

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN - FINAL

GFA NO. 23045

DATE: JUNE 1, 2023

CHARTER TOWNSHIP OF UNION WATER SYSTEM IMPROVEMENTS



Submitted on behalf of the Charter Township of Union by:



Engineering
Surveying
Testing &
Operations

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- C. Zoning Map
- D. Areas of Potential Future Land Use Change
- E. EGLE Sanitary Survey
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1.0 Executive Summary

The Charter Township of Union is seeking funding through the Drinking Water State Revolving Fund (DWSRF) for projects related to the Townships' water supply, treatment and distribution systems. The proposed projects include construction of a new Type 1 production Well, improvements and expansion of the Isabella Treatment Facility including pumps, iron removal filters and mechanical piping, watermain extensions and investigation / replacement of lead service lines. The Township provides water services to its residents with a historical average daily demand of 1.08 million gallons per day (MGD). This project is being considered to provide necessary water supply, treatment, and distribution capacity for the Charter Township of Union capable of meeting the next 20–30-year projected demands.

The Township is located in the SE part of Isabella County, surrounding the City of Mt. Pleasant. The Township was founded in 1861 and traces its' history and name back to the Civil War.

The purpose of this *Project Plan* is to present the current issues and proposed solutions for the supply, treatment, storage, and distribution infrastructure.

2.0 Project Background

The Townships' drinking water needs are based on comprehensive review of its water system and other planning information. This Project Plan was developed using the information presented in the following reports:

- Master Plan, 2018
- Water Reliability Study, November 2022
- Water Well Feasibility Study, November 2021
- EGLE Asset Management Plan, May 2019
- Lead and Copper Inventory, DSMI, June 2018

2.1 Study and Service Area

The Charter Township of Union is in Isabella County and includes all land within the Township except the City of Mount Pleasant with the limits depicted in Figure 1 on the next page. The Township has US-127 (a freeway) running through it, north to south on the east edge of the Township, with county roads on all mile section lines, as well as other subdivisions and minor roadways servicing the Township. It also has a rail line that runs north and southeast through the Township. The topography is relatively flat and is serviced by several county drains. Soils in the area are typically heavy soil and clays with pockets of sandy soils.

The study area related to the water system is encompassed by the Township Limits as this is the extent of the Townships' water distribution service area. The entire water supply, treatment, storage, and distribution systems are included in this *Project Plan* are located within the Township limits.

A detailed map of the study area of the water supply, treatment, storage, and distribution system infrastructure including component, population distribution, and other significant features are provided in the Appendix.

FIGURE 1 – LOCATION MAP



2.1.1 Land Use in the Study Area

The current Zoning Map and Future Land Use maps are attached in the Appendix. The current land use is a mix of Industrial, Commercial, Residential, Institutional, and Agricultural uses. The Township has slowly been transforming from an agricultural community to a regional service community serving area needs, such as college housing for Central Michigan University, commercial shopping districts, and residential housing for a growing number of college workers and service workers.

2.1.2 Surface and Groundwaters

The Chippewa River Flows through the Township and is the major surface water feature in the Township. There are several smaller creeks and drainage ways that discharge to the Chippewa River. The Chippewa River originates to the west and is a major stream as it passes through Union Township and the City of Mount Pleasant. It flows to the east and discharges to the Tittabawassee River and Saginaw River and Saginaw Bay in Lake Huron. Figure 2 provides a map illustration of the surface waters in the Township.

Groundwater aquifers vary in the region. Upper groundwater levels are typically within 20' of the ground surfaces with many areas in the Township experiencing groundwater less than 5' from surface levels. County drains that service the Township maintain groundwater levels by out-letting discharges from drain tiles throughout the Township. The Charter Township of Union established a Wellhead Protection Program in 2013 to delineate and define a protection area for their potable water system. Limits of this area are depicted in Figure 3.

