through a commodity charge based on the current average daily water demand. The City uses approximately 75% of the demand and the Township uses the remaining 25%.

The costs are allocated based on current (2021) ADD as summarized in Table 40 below. The City hopes that the project loan will be awarded the maximum funding available. The loan would be eligible for the maximum DWI grant of $2 million. Because eligibility is not a guarantee of award, the following tables review user costs under two scenarios; if all funding is awarded and if no funding is awarded.

Table 40 – Estimated Total Cost per Community Based on Current (2021) ADD

Community	2021 ADD	Percent of Total	Cost without Award	Cost with Award
City of St. Clair	0.635	75%	$6,717,000	$5,217,000
St. Clair Township	0.212	25%	$2,239,000	$1,739,000
Total	0.847	100%	$8,956,000	$6,956,000

The cost per 100 cubic feet of water to finance the projects over a 20-year period at an interest rate of 1.875% (obtained from EGLE as the DWSRF interest rate) is summarized in Table 41. The table presents the monthly costs to finance the projects for a family of four consuming 100 gallons per day per person (400 gpd total).

Table 41 – Estimated User Cost to Finance the Project

	Without Award		With Award	
Community	Cost per 100 cubic feet	Estimated Monthly Cost @ 400 gpd	Cost per 100 cubic feet	Estimated Monthly Cost @ 400 gpd
City of St. Clair	$0.67	$10.87	$0.52	$8.44
St. Clair Township	$0.67	$10.87	$0.52	$8.44

The current average monthly cost for a family of four is presented in Table 42 along with the adjusted monthly cost once the proposed project has been financed. The current cost represents the monthly water bill for a typical family of four, which includes the City's commodity charge (dollars per 1,000 gallons), service charge, and billing charge. Costs have been allocated proportionately based on the current system and current users. As the system is improved or demands change, the City may need to periodically reallocate the capital improvements.

Table 42 – Current and Adjusted Typical Monthly Cost for Family of Four

	Typical Monthly Cost for Family of Four		
Community	Current Monthly Cost	Adjusted Monthly Cost without Award	Adjusted Monthly Cost with Award
City of St. Clair	$38.60	$49.46	$47.04
St. Clair Township	$38.60	$49.46	$47.04

5.5 Disadvantaged Community

EGLE reviewed the City of St. Clair regarding Disadvantaged Community Status and determine the City does not meet the qualifications.

5.6 Ability to Implement the Selected Alternative

The WTP facilities are owned and operated by the City of St. Clair. The City has water service agreements with St. Clair Township for sale of water. No amendments to the agreements will be necessary for the DWSRF loan. Although it is not needed for completion of the project plan, the City may choose to obtain a resolution with the Township to adopt the project plan. If a resolution is obtained, it will be included in the final project plan. All financial and loan-related work will be handled by the City's financial department.

6.0 Environmental Evaluation

6.1 Historical/Archaeological/Tribal Resources

To identify sites of historical and cultural significance, the National Register of Historic Places, Michigan Historical Markers, and the list of Michigan State Historic Sites by County were reviewed. Because the proposed projects are all within the existing water treatment plant and low service pump station, there are no direct historical or archeological impacts expected as a result of the projects. Similarly, correspondence with the State Historical Preservation Office and the Tribal Historic Preservation Offices was not required.

6.2 Water Quality

The proposed projects at the treatment plant facilities will ensure that the City continues to provide high-quality water to its users. Modifications to various processes and upgraded technology through the WTP will increase reliability and improve operations of the plant. The proposed projects will not affect surface water or groundwater quality or quantity.

6.3 Land/Water Interface

The WTP and Shorewell Pumping Station are not located within wetlands according to data available on the US Fish and Wildlife Service webpage, so no negative impacts to wetlands are expected as a result of the proposed projects. Map 5 shows wetlands within the City of St. Clair.

Map 6 illustrates flood zones in the City. The Shorewell Pumping Station, located along the St. Clair River, is within Zone AE according to FEMA flood zone maps. This implies it is subject to flooding during the 100-year storm event. Construction activities for expansion of the station will likely require a state floodplain permit under Part 31 of the Natural Resources and Environmental Protection Act. Local building codes will require building additions be elevated above the 100-year flood elevation.

Because of the proximity to the St. Clair River, it is important that proper construction precautions and mitigation measures are taken to avoid any negative impact on the environment due to construction activities.

6.4 Endangered Species

Endangered or threatened species are defined as those species that are or could become endangered or threatened and, therefore, are protected under the Endangered Species Act. The objective of the act is to preserve and restore species threatened with extinction. The federally listed endangered and threatened species that are found within St. Clair County are detailed in Table 43. Appendix 2 contains a list of the state-listed endangered, threatened, rare, and special concern species for St. Clair County. The Michigan Natural Features Inventory was not contacted, as this project has been deemed a non-equivalency project.

Table 43 – Federally Threatened and Endangered Species in St. Clair County

Name	Status
Rayed Bean	Endangered
Snuffbox mussel	Endangered
Eastern prairie fringed orchid	Threatened

The proposed projects will occur at the WTP and Pumping Station sites, so it is not expected the projects will have any negative impact on endangered wildlife habitat.

6.5 Agricultural Land

Because the proposed projects are all within the property boundaries of the existing WTP and pump station, there are no impacts on agricultural land as a result of the projects. Map 7 illustrates areas that are classified as prime farmland in the region, but according to the City's master plan there is no longer any agricultural land within the City.

6.6 Social/Economic Impact

Upgrading the WTP facilities will result in direct cultural and social benefits. Public health and safety will benefit from the increased quality and reliability the proposed projects will foster. In addition, the construction phase of the projects could create jobs and contribute favorably to the local economy.

6.7 Construction/Operational Impact

The proposed projects primarily occur inside the WTP or the Shorewell Pumping Station buildings. Both sites are situated near neighborhoods and public spaces. During construction, there will likely be some heightened traffic due to construction vehicles, but the sites are such that there will likely be no need to modify traffic patterns for a prolonged period of time. Both sites have adequate space for construction activities. Some construction will likely have some impact on noise, but because most activities will occur indoors, the noise impact will be mitigated. There are two aspects of the proposed projects that will require building additions; one is to add a new floc/sed basin to the WTP and the other is to construct an addition to the Shorewell Pumping Station for sodium hypochlorite storage and to house a standby generator. There is adequate space to the west of the WTP for the basin addition, such that tree removal will likely not be needed. For the Shorewell Pumping Station, if the addition is constructed to the south of the existing station, some minor tree removal may be needed.

6.8 Indirect Impacts

Improving the existing facilities by upgrading equipment and processes will ensure that the WTP can continue producing quality water to its users. The improvements will not have adverse impacts but rather will lower the risk of shutdown or limited capacity due to equipment failure.

If the plant were expanded to 4.0 mgd rated capacity in the future, the project would support future growth and development of the City. The City's zoning is such that any future industrial users are distanced from the City's downtown and primary residential areas. Because zoning is in place to ensure that the aesthetics, air quality, and ecosystems of public spaces and residential areas are maintained, it is unlikely that the potential growth supported by plant expansion would negatively impact these areas. It is possible resource consumption in the form of energy could increase with expansion of the plant's capacity, but the impacts are not anticipated to be great. Alternatively, some improvements will likely conserve energy use, such as the installation of VFDs for the high service pumps, such that resource consumption is mitigated.

7.0 Mitigation Measures

Measures that will be taken to avoid, eliminate, or mitigate potential short-term environmental impacts include the following:

- Traffic: use of designated traffic routes for construction traffic, as well as flagmen, warning signs, barricades, and cones.
- Air emissions: use of calcium chloride or water for dust control and proper maintenance on heavy equipment to reduce exhaust emissions.
- Noise control: use designated daytime work hours, use mufflers on all equipment, and minimize work on weekends and/or holidays.
- Soil erosion and sedimentation control: use riprap, hay bales, erosion control fence, silt fence, etc.
- Restoration: use topsoil, seed, sod, mulch, gravel, and pavement.

Air emissions will be mitigated using the methods described above. However, there may be odors from exhaust of motorized equipment which could have a minor adverse impact on the surrounding environment during construction. Most of the proposed improvements will take place indoors, however, where odors will not greatly affect the surrounding area.