FIGURE 2 – SURFACE WATER MAP

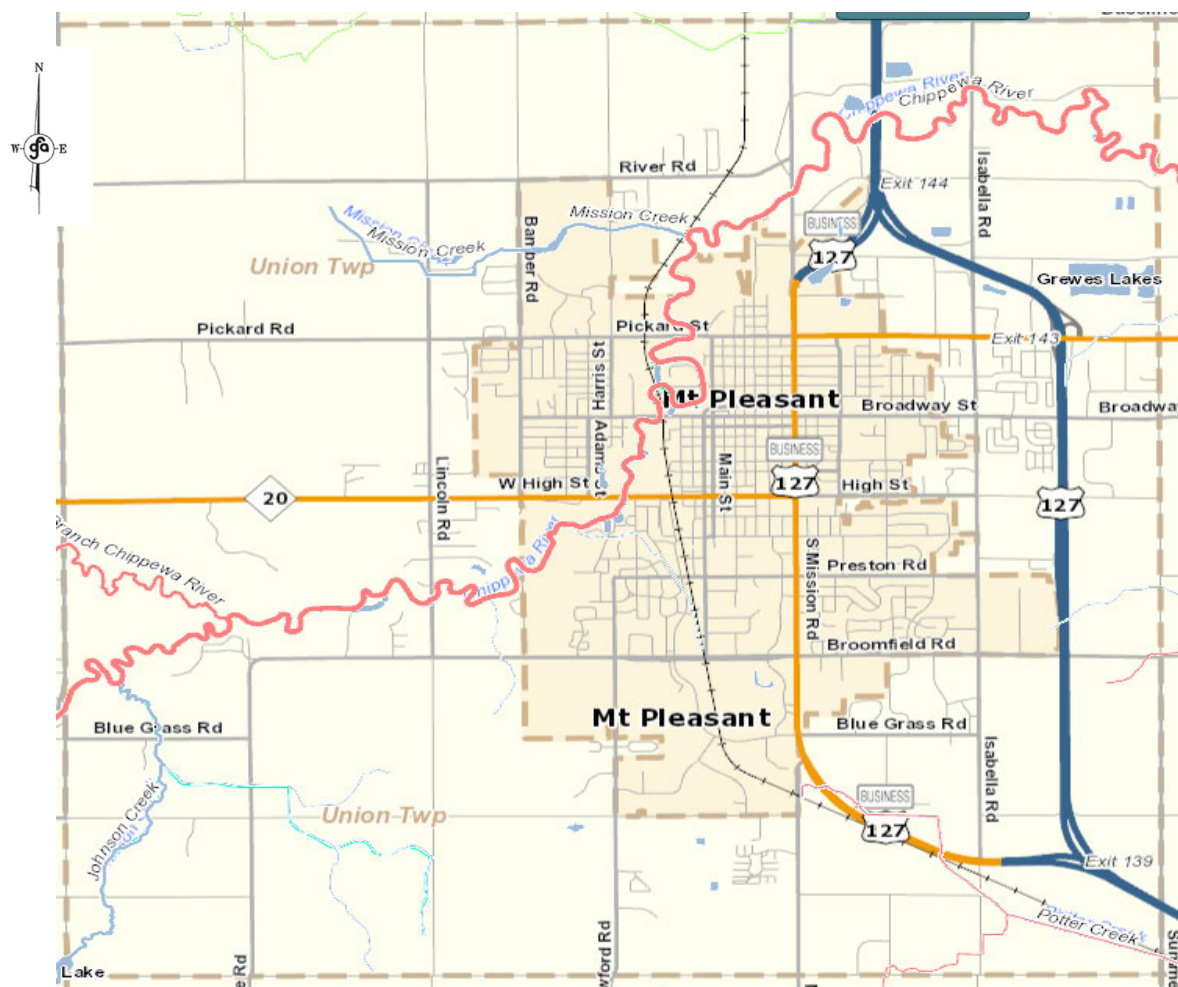
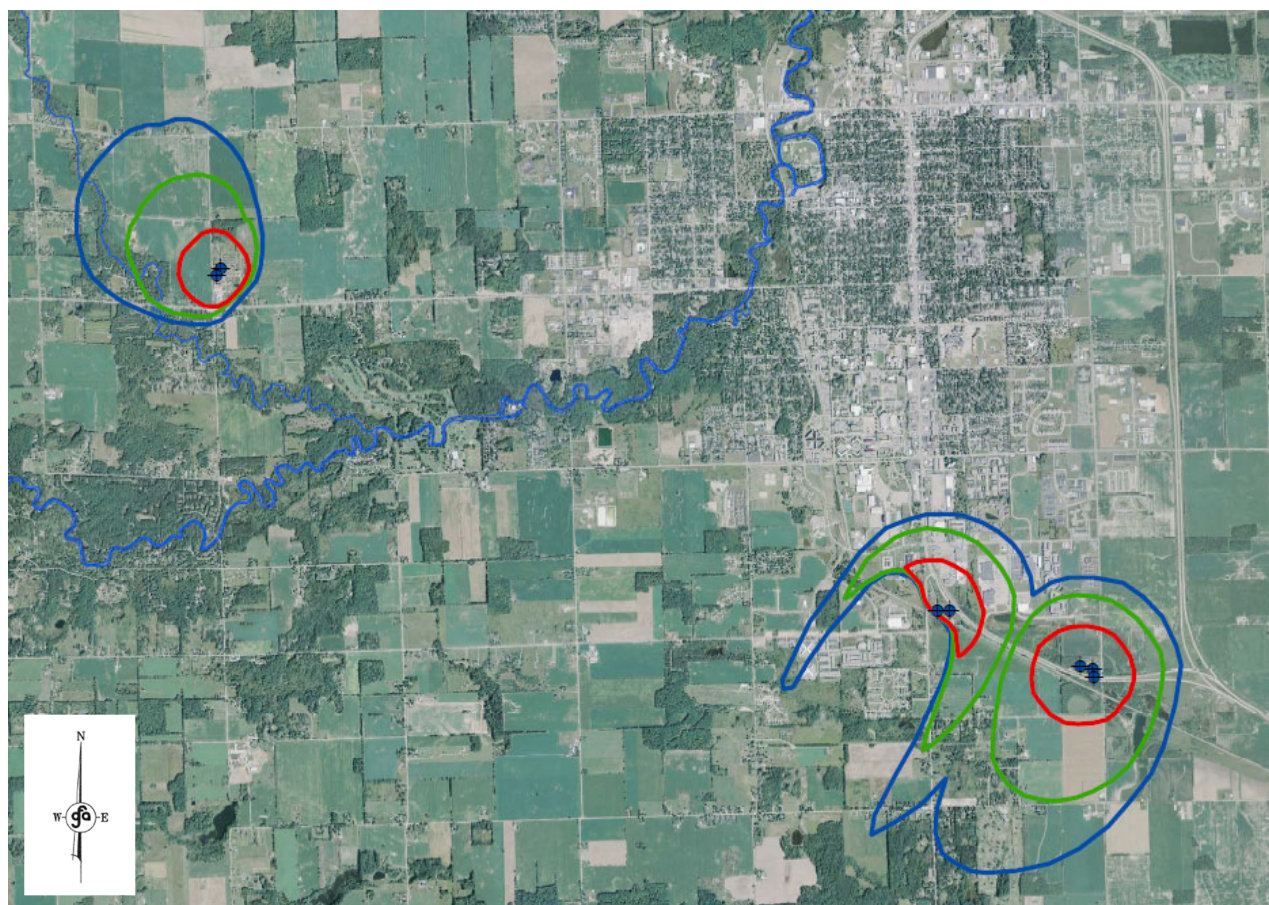


FIGURE 3 – WELLHEAD PROTECTION AREA MAP



2.2 Population Data

2.2.1 Study Area Population

The populations trends (Figure 4) detail irregular and inconsistent growth within Union Township, with an average annual increase of 3.12% tabulated over the last 20 years. From 2000 to 2010 the population increased by an annual rate of 6.98%, whereas a decline was experienced from 2010 to 2020 at an annual rate of -0.95%. Comparatively, Isabella County and the City of Mt. Pleasant experienced an annual decline of around -0.84% to -1.66% over this same period. Despite the recent declining population trends from 2010 to 2020, both the City of Mt. Pleasant and Charter Township of Union anticipate the future projections will reverse and population will grow. Similarly, for purposes of predicting sewage collection and treatment system usage for the future, a growth rate of 2.0% every year has been assumed to be conservative.

FIGURE 4 – HISTORICAL AND PROJECTED POPULATIONS

Service Location	2000	2010	2023	2033*	2043*
City of Mt. Pleasant	25,946	26,016	21,688	26,438	32,227
Annual Growth Rate, %	-	0.03%	-1.28%	2.00%	2.00%
Union Township	7,615	12,927	11,699	14,261	17,384
Annual Growth Rate, %	-	6.98%	-0.73%	2.00%	2.00%
Isabella County	63,351	70,311	64,394	78,496	95,686
Annual Growth Rate, %	-	1.10%	-0.65%	2.00%	2.00%

*Estimated Figures

2.2.2 Residential Equivalent Units (REUs) Served by Water System

A portion of these projected growth trends account for the availability of public water service to existing development and/or parcels in addition to the new development growth. The Future Land Use Map illustrates several potential areas available for large scale development. With respect to time, undeveloped parcels will experience increased growth in direct proportion to the public water service that fronts them, i.e. the longer public water service is made available, the greater the potential for growth and consequently supply, distribution, and storage systems usage. Furthermore, the Township recently updated their Master Plan and through this process created “Primary” and “Secondary” growth areas designed to concentrate future development closer to Mount Pleasant and preserve natural features and agricultural land, as well as provide a basis for future rezonings and utility expansions in a systematic way. The Master Plan is located on the Townships’ Website:

(http://www.uniontownshipmi.com/Portals/0/Planning%20and%20Zoning/UnionTownshipMP_Adopted_2018.pdf?ver=2020-09-22-111307-823)

While it is difficult to predict the future, for purposes of predicting water system usage for the future, a growth rate of 2.0% every 10 years has been assumed to be conservative.

The following data in table below represents more detailed information presenting actual REU counts for the current year and applying the average historical growth.

FIGURE 5 – HISTORICAL AND PROJECTED REUs

Year	2017	2018	2019	2020	2021	2033*	2043*
Residential	4,246	4,911	4,784	4,782	4,659	5,227	5,750
Other	1,456	1,586	1,536	1,571	1,545	1,733	1,907
Total REUs	5,702	6,497	6,320	6,353	6,204	6,961	7,657
Annual Growth Rate, %	-	13.9%	-2.72%	0.52%	-2.35%	1.00%	1.00%

*Estimated Figures

2.3 Existing Environment Evaluation

2.3.1 Cultural and Historic Resources

The Charter Township of Union surrounds several governmental and institutional entities including the City of Mt. Pleasant, Central Michigan University, and the Saginaw Chippewa Indian Tribe that are an integral part of the community fabric. The Township has an agricultural history and is home to several oil/gas exploration operations. As the Township continues to evolve into a regional service provider and shopping destination, it seeks to balance development pressures and accompanying utility expansion with agricultural and natural resource preservation.

From the National Register of Historic Places, there were no listings located within the Charter Township of Union boundaries. Five (5) Historic Places were located within the City of Mt. Pleasant and therefore none of these properties will be affected by this project proposal.

Per Michigan Department of Environment, Great Lakes, and Energy (EGLE), the Michigan State Historic Preservation Office (SHPO) and the Tribal Historic Preservation Office (THPO) are not required to be contacted by the Township regarding the proposed *Project Plan*.

The list of National Natural Landmarks in Michigan, from EGLE DWSRF forms and guidance webpage, was assessed and there are not any listed landmarks that could be impacted by this proposed project and construction.

The proposed project does not involve any elevated storage tanks or any wildlife attractants in the vicinity of an airport. The Federal Aviation Administration, therefore, does not need to be consulted for this project.