Measures that will be taken to avoid, eliminate, or mitigate potential long-term environmental impacts include the following:

- Soils disposal and contaminated soils: if construction occurs in floodplains or near a lake or stream, a U.S. Army Corps of Engineers-EGLE Joint Permit will be filed that indicates quantities of soils taken offsite or used onsite as fill, new fill materials utilized onsite, buffer zones from ecologically sensitive areas, and measures that will be taken to stabilize embankments.
- A Soil Erosion Plan for the construction of the selected alternative will be filed with the local Soil Erosion and Sedimentation Control Agency (St. Clair County Health Department). The plan will also be reviewed by the EGLE Land and Water Management Division. The plan will summarize the quantity of soils that will be excavated, locations where soil will be stored, the destination of soils (onsite or offsite) and measures that will be taken (silt fence, sod, etc.) to minimize erosion.

Measures that will be taken to avoid, eliminate, or mitigate potential indirect environmental impacts include the following:

- Planning: The Master Plan for the City of St. Clair outlines the potential for growth and expansion, especially of new industrial users. Because the proposed improvements are within the boundaries of the City's existing facilities, there are no anticipated conflicts with local zoning ordinances or master planning initiatives.

8.0 Public Participation

8.1 Public Hearing Advertisement

The public hearing was advertised in The Times Herald on May 21, 2021. The advertisement listed the public hearing date, described the availability of the report for viewing, and briefly described the proposed projects and estimated costs. Due to the COVID-19 pandemic and the active executive orders, the DWSRF Project Plan is being made available online for public review and comment.

The advertisement is included in Appendix 3.

8.2 Formal Public Hearing

A formal public hearing is being held online on June 21, 2021 at 7:00 p.m. The following items will be discussed during the public hearing, followed by a question and comment period.

- A description of the drinking water quality needs and problems to be addressed by the proposed project and the principal alternatives that were considered.
- A description of the recommended alternative, including its capital costs and a cost breakdown by project components.
- A discussion of project financing and costs to users, including the proposed method of project financing and the proposed monthly charge to the typical residential customer.
- A description of the anticipated social and environmental impacts associated with the recommended alternative and the measures that will be taken to mitigate adverse impacts.

Any questions or comments that are received prior to the public hearing or during the question and comment period of the public hearing with be addressed in the final Project Plan.

8.3 Public Hearing Transcript or Recording

The online public hearing will be recorded. The video recording will accompany the final submittal of the Project Plan.

8.4 Comments Received and Answered

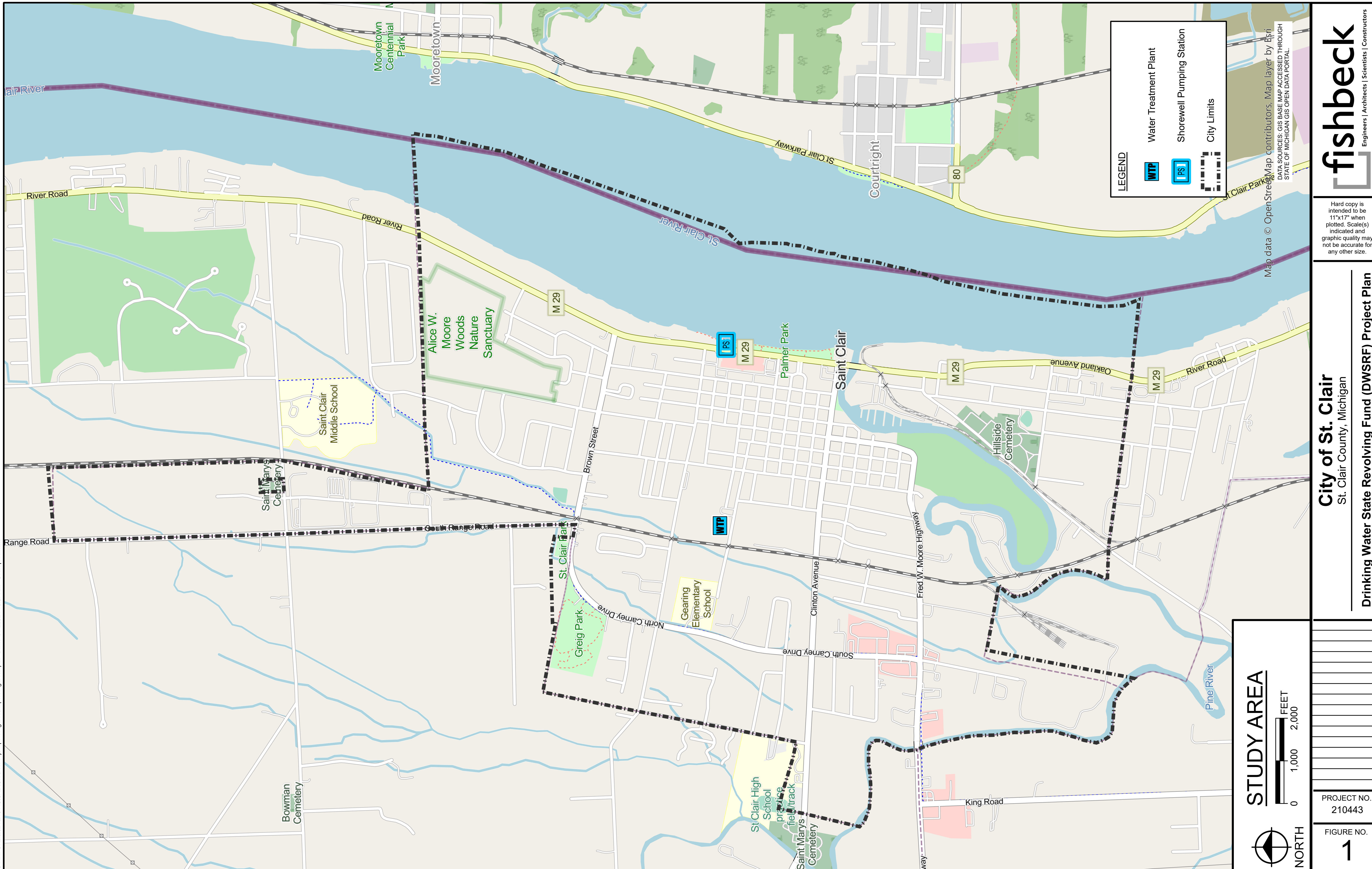
Following the formal public hearing, Appendix 4 will contain the following information:

- A typed list with the names and addresses of the people who attend the public hearing.
- A copy of any written comments that were received during the public comment period for the proposed project.
- The applicant’s responses to the comments received.
- A description of any changes that were made to the project as a result of the public participation process.

8.5 Adoption of the Project Plan

The final project plan will be presented to the St. Clair City Council during the June 21, 2021, regular session. Following this meeting, Appendix 5 will include the Resolution Adopting the Final Project Plan and the DWSRF Project Plan Submittal Form.