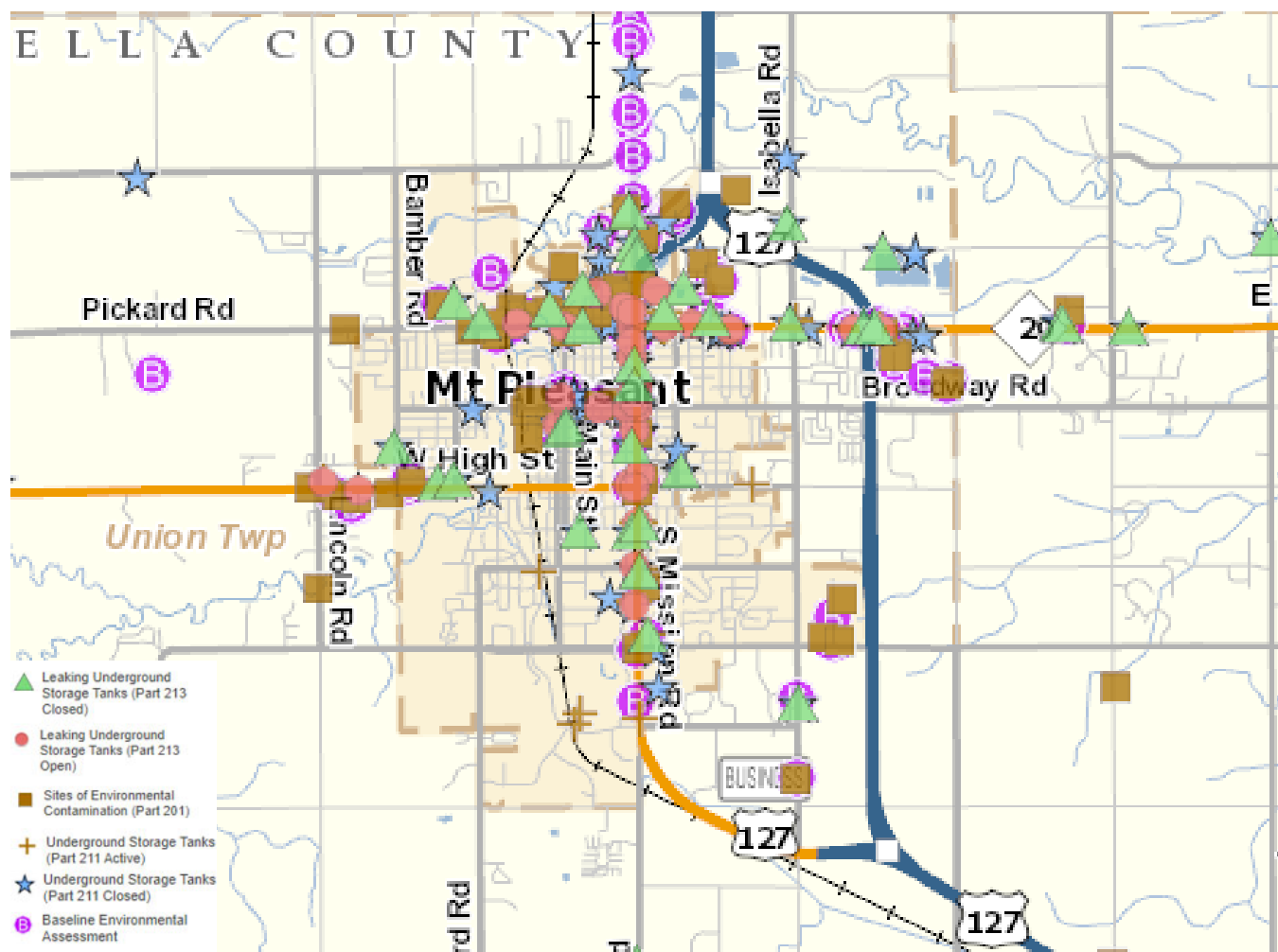
2.3.2 Air Quality

No changes in air quality stemming from primary or secondary development from this project are anticipated. Any air quality issues associated with this project will be temporary in nature and limited to the time of construction.

The proposed project will not impact the future air quality of the Township. The project will not contribute to direct residential or commercial growth that may be facilitated by the project. The planning area has no heavy industries and does not contribute any adverse elements to pollute or degrade air quality.

There are 6 leaking underground storage tanks, 6 Part 201 contaminated sites, and no U.S. EPA Superfund sites in the Water Distribution Service Area, including those located in the City of Mt. Pleasant. An illustration of these locations is shown below, and the actual sites are provided in the Appendix.

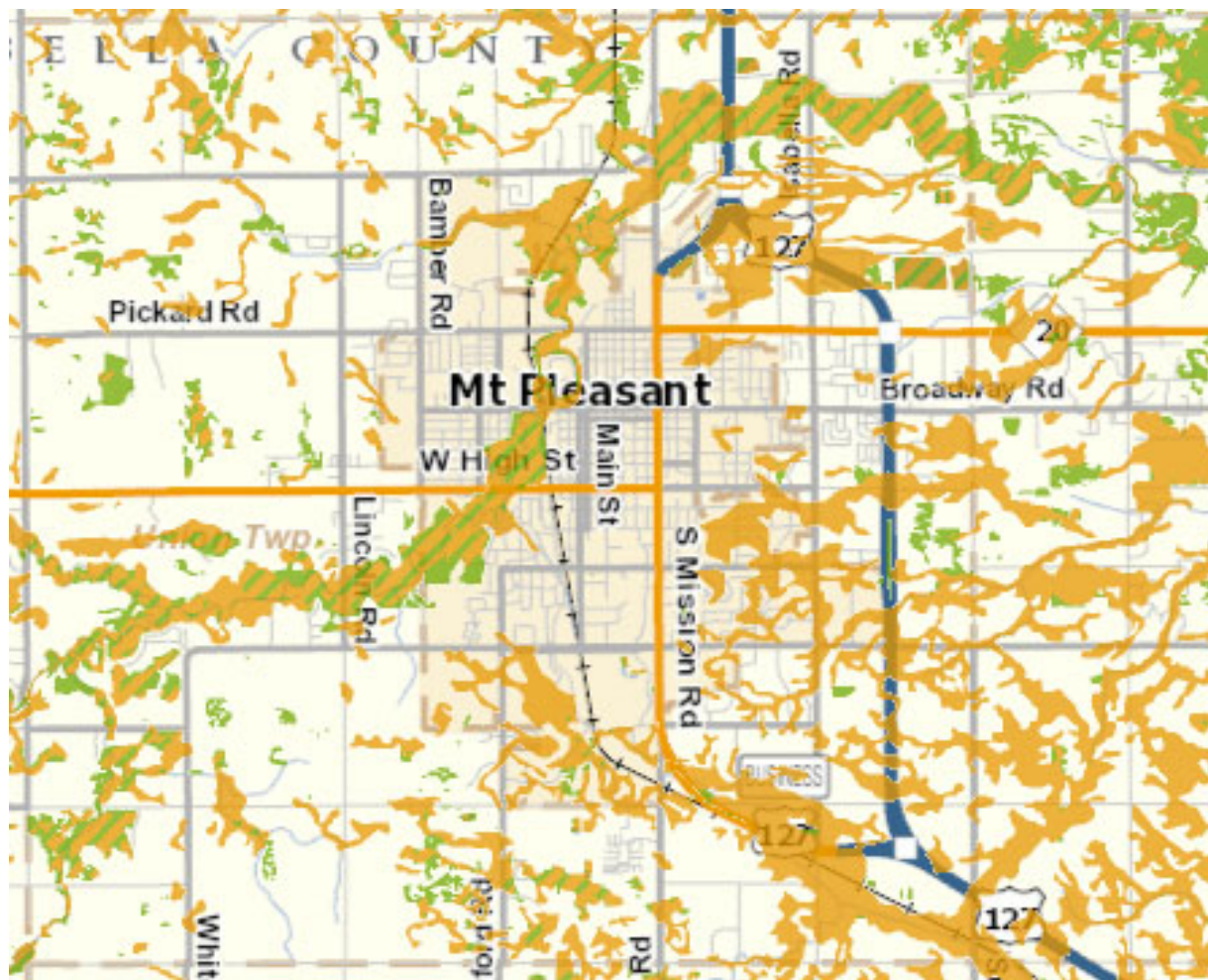
FIGURE 6 – EGLE ENVIRONMENTAL SITE LOCATION MAP



2.3.3 Wetlands

There are wetlands within the service area for the Charter Township of Union, especially along the County Drains and Rivers. The Wetlands Inventory Map is provided on the next page that shows the general locations. The proposed projects in this project plan do NOT encroach into wetland areas that are identified on the inventory map or were previously delineated.

FIGURE 7 – EGLE WETLAND INVENTORY MAP



2.3.4 Floodplains

The Charter Township of Union has a floodplain map on their website (www.uniontownshipmi.com). There is no work within the floodplain being proposed under this project.

2.3.5 Natural or Wild and Scenic Rivers

The Chippewa River is not listed on the National Wild and Scenic River System list.

2.3.6 Major Water Sources

The Chippewa River is the major surface water within the Township. Any contaminant entering the ground water in Union Township could end up in the Chippewa River.

2.3.7 Topography

The topography is relatively flat and drains toward the Chippewa River in most areas of the Township. Some County Drains direct water to the east along the eastern edge of the Township.

2.3.8 Geology / Soils

The unconsolidated glacial terrain of Union Township is characterized by medium to coarse textured glacial till, end moraine deposits of medium to coarse-textured till, glacial outwash sand and gravel and postglacial alluvium, and lacustrine deposits. The glacial deposits range in thickness from 50 feet to 500 feet throughout and provide the majority of potable water to communities and residents in the northwestern parts. Unconsolidated deposit thickness ranges from 200 ft to 400 ft in the north-northeast portion of Union Township and 400 ft to 600 ft in the southwest portion of Union Township. Unconsolidated glacial deposits provide most of the potable water in the region. Bedrock underlying Union Township is predominantly the Pennsylvanian-age Saginaw Formation which consists of sandstone and shale with minor amounts of limestone, coal, and gypsum.

2.3.9 Agricultural Resources

The Charter Township of Union 2018 Master Plan outlines Agricultural Preservation as a priority and specifies limiting sewer and water extensions to areas designated as such in order to control direct development or displacement of this land. The Master Plan also required vegetated buffers from all wetlands, streams, lakes, and rivers to protect water quality and prevent deterioration. Goal No. 1 of the plan is "Preserve and protect key natural and agricultural resources. This includes protecting significant, sensitive natural amenities, coordinating utility expansion in a way that encourages development along existing arterial roadways and on vacant or underutilized sites first, and preserve areas suitable for farming and agriculture related uses.

2.3.10 Fauna and Flora

An environmental review through Michigan Natural Features Inventory database (MNFI) identified 4 endangered species, 9 threatened species and 21 species of concern that exist within Isabella County. There are no threatened or species of concern within the proposed project areas.

2.4 Existing Water Supply System

The Charter Township of Union water distribution system construction began in the late 1980's initiated by the need for reliable potable water for domestic use. Growth in population and construction in select commercial and residential locations generated the need to expand the system through the years. The Charter Township of Union water system construction began in the late 1980's and has expanded through the years with the growth in population. The sole water source is supplied by three (3) Treatment Facilities comprised of onsite Type I ground water wells (total of seven (7) wells), iron/manganese filtration and booster pumps to distribute water to the users. Storage is provided by

gravity as well as through pumping, including three (3) elevated tanks and one (1) ground tank with booster pumps to supply water and maintain system pressures for the users. This distribution infrastructure includes approximately 74 miles of piping.

Historically, the Charter Township of Union has been segregated into three (3) independent water districts. Starting in 2010 the water system was reorganized and interconnected by installing a watermain extension and two (2) control valve stations. Presently the entire distribution system operates as one (1) primary centralized Service District referred to as the East side Upper District providing domestic and fire flows to a total of 6,204 benefits. This district is the primary source of water to meet the domestic and fire demands for all the users of the system. This district contains two (2) secondary lower pressure zones referred to as (#1) the Broadway zone and (#2) West Side Zone. The limits of service are defined by the pressure limitations of their primary infrastructure that supplies the users and is as follows:

- East Side: 45- 93 psi operating range
- Lower Pressure Zone #1 (Broadway): 50 - 60 psi
- Lower Pressure Zone #2 (WestSide): 53 - 62 psi

The final phase of this project is underway and to be completed this year and includes the installation of a high service pump in one (1) of the control valve stations to allow for a reliable means for water to move both east and west without restriction. The operating pressures for the Service District and each respective pressure zone are dictated by the well / booster pumps in conjunction with gravity (ground or elevated) storage.

The municipal water utilities are operated by Township staff, the Department of Public Services (DPS), providing quality water to the residents, businesses, and industries within the limits of the Township. A description of the existing Service District and their corresponding service limits is illustrated on the Existing Water Service District Boundary Map located in the appendices (located in the 2022 Water Reliability Study). A schematic of the existing Water Supply and Distribution infrastructure is provided on the following page.