Figures



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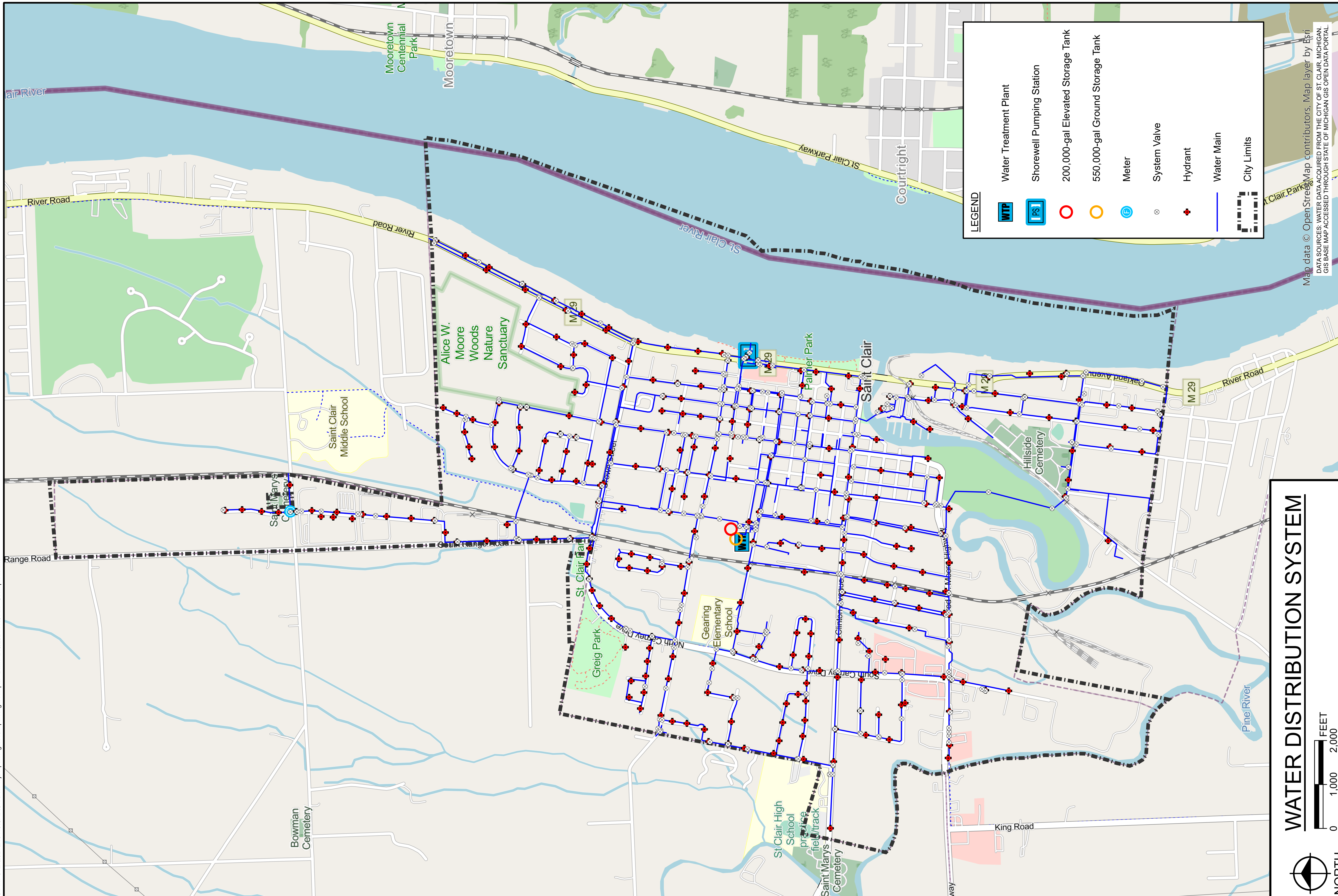

WATER DISTRIBUTION SYSTEM

NORTH

0 1,000 2,000 FEET

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Engineers | Architects | Scientists | Constructors

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City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

PROJECT NO.
210443

FIGURE NO.
2

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DATA SOURCES: ORIGINAL MAP CREATED FOR THE CITY OF ST. CLAIR, MICHIGAN BY BMJ ENGINEERING & SURVEYORS, INC.

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WATER DISTRIBUTION SYSTEM IN ST. CLAIR TOWNSHIP

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

PROJECT NO.
210443

FIGURE NO.
3

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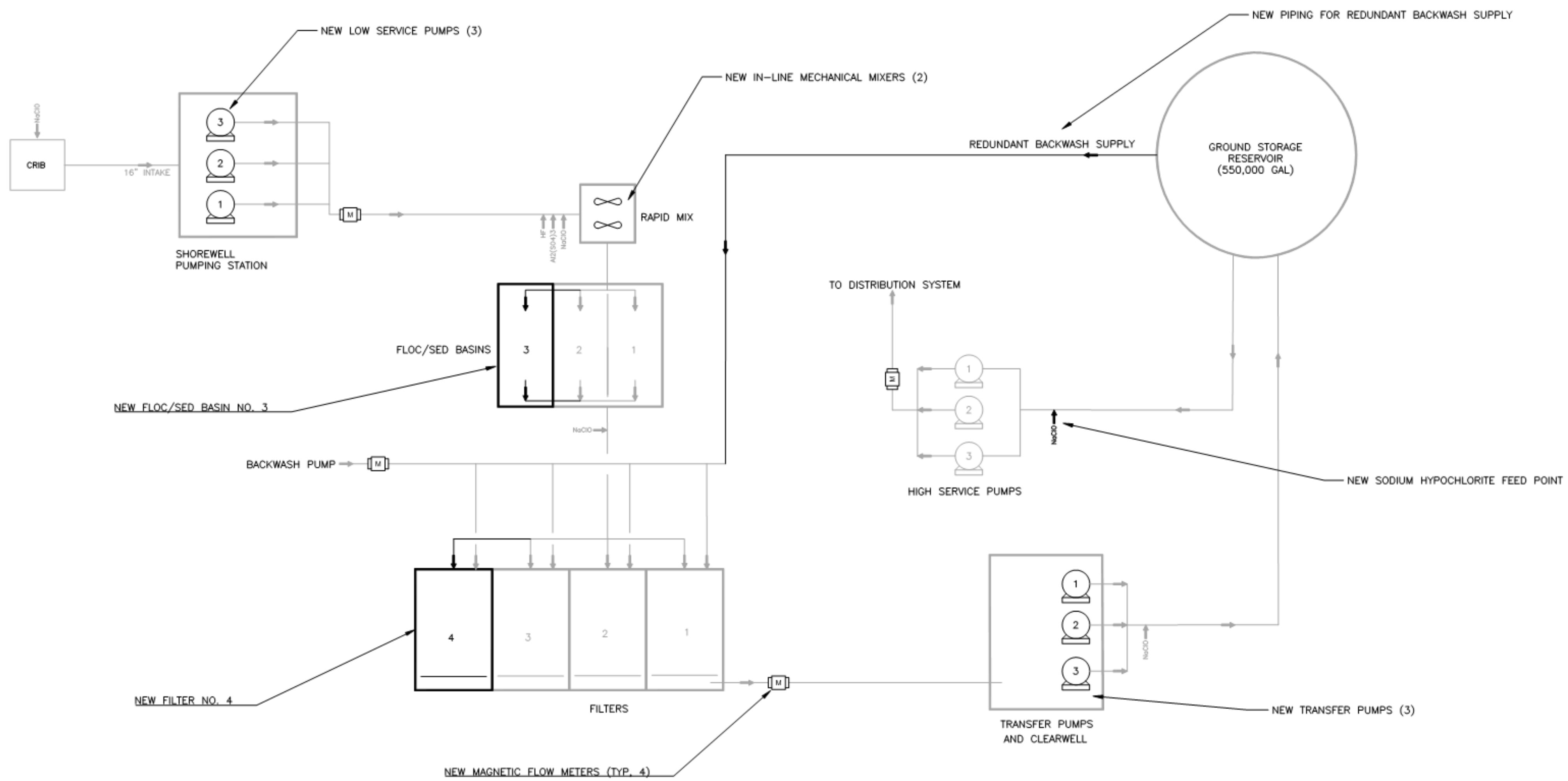

WATER TREATMENT PLANT SCHEMATIC WITH PROPOSED IMPROVEMENTS

City of St. Clair
St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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PROJECT NO.
210443

FIGURE NO.
6

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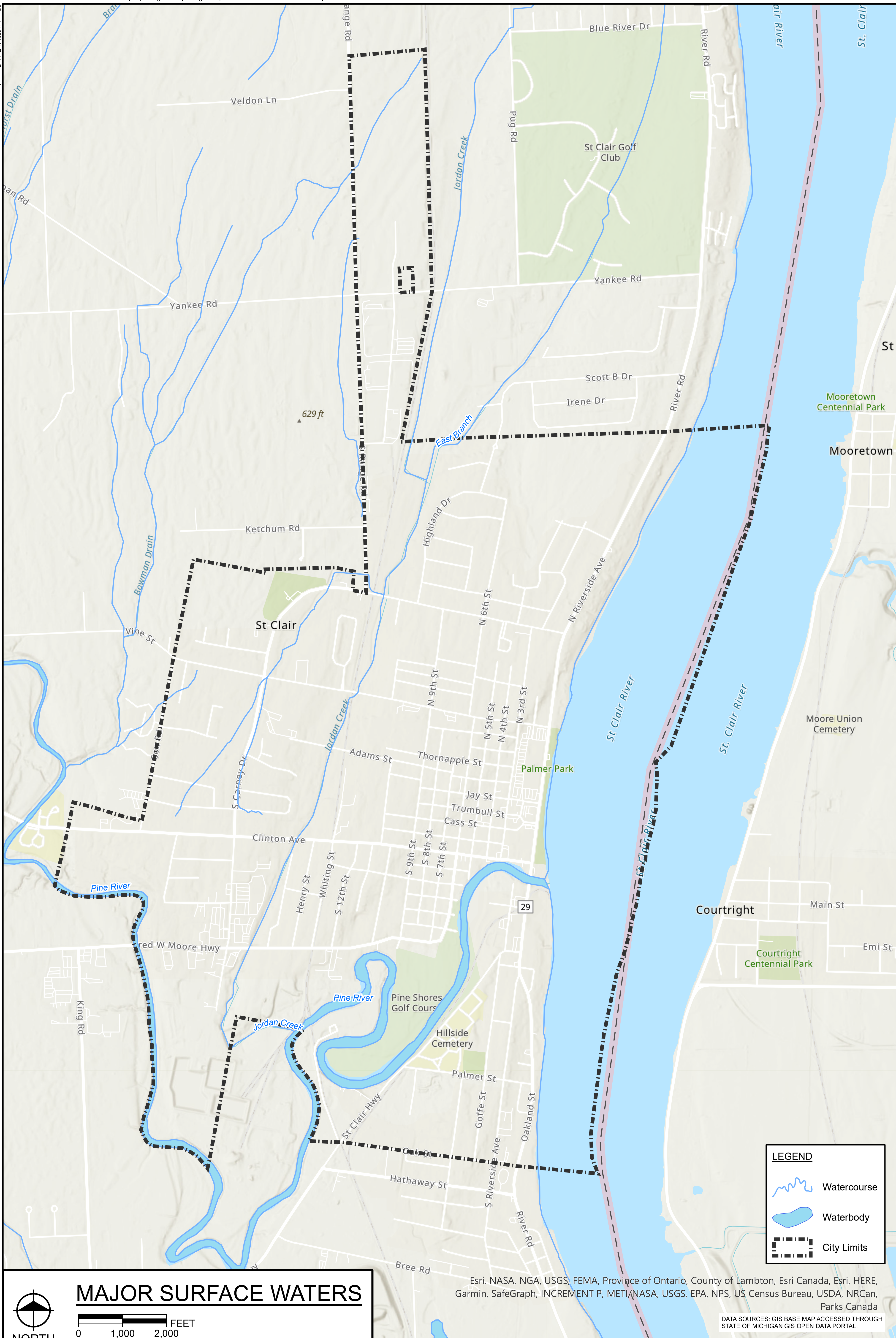
Maps



Esri, NASA, NGA, USGS, FEMA, Province of Ontario, County of Lambton, Esri Canada, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

DATA SOURCES: GIS BASE MAP ACCESSED THROUGH STATE OF MICHIGAN GIS OPEN DATA PORTAL.

MAJOR SURFACE WATERS

NORTH

0 1,000 2,000 FEET

MAP NO. 1

PROJECT NO. 210443

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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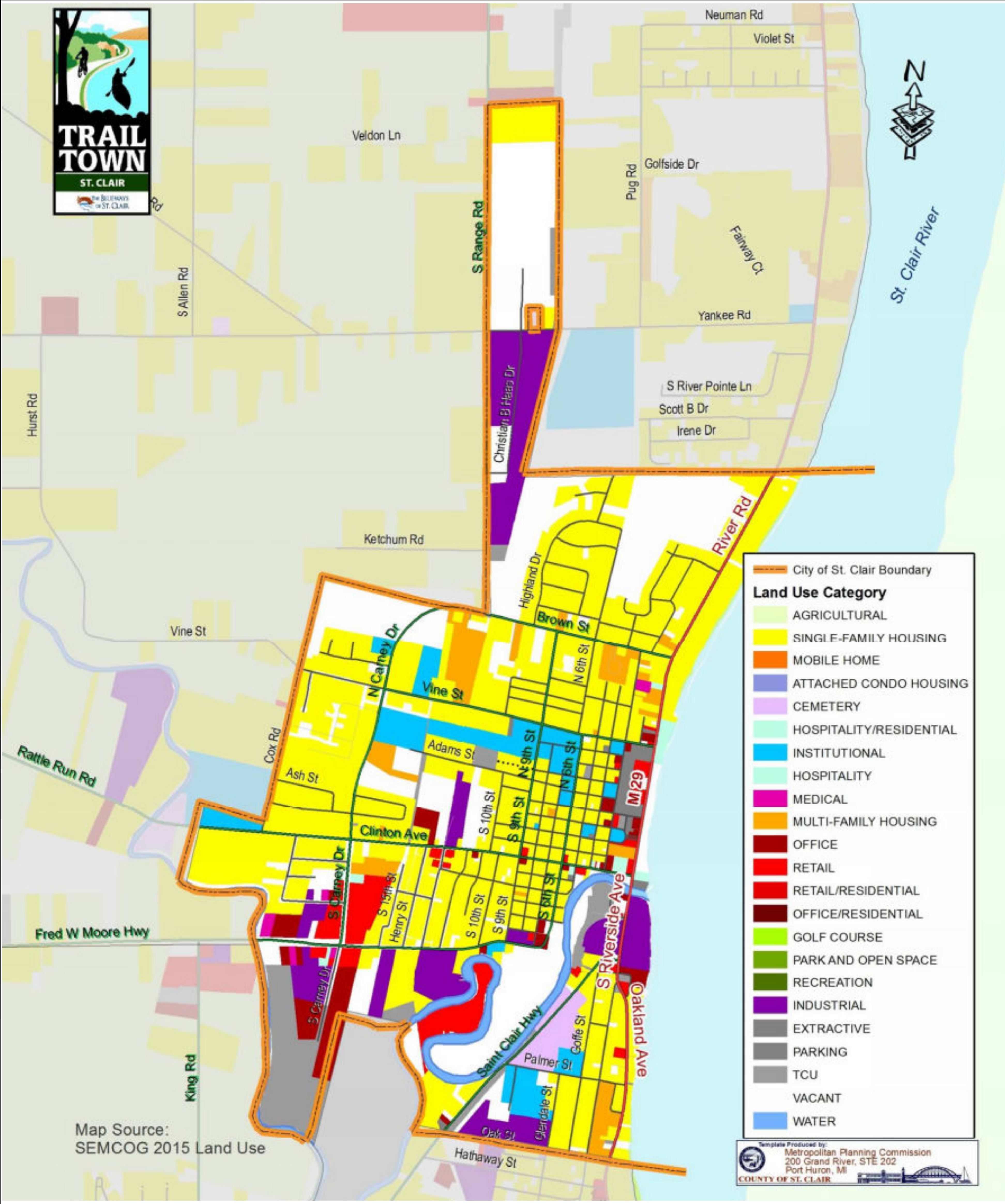