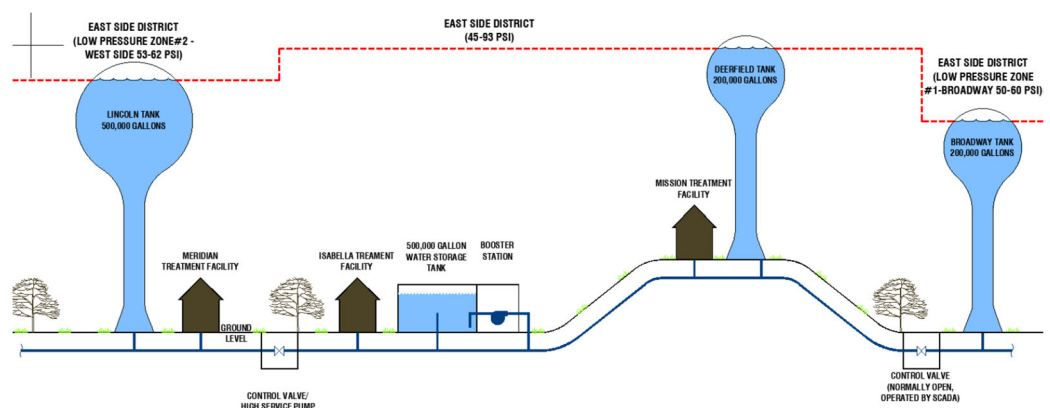
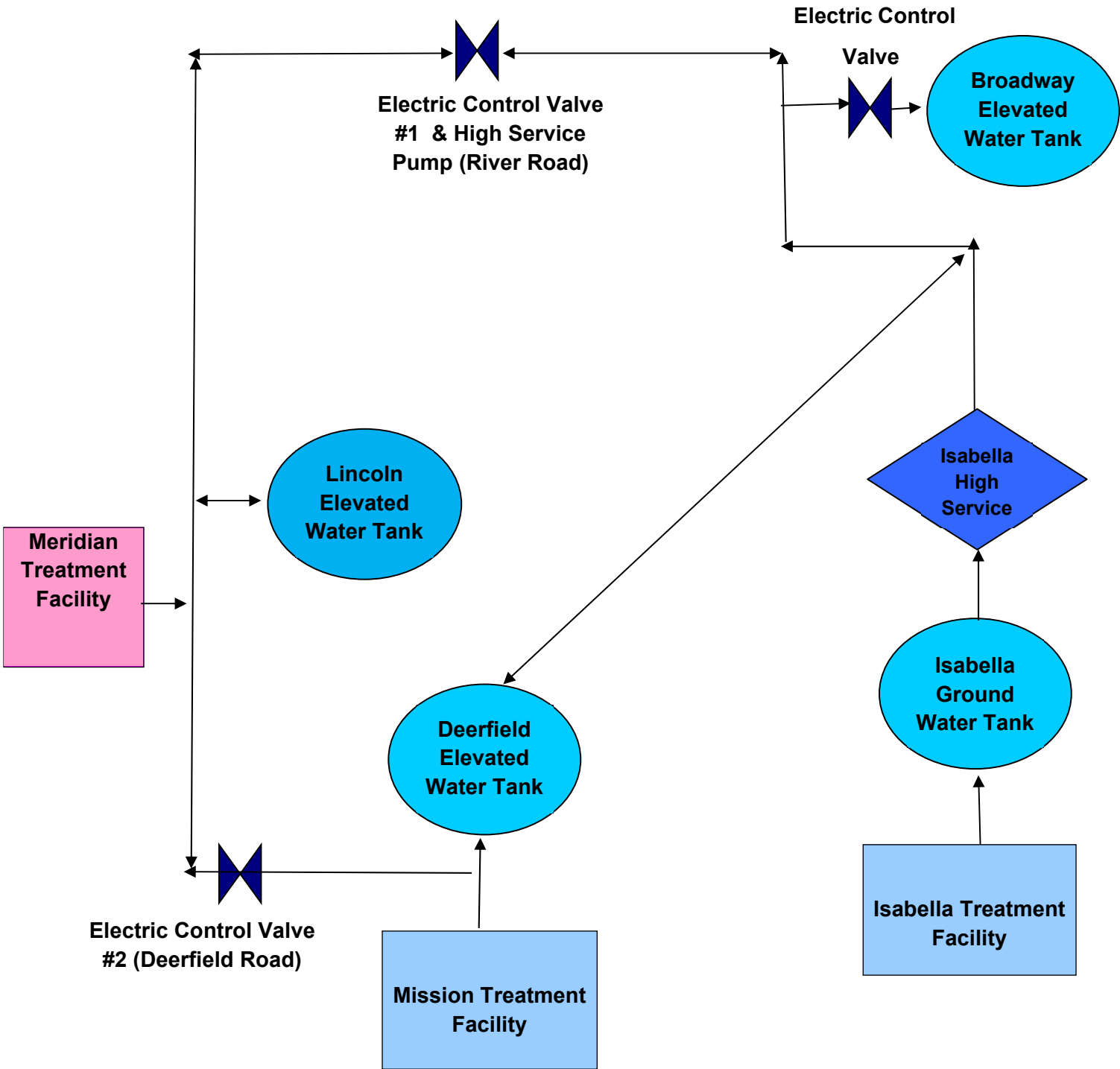


FIGURE 8 – WATER SYSTEM INFRASTRUCTURE SCHEMATIC



2.4.1 Supply and Treatment

The Charter Township of Union provides the treatment and supply of water for the water customers through the use of three (3) treatment facilities located throughout the Township. Each facility has onsite Type I water wells with each treated by continuous regeneration (pressure) filtration or a combination thereof. In addition, chemicals are added at each facility including Phosphate to maintain water quality and Sodium Hypochlorite (NaCl) for disinfection, to maintain chlorine residual levels, and to assist with iron/manganese oxidation throughout the Service District and each pressure zone in the distribution system. Water Treatment, although not a requirement, is utilized to remove iron and manganese naturally occurring in the groundwater. Filtration is the preferred cost-effective method and entails filters, comprised of media, typically anthracite or combination to capture the suspended solids. Initially aeration and/or chemicals are introduced to supplement and oxidize the iron and manganese to assist with the removal process. Over time, backwashing is required to clean the media and restore the normal filtration rate. The existing types of treatment are described below.

- *Continuous Regeneration (Pressure) Filtration* – Pressure filters are typically used to allow high-rate operation and eliminate the need for re-pumping of filtered water.

Figures 9 and 10 below provide a summary of the Townships' supply and treatment infrastructure.

Figure 9 – Water Supply Infrastructure

	East Side Service District						
	West Side Lower Pressure Zone		Upper Pressure Zone				
Location	Meridian Treatment Facility		Isabella Treatment Facility			Mission Treatment Facility	
Well I.D	Well No. 3	Well No. 4	Well No. 11*	Well No. 10*	Well No. 7	Well No. 8*	Well No. 9*
Year Drilled	1988	1987	2019	2014	2008	2011	2011
Year Upgraded	2012 / 2016 / 2020 / 2022	2016 / 2020 / 2021	N/A	N/A	2016	N/A	N/A
Upgrade Type	Cleaned, Televised, Pump & Motor Replacement	Cleaned, Televised, Pump & Motor Replacement	N/A	N/A	Cleaned, Televised Pump & Motor Replacement	N/A	N/A
Casing Diameter	12"	12"	12"	12"	12"	12"	12"
Depth	160'	125'	97'-0"	77'-9"	86'	71'	89'
Motor Depth	109'	85.6'	70'	49'	60'	60'	78.5'
Static Water Level (SWL)	23'	26.3'	8.2'	14'	16'-9"	4'	5'
Pump Motor	30 Hp	40 Hp	15 Hp	15 Hp	40 Hp	40 Hp	40 Hp
Permitted Capacity	380 gpm	380 gpm	396 gpm	400 gpm	700 gpm	400 gpm	400 gpm
Actual Capacity**	418 gpm	428 gpm	396 gpm	409 gpm	798 gpm	433 gpm	427 gpm
Aquifer Restriction	One (1) Well in operation at a time		1,100 GPM (Able to run only 2 wells at a time)			None	