EXISTING LAND USE

MAP NO. 2

PROJECT NO. 210443

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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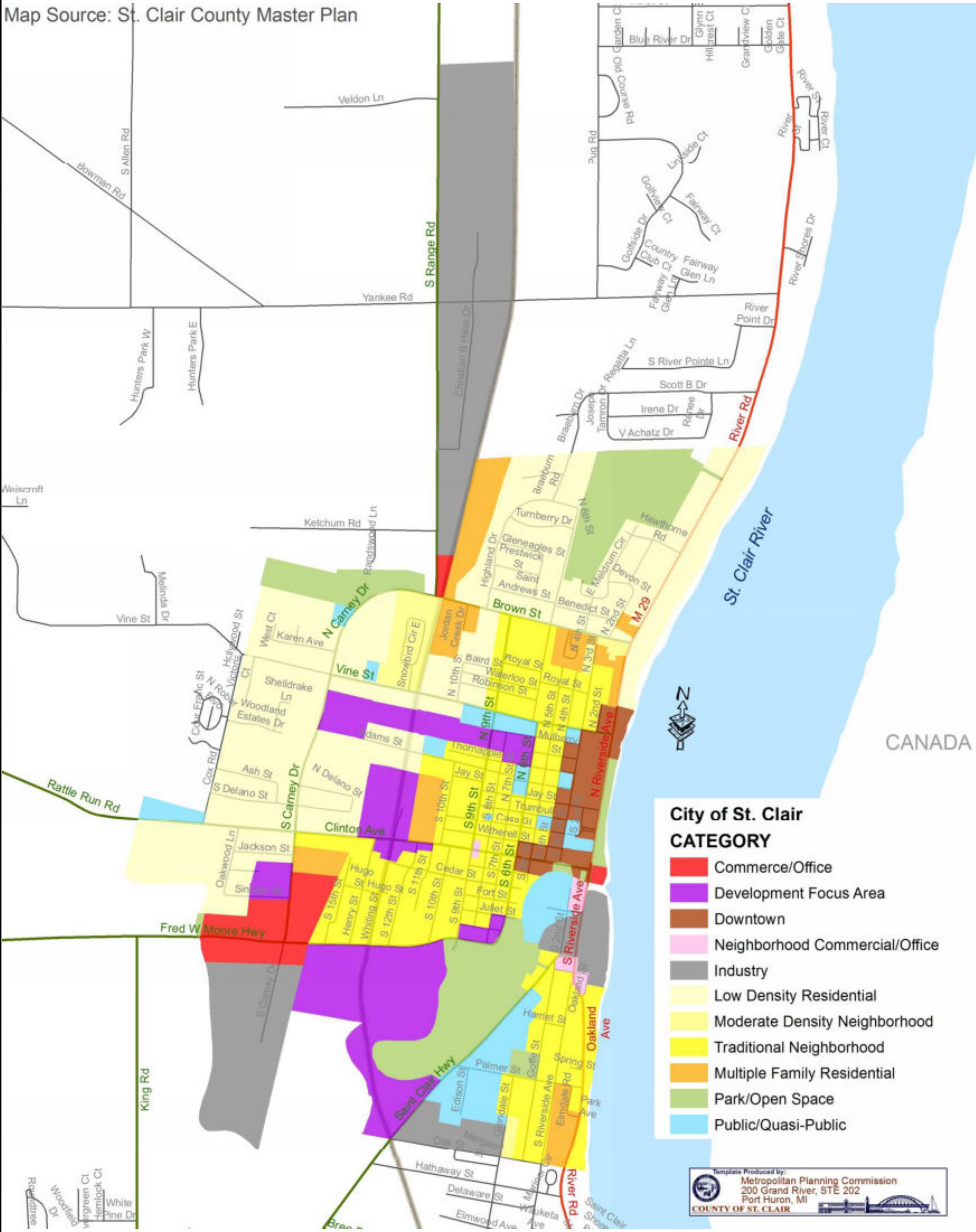

FUTURE LAND USE

City of St. Clair
St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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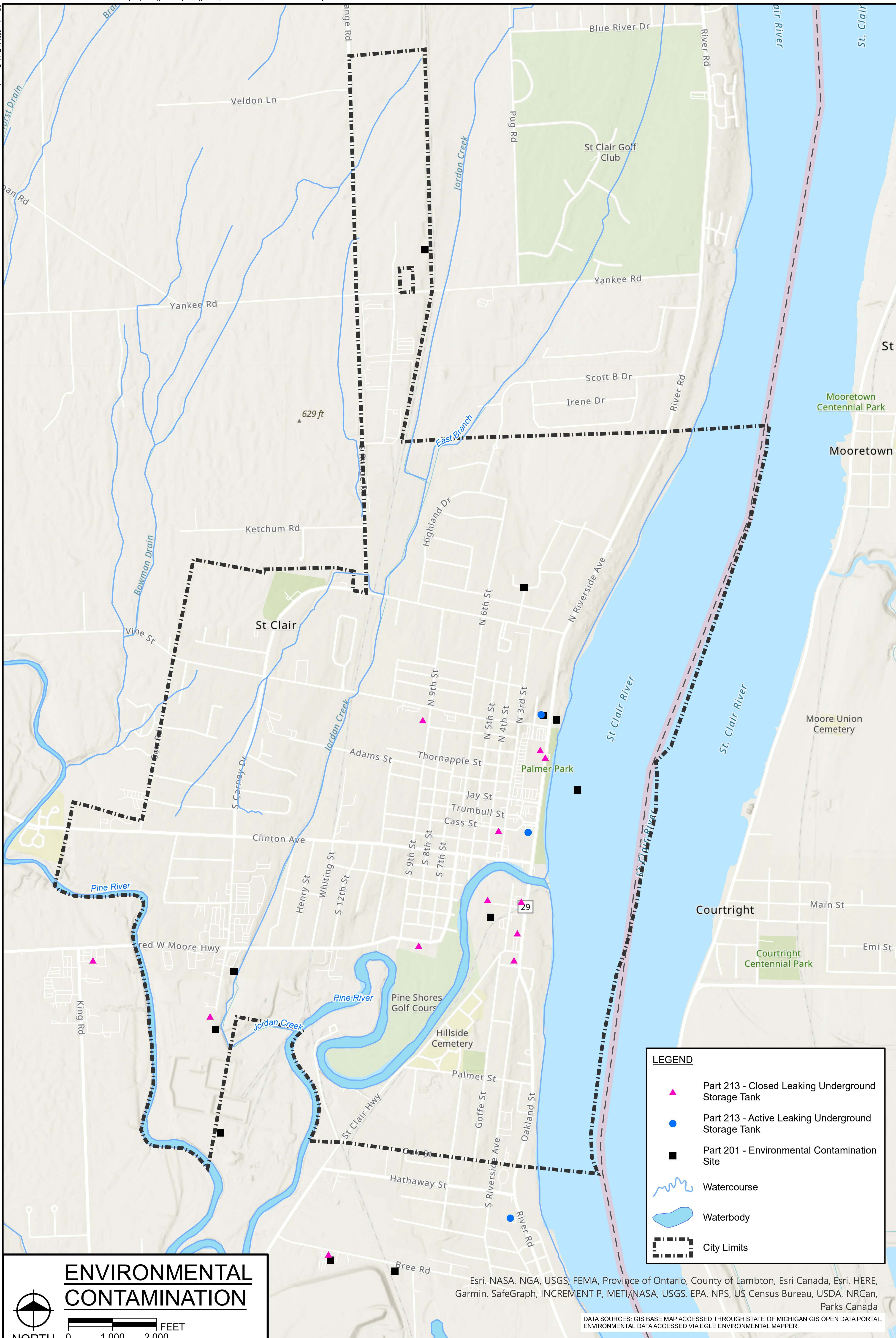
PROJECT NO.
210443

MAP NO.
3

PLOT INFO: Z:\2021\210443\CAD\GIS\ProProj\Report Figures\Report Figures.aprx Date: 3/30/2021 9:41 AM User: prbaskins



ENVIRONMENTAL CONTAMINATION

NORTH

0 1,000 2,000 FEET

MAP NO. 4

PROJECT NO. 210443

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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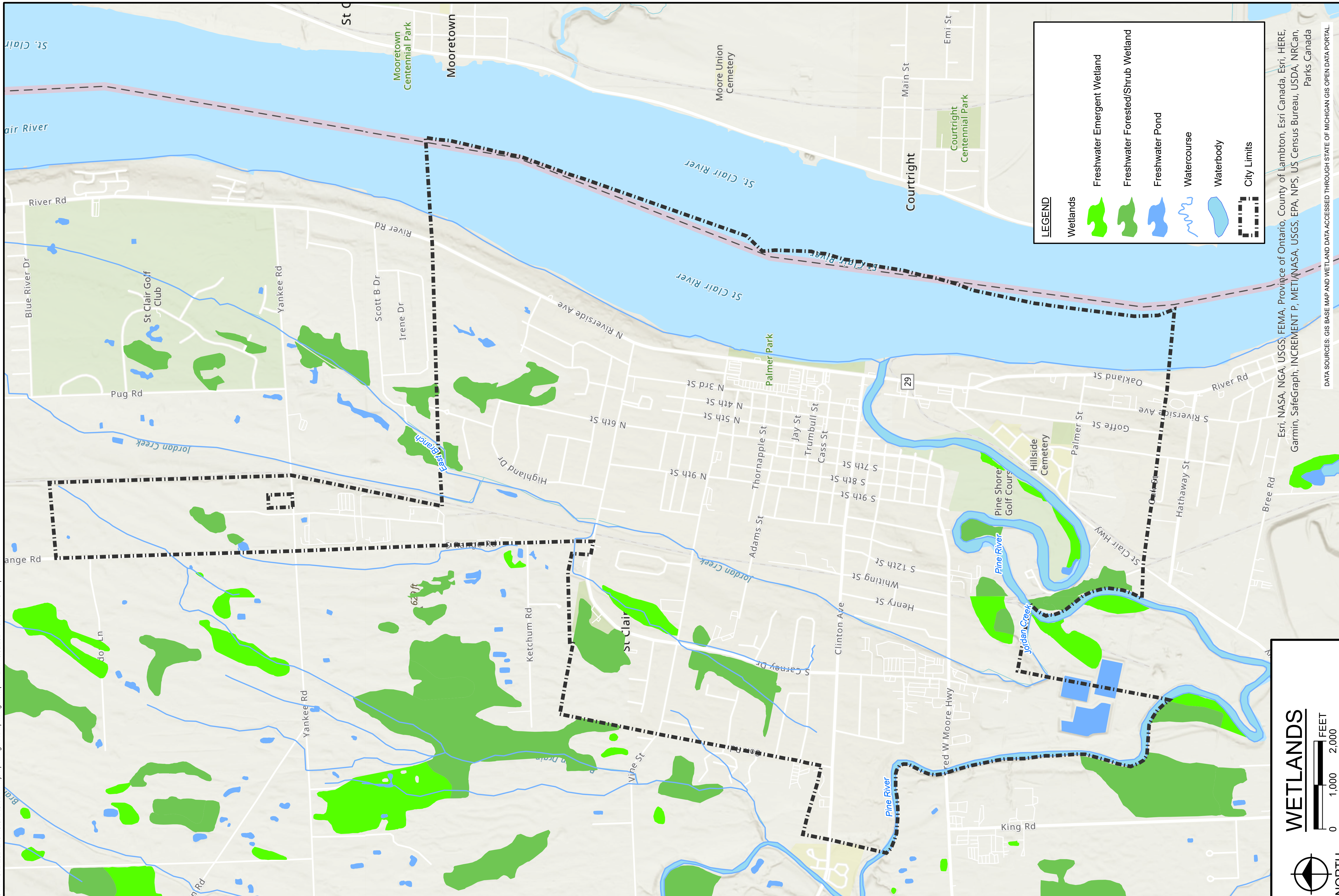

WETLANDS

0 1,000 2,000 FEET

NORTH

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City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

PROJECT NO.
210443

MAP NO.
5

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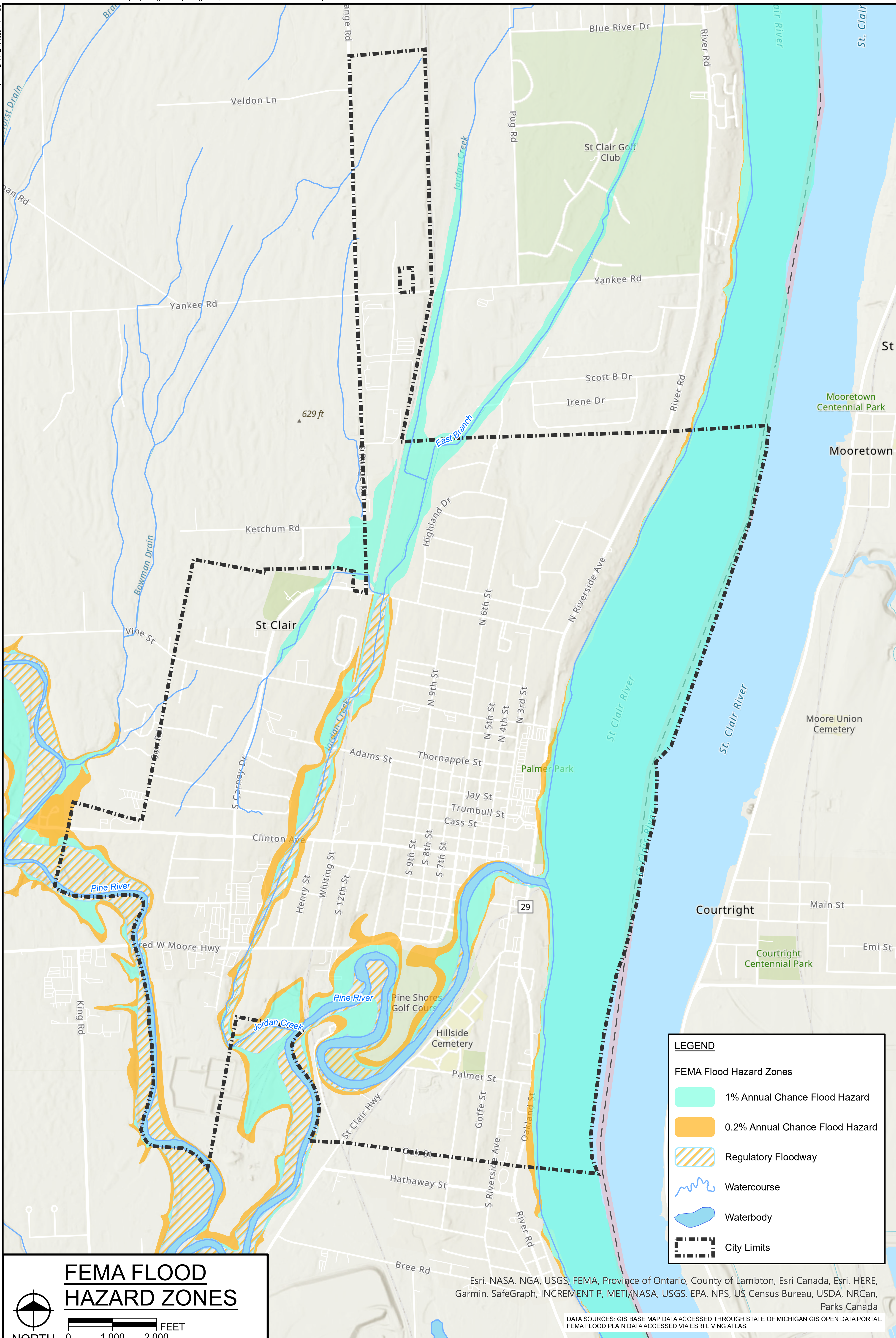