Figure 10 – Water Treatment Infrastructure

	East Side Service District					
	West Side Lower Pressure Zone		Upper Pressure Zone			
	Meridian Treatment Facility		Isabella Treatment Facility		Mission Treatment Facility	
Year Built	1988		1987		1987	
Year Upgraded	2005		2011		2006	
Type of Treatment	Fe Removal	Disinfection	Fe Removal	Disinfection	Fe Removal	Disinfection
Primary Method of Treatment	Continuous Regeneration (Pressure) Filtration	12.5% NaCl (liquid)	Filtration 2- Pressure	0.9% NaCl (Onsite generation system)	Filtration 1- Pressure	12.5% NaCl (liquid)
Supplemental Treatment Method	None		Aeration & PO ₄ addition to assist with inorganic removal		Aeration & PO ₄ addition to assist with inorganic removal	
Number of Units	2		2-Pressure w/2 cells each		2	
Supply From	Well No. 3 & No. 4 (Dedicated bypass)		Wells No. 11, 10 & No. 7 (Dedicated bypass)		Well No. 8 & No. 9 (Dedicated bypass)	
Treatment Capacity	800 gpm (Total) 400 gpm (per Unit)		1,500 gpm (Total) 375 gpm (per Cell)		400 gpm (Total) 400 gpm (per Unit)	
Backup Power Supply	Onsite Generator		Onsite Generator		Onsite Generator	

The Union Township water supply and treatment is comprised of three (3) supply elements, raw water (source), treatment and finished supply (pumped). The evaluation of their capacity is limited to the smallest rated capacity of each of these. Their description and method for analysis is provided below.

Raw Water (Source) Supply: The current source of supply for all of Union Township is provided by onsite Type I groundwater wells located at each of the treatment facilities. The capacity of this raw water supply is defined by the existing firm capacity of the wells. *Firm capacity* is the wells' ability to meet maximum daily demand with the largest pump out of service. The available firm capacity is 2.3 MGD (1600 GPM)

Treatment: Treatment is provided to the raw water supply through the use of pressure filtration or combination thereof. The capacity of the treatment process at each of the treatment facilities is established by the maximum allowable filtration rate or maximum allowable treatment rate with the largest filter out of service when less than four (4) filters are provided. The available firm capacity is 2.16 MGD (1500 GPM)

Finished (Pumped) Supply: The evaluation of the capability to provide finished water supply to system is defined by existing firm capacity. This supply is distributed to system either by well pump (treated by pressure filter), booster pump (treated by pressure filter) or booster pumps supplying water from a dedicated storage tank. *Firm capacity* is the pumps' ability to meet

maximum daily demand with the largest pump out of service. The available firm capacity is 4.18 MGD (2900 GPM).

Evaluations of the infrastructure and existing and future demands indicate the raw water (wells) and treatment are the limiting components with finite capacity and will be at or near capacity in the next five (5) years. A well feasibility study was completed in November 2021 to identify locations for a new water source. Recently the Township was awarded a Source Water Protection Grant to initiate evaluations for a potential site owned by the Township. These efforts are underway including soil, water quality and quantity testing that will be completed in the next couple of months.

2.4.2 Storage

Water Storage is a requirement for all systems that service more than 150 units to meet peak hour, fire suppression, and emergency demands. This storage is typically provided by one of the following two methods:

- *Gravity Storage* – Elevated or ground-based tank in which the hydraulic grade line is controlled by gravity.
- *Pumped Storage* – Booster pumps control the hydraulic grade line and receive water from a ground storage tank (suction side)

Traditionally for Union Township, all the existing storage facilities provide gravity storage to all their users, with the exception of the ground storage tank located at the Isabella Treatment Facility. This particular pumped storage operation is capable to provide equalization, fire, and emergency volumes to the East Side District in conjunction with the Deerfield Tower through the use of three (3) pumps. The pumps maintain constant pressure with Variable Frequency Drives. The existing storage facilities are described in Figure 11 below.

Figure 11 – Storage Infrastructure

	East Side Service District			
	West Side Lower Pressure Zone	Upper Pressure Zone		Broadway Lower Pressure Zone
	Lincoln Tank	Deerfield Tank	Isabella Tank	Broadway Tank
Supply From	Meridian Treatment Facility	Mission & Isabella Treatment Facility	Isabella Treatment Facility	Mission & Isabella Treatment Facility
Year Built	2001	1991	2011	1987
Last Inspection	2021	2021	N/A	2021
Type of Storage	Elevated Standpipe	Elevated Standpipe	Ground based	Elevated Standpipe
Available Volume of Storage, Gallons	500,000	200,000	500,000	200,000
Diameter	Varies	Varies	62"	Varies
Normal Operating LWL / HWL	26.5'/34' (942/949.5)	20'/29' (959.7/968.7)	1.5'/24' (787/809)	19'/25' (893/899)
Available Head Range, ft	37.5'	29'	23.8'	29'
Telemetry /Controls	SCADA (gravity based on demand & fill based on tank level - Open / closes Control Valve for Upper Pressure zone)	SCADA (gravity based on demand & fill based on tank level)	SCADA (pumped based on system pressure & Deerfield Tank level/fill based on tank level)	SCADA (open/closes Control Valve at base of tank)

Overall the Charter Township of Union has available 1,200,000 gallons of water storage. Evaluations of the infrastructure condition and volume in comparison to existing and future 10 year demands indicate the Township has adequate storage to meet needs and no further upgrades are needed. The EGLE Sanitary Survey completed in 2020 noted minor items for correction and all improvements have been implemented to date, the survey is provided in the Appendix.

2.4.3 Distribution

The majority of system piping is composed of PVC (C900) ranging in size from 4-inch to 16-inch. The two most common sizes of distribution piping within the system are 8-inch and 12-inch, installed as development dictated requiring associated water main extensions. Figure 12 below shows the piping characteristics.

Figure 12– Distribution Piping

Length	Size	Material
22,347 LF	4-inch	C900 PVC/Ductile Iron
32,500 LF	6-inch	C900 PVC/HDPE DR11
178,568 LF	8-inch	C900 PVC/HDPE DR11
2,702 LF	10-inch	C900 PVC
152,419 LF	12-inch	C900 PVC
850 LF	16-inch	C900 PVC

Evaluations in the water reliability study indicated two (2) specific areas where dead ends were identified that were preventing proper flow and creating restrictions for treatment and/or supply.

2.4.4 Lead Service Lines

The Township has begun investigating lead service lines throughout the service area and during the preliminary Distribution System Materials Inventory (DSMI) identified 466 leads out of the 1930 leads likely do not contain lead but may (24%). With this project the Township proposes to utilize the available preliminary DSMI data collected to implement a final DSMI and corresponding lead service line replacement of the suspected 466 service lines.