FEMA FLOOD HAZARD ZONES

NORTH

0 1,000 2,000 FEET

MAP NO. 6

PROJECT NO. 210443

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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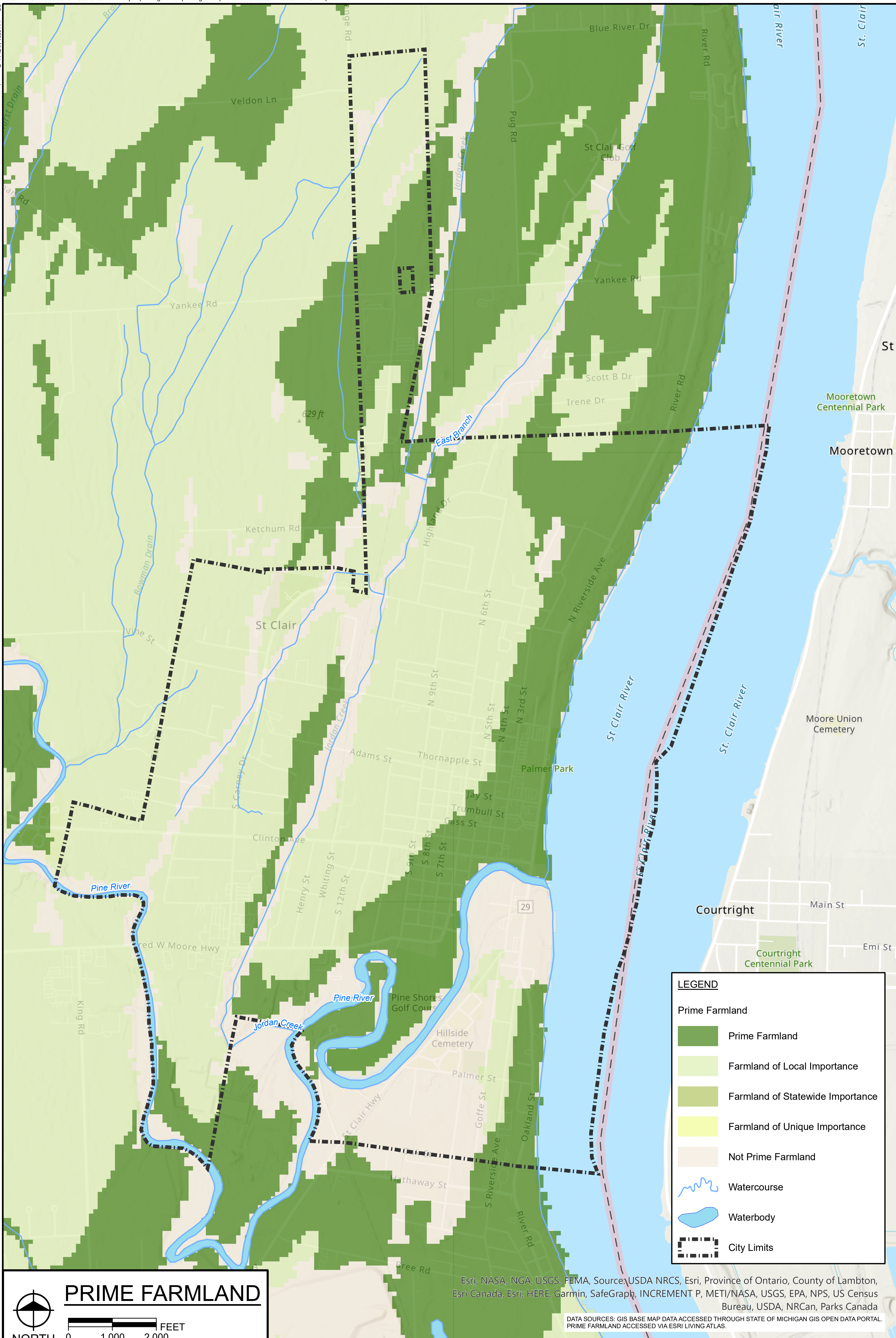

Esri, NASA, NGA, USGS, FEMA, Source: USDA NRCS, Esri, Province of Ontario, County of Lambton, Esri Canada, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

DATA SOURCES: GIS BASE MAP DATA ACCESSED THROUGH STATE OF MICHIGAN GIS OPEN DATA PORTAL. PRIME FARMLAND ACCESSED VIA ESRI LIVING ATLAS.

PRIME FARMLAND

NORTH

0 1,000 2,000 FEET

MAP NO. 7

PROJECT NO. 210443

City of St. Clair

St. Clair County, Michigan

Drinking Water State Revolving Fund (DWSRF) Project Plan

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Appendix 1

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

Notice of Drinking Water Chemical Overfeed on January 12, 2020

City of St. Clair

Due to the severe weather on January 11-13, 2020, deteriorated raw water quality entering the water plant resulted in feeding a water treatment chemical, aluminum sulfate (alum) at a dose exceeding certified levels. When feeding alum above the certified dose, trace metals or other contaminants may have entered the distribution system. The high alum dosage also caused a change in the usual pH and alkalinity levels. The change in water chemistry itself is not a health concern, but it can cause the water to be more corrosive which could result in the release of metals from water mains and plumbing systems. City crews acted quickly to minimize the amount of impacted water entering the distribution system; however, we cannot be sure of the quality of your drinking water during that time.

What should I do?

There is nothing you need to do at this time. This is not an emergency because exposure to any of the potential contaminants is not an acute health risk. City personnel have addressed the immediate concerns. You do not need to boil water or use an alternative source of water at this time. Even though this is not an emergency, as our customers, you have a right to know what happened and what we are doing to correct the situation.

What happened?

Drinking water in the City of St. Clair is continuously treated with alum to remove pathogens. At proper concentrations, this water treatment additive helps to assure that customers are provided safe water that meets state and federal requirements. On January 12, 2020, the alum dose at the City of St. Clair was as high as 303 mg/L. There is a concern that trace metals or other contaminants may be above safe limits when the alum dose is above 150 mg/L. Although the intent of feeding a high dosage was to treat dirty water from the storm, feeding any treatment chemical above the certified dosage is a violation of the Michigan Safe Drinking Water Act.

What is being done?

The City made every effort to flush the impacted water from the system. Lab testing was done to determine an alum dose that meets certification levels and treatment objectives. Additional sampling was also performed to address the change in water chemistry, including lead and copper sampling and other corrosion related water quality parameters.

For more information, please contact the City of St. Clair water plant at (810) 329-5276.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

CERTIFICATION: WSSN: 6270

I certify that this water supply has fully complied with the public notification regulations in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules.

Signature:______________________________ Title:_________________________ Date Distributed:_______

Appendix 2

MICHIGAN STATE UNIVERSITY
Michigan Natural Features Inventory
MSU Extension

County Element Data

The lists include all elements (species and natural communities) for which locations have been recorded in MNFI's database for each county. Information from the database cannot provide a definitive statement on the presence, absence, or condition of the natural features in any given locality, since much of the state has not been specifically or thoroughly surveyed for their occurrence and the conditions at previously surveyed sites are constantly changing. The County Elements Lists should be used as a reference of which natural features currently or historically were recorded in the county and should be considered when developing land use plans. Included in the list is scientific name, common name, element type, federal status, and state status for each element.

Choose a county St. Clair

St. Clair County

Code Definitions

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	Occurrences in County	Last Observed in County
Platanthera leucophaea	Prairie white-fringed orchid	LT	E	G2G3	S1	2	2006
Epioblasma triquetra	Snuffbox	LE	E	G3	S1S2	11	2016
Villosa fabalis	Rayed bean	LE	E	G2	S1S2	12	2012
Acipenser fulvescens	Lake sturgeon		T	G3G4	S2	3	2016
Acris blanchardi	Blanchard's cricket frog		T	G5	S2S3	1	2011
Agalinis gattingeri	Gattinger's gerardia		E	G4	S1	1	1999
Agalinis skinneriana	Skinner's gerardia		E	G3G4	S1	1	1994
Alasmidonta marginata	Elktoe		SC	G4	S3?	10	2011
Alasmidonta viridis	Slippershell		T	G4G5	S2S3	10	2016
Ammocrypta pellucida	Eastern sand darter		T	G4	S1S2	4	2010
Ammodramus henslowii	Henslow's sparrow		E	G4	S3	1	2006
Ammodramus savannarum	Grasshopper sparrow		SC	G5	S4	1	2011
Aristida longespica	Three-awned grass		T	G5	S2	3	2002
Asclepias purpurascens	Purple milkweed		T	G5?	S2	3	2006
Asclepias sullivantii	Sullivant's milkweed		T	G5	S2	10	2016
Astragalus canadensis	Canadian milk vetch		T	G5	S1S2	1	2011
Baptisia lactea	White or prairie false indigo		SC	G4Q	S3	1	1912
Beckmannia syzigachne	Slough grass		T	G5	S2	5	1996
Bombus borealis	Northern amber bumble bee		SC	G4G5	S3	2	1966

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	Occurrences in County	Last Observed in County
Bombus terricola	Yellow banded bumble bee		SC	G3G4	S2S3	1	1990
Botaurus lentiginosus	American bittern		SC	G5	S3	2	2017
Buteo lineatus	Red-shouldered hawk		T	G5	S4	1	2004
Callitriche heterophylla	Large water starwort		T	G5	S1	1	1896
Cardamine maxima	Large toothwort		T	G5	S1S2	2	2003
Carex festucacea	Fescue sedge		SC	G5	S1	1	1920
Carex platyphylla	Broad-leaved sedge		E	G5	S1	1	1988
Carex squarrosa	Sedge		SC	G4G5	S1	1	2016
Castanea dentata	American chestnut		E	G3	S1S2	1	1900
Cerastium velutinum	Field Chickweed		X	G5T4?	SX	1	1832
Chlidonias niger	Black tern		SC	G4G5	S2	1	2009
Cincinnatia cincinnatiensis	Campeloma spire snail		SC	G5	S3	1	
Cirsium hillii	Hill's thistle		SC	G3	S3	1	1904
Cistothorus palustris	Marsh wren		SC	G5	S3	2	2017
Clemmys guttata	Spotted turtle		T	G5	S2	3	2009
Cuscuta indecora	Dodder		SC	G5	SH	1	1904
Cyclonaias tuberculata	Purple wartyback		T	G5	S2	1	2011
Cypripedium candidum	White lady slipper		T	G4	S2	1	1991
Dalea purpurea	Purple prairie clover		X	G5	SX	1	1915
Diarrhena obovata	Beak grass		T	G4G5	S2	1	2011
Dichanthelium leibergii	Leiberg's panic grass		T	G4	S2	1	1961
Dorydiella kansana	Leafhopper		SC	GNR	S3	1	1994
Draba reptans	Creeping whitlow grass		T	G5	S1	1	1913
Emydoidea blandingii	Blanding's turtle		SC	G4	S2S3	5	2014
Euonymus atropurpureus	Wahoo		SC	G5	S3	1	2011
Falco columbarius	Merlin		T	G5	S3	1	2015
Falco peregrinus	Peregrine falcon		E	G4	S3	2	2018
Faxonius immunis	Calico crayfish		SC	G5	S4	1	2015
Fimbristylis puberula	Chestnut sedge		X	G5	SX	1	1904
Flexamia reflexa	Leafhopper		SC	GNR	S1	3	2017
Galearis spectabilis	Showy orchis		T	G5	S2	2	1952
Gallinula galeata	Common gallinule		T	G5	S3	2	2017
Gentiana alba	White gentian		E	G4	S1	1	1900

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	Occurrences in County	Last Observed in County
Gentianella quinquefolia	Stiff gentian		T	G5	S2	1	1895
Gymnocarpium robertianum	Limestone oak fern		T	G5	S2	1	1888
Haliaeetus leucocephalus	Bald eagle		SC	G5	S4	6	2017
Helianthus mollis	Downy sunflower		T	G4G5	S2	1	2011
Hiodon tergisus	Mooneye		T	G5	S1	2	1984
Hydrastis canadensis	Goldenseal		T	G3G4	S2	1	2011
Hypericum gentianoides	Gentian-leaved St. John's-wort		SC	G5	S3	2	2002
Ixobrychus exilis	Least bittern		T	G4G5	S3	1	2017
Jeffersonia diphylla	Twinleaf		SC	G5	S3	1	1904
Juncus brachycarpus	Short-fruited rush		T	G4G5	S1S2	1	1999
Juncus scirpoides	Scirpus-like rush		T	G5	S2	2	2008
Lampsilis fasciola	Wavyrayed lampmussel		T	G5	S2	8	2011
Lasmigona compressa	Creek heelsplitter		SC	G5	S3	6	2016
Lasmigona costata	Flutedshell		SC	G5	SNR	7	2016
Ligumia nasuta	Eastern pondmussel		E	G4	S2	7	2016
Ligumia recta	Black sandshell		E	G4G5	S1?	3	2011
Lipocarpha micrantha	Dwarf-bulrush		SC	G5	S3	1	1988
Lithobates palustris	Pickerel frog		SC	G5	S3S4	3	2018
Lithospermum incisum	Narrow-leaved puccoon		X	G5	SX	1	1915
Lithospermum latifolium	Broad-leaved puccoon		SC	G4	S2	3	2011
Lycopodiella margueritae	Northern prostrate clubmoss		T	G1G2	S1S2	1	2002
Lycopodiella subappressa	Northern appressed clubmoss		SC	G2	S2	1	1999
Macrhybopsis storeriana	Silver chub		SC	G5	S1	2	1985
Moxostoma carinatum	River redhorse		T	G4	S2	1	1984
Notropis anogenus	Pugnose shiner		E	G3	S1S2	4	2018
Noturus miurus	Brindled madtom		SC	G5	S2	2	2010
Noturus stigmosus	Northern madtom		E	G3	S1	3	2017
Obliquaria reflexa	Threehorn wartyback		E	G5	S1	1	2011
Obovaria subrotunda	Round hickorynut		E	G4	S1	9	2016
Panax quinquefolius	Ginseng		T	G3G4	S2S3	1	1900

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	Occurrences in County	Last Observed in County
Pandion haliaetus	Osprey		SC	G5	S4	3	2017
Pantherophis gloydi	Eastern fox snake		T	G3	S2	5	2017
Papaipema beeriana	Blazing star borer		SC	G2G3	S2	5	2017
Papaipema sciata	Culvers root borer		SC	G3	S3	4	2017
Papaipema speciosissima	Regal fern borer		SC	G4	S2S3	1	2015
Parkesia motacilla	Louisiana waterthrush		T	G5	S2	1	2011
Penstemon calycosus	Beard tongue		T	G5	S2	2	2005
Percina copelandi	Channel darter		E	G4	S1	3	1996
Persicaria careyi	Carey's smartweed		T	G4	S1S2	1	1900
Pisidium idahoense	Giant northern pea clam		SC	G5	SNR	1	
Plantago cordata	Heart-leaved plantain		E	G4	S1	3	2011
Platanthera ciliaris	Orange- or yellow-fringed orchid		E	G5	S1S2	1	1903
Pleurobema sintoxia	Round pigtoe		SC	G4G5	S3	8	2016
Poa paludigena	Bog bluegrass		T	G3G4	S2	1	1904
Polygala cruciata	Cross-leaved milkwort		SC	G5	S3	1	1914
Polygala incarnata	Pink milkwort		X	G5	SX	3	1900
Potamilus alatus	Pink heelsplitter		SC	G5	SNR	4	2016
Potamilus ohiensis	Pink papershell		T	G5	SNR	1	2009
Pterospora andromedea	Pine-drops		T	G5	S2	2	1893
Ptychobranchus fasciolaris	Kidney shell		SC	G4G5	S2	4	2016
Rallus elegans	King rail		E	G4	S2	5	2014
Ranunculus ambigens	Spearwort		T	G4	SX	1	1904
Ranunculus rhomboideus	Prairie buttercup		T	G5	S2	2	1915
Sander canadensis	Sauger		T	G5	S1	3	1983
Scleria pauciflora	Few-flowered nut rush		E	G5	S1	1	1903
Scleria triglomerata	Tall nut rush		SC	G5	S3	2	1999
Setophaga cerulea	Cerulean warbler		T	G4	S3	2	2011
Setophaga citrina	Hooded warbler		SC	G5	S3	2	2011
Simpsonaias ambigua	Salamander mussel		E	G3	S1	4	2003
Solidago bicolor	White goldenrod		E	G5	S1	1	1896
Sterna forsteri	Forster's tern		T	G5	S2	2	2007
Sterna hirundo	Common tern		T	G5	S2	2	2002

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	Occurrences in County	Last Observed in County
Trichophorum clintonii	Clinton's bulrush		SC	G4	S3	1	1999
Trillium undulatum	Painted trillium		E	G5	S1S2	9	2011
Triplasis purpurea	Sand grass		SC	G4G5	S2	1	1954
Truncilla truncata	Deertoe		SC	G5	S2S3	4	2011
Villosa iris	Rainbow		SC	G5	S3	21	2016
Vitis vulpina	Frost grape		T	G5	S1S2	1	1899
Zizania aquatica	Wild rice		T	G5	S2S3	2	2005

Appendix 3

Public Hearing for the Drinking Water State Revolving Fund Project Plan

The City of St. Clair is preparing an application to fund improvements to the City's water system. This work is proposed for funding through the Michigan Department of Environment, Great Lakes, and Energy Drinking Water State Revolving Fund.

The project plan will include work at the City's water treatment plant and low service pumping station. The primary reason for the proposed project is to improve reliability of the facilities and maintain water quality. The improvements will replace and upgrade aging infrastructure and equipment at the plant.

The estimated cost for the proposed improvements is $8,956,000. The estimated monthly user cost for a family of four to fund the proposed projects is $10.87. User cost is discussed in further detail in Section 5.4 of the Project Plan.

The City will hold a public hearing on the proposed DWSRF Project Plan on Monday, June 21, at 7 p.m., in the Council Chambers of the Municipal Building (547 N. Carney Drive, St Clair, MI 48079). The Project Plan will be available on the City's webpage from May 21, 2021 through June 21, 2021, for public viewing and comment. Written public comments can be submitted to Kerala Porch at khporch@fishbeck.com. Comments received before June 21, 2021 will receive responses in the final Project Plan.