2.4.5 Water Service Meters

The Township owns approximately 1948 service meters that monitor each connections' water usage. Township meter reading services are currently being provided on a quarterly basis using a combination touch read and radio read automated meter reading system. Meter reading functions are completed by existing township staff who visit each customer location to perform readings, final reads, and on/off readings for permanent and transient customers. These readings are then exported to the Township's Utility Billing Software from our meter reading equipment for producing quarterly billing statements.

2.4.6 Water System Losses

Water loss is calculated as unbilled water divided by the total water supplied or pumped. Water losses were calculated for 2021 to be 7%.

FIGURE 13 – SUMMARY OF UNACCOUNTED WATER FOR 2021

	2021
Total Water Treated (MGD)	381.42
Total Billings to Customers (MGD)	353.98
Percentage Unaccounted, %	7%

2.5 Need for Project

The 2021 Annual Drinking Water Quality Report is in the Appendix. The Townships 2022 Water Reliability Study is attached in the Appendix.

2.5.1 Compliance with Act 399

The Township water supply has remained in compliance with the standards defined in Act 399 and has not received any acute or non-acute violations. The Township annually tests water quality and it has historically been found to meet state and federal regulations. The proposed projects will ensure continued compliance with drinking water standards and reduce the risk of any potential non-compliance to meet firm capacity due to projected increased water supply demand within the existing service area. Specifically, the proposed projects intend to address the following:

- Investigation / replacing LSL will avoid the potential for future water quality issues and meet state and federal regulations.
- Extending / Looping watermain will improve pressures, particularly during emergency conditions, increase redundancy by reducing water main breaks, and improve water quality by reducing flushing operations to remove accumulated sediments and also reduce potential for lost water.
- Increasing supply and treatment capacity will provide protection of the existing water source and ensure adequate capacity to meet customer demands

2.5.2 Orders of Enforcement Actions

No court or enforcement order is currently against the water supplier for deficiencies or non-compliance with Act 399.

2.5.3 Drinking Water Quality Problems

There are currently no water quality issues experienced by the water supplier and the aesthetic quality of water distributed is free of color, odors, and taste.

2.6 Projected Future Needs

Figure 14 below illustrates that Union Township has experienced some negative water system growth over the past 5 years that equates to an average of 2.33% decrease annually. The decline in water system users between 2020 and 2021 is predominantly due to the COVID -19 global pandemic that mandated businesses close (including Central Michigan University) thus suspending in person attendance and subsequently many residents left the area and/or worked remotely. All data provided through REU analysis show that the growth decline in the most recent years correlates directly with the pandemic. Future anticipations are optimistic with new developments presenting opportunities for growth which correlates with a need for water service.

The following data represents more detailed information presenting actual REU counts within each service district for the current year and applying the average historical growth rate of 2.0% to account for 5-, 10- and 20-year growth.

FIGURE 14 - EXISTING AND PROJECTED REUs

Service District	2021	2026 ¹	2031 ¹	2041 ¹
Upper Pressure Zone*				
No. of Benefits	4,963	5,459	6,005	7,206
Benefit Increase	N/A	496	546	1,201
% Annual Increase	N/A	2.0%	2.0%	2.0%
Lower Pressure Zone #2				
No. of Benefits	1,241	1,365	1,502	1,802
Benefit Increase	N/A	124	137	300
% Annual Increase	N/A	2.0%	2.0%	2.0%
TOTAL BENEFITS	6,204	6,824	7,507	9,008

¹estimated figures

*Includes the Lower Pressure Zone #1 (Broadway)

The projected water usage for the next 20 years is provided below and is based on existing historical water usage discussed in the previous section. In comparison to the available firm capacity of 2.3 MGD for raw water (supply) and 2.13 MGD for Treatment, it is apparent the Township does not have capacity to meet projected usage demands for the next 5 years.

Project needs for the next 20 years beyond those listed in the Project Plan are documented in the Water Reliability Study. Future needs outside this project plan are primarily related to additional main extensions and new water storage tank.

FIGURE 15- EXISTING AND PROJECTED FLOWS

Total System	2021	2026	2031	2041
REU	6,204	6,824	7,507	9,008
ADD (gpd)	1,039,000	1,143,429	1,257,873	1,509,380
ADD / REU (gpd)	168	168	168	168
MDD (gpd)	2,384,000	2,575,456	2,833,228	3,399,722
PHD (gpd)	6,234,000	6,860,577	7,547,238	9,056,283

2.7 Infrastructure Needs

Upon review of the information above, it is apparent the wells and treatment both are the limiting component with respect to capability to meet the maximum daily demands for the entire service district including both lower pressure zones. There is capacity with raw water supply and respective treatment to meet the existing and projected demands for the next 5 years of operation.

2.7.1 Source / Treatment

Based upon the findings above, the existing capacity of the water supply (source, treatment and pumped) were identified as being currently sufficient. However after next 5 years with increased growth and demand the raw water supply and respective treatment that services the entire system will initially be deficient, with an ultimate need of 761 gpm and 860 gpm to meet the projected 20 year demands for the system. Requirements of the SDWA state that the firm capacity of the system must be capable to meet the maximum demands, meaning the largest well taken offline. Therefore to meet this criterion the Township is required to install a new water supply well to meet these demands.

The system does, however, have the ability to provide raw water source to the 20 year projected demands on an as needed basis due to the installation of the River Road High Service Pump (to be completed 2023). The pump is intended to add reliability and redundancy to the water system, in case of emergency.

2.7.2 Distribution

A dedicated transmission line between the Mission Treatment Facility and the Isabella Treatment Facility will allow for the distribution of raw / finished water between the two (2) systems which would create added redundancy / reliability in the system. Specifically as components are taken offline for repairs, cleaning, replacement this would provide the ability for any well to receive treatment and send to system at either site. Additionally the improvements will allow for the ability to provide a central treatment facility for raw water within the system.

Development and future land use changes are anticipated to increase the water demand near Enterprise Park, as seen in the Areas of Potential Future Land Use Changes map provided in the Appendix. It has been discovered that expanded industrial / business park development will require distribution modifications to accommodate peak hourly flows while maintaining pressure in excess of 35 psi, and the need to provide fire flows during maximum day water demands while maintaining at least 20 psi in the system. Installation of a water main loop along Summerton Road, between Pickard Road and Broadway Road is required to provide required water supply and pressure to this service area.

2.7.3 Climate Resiliency

The Treatment Facilities and well sites all have existing backup power generation with automatic transfer switches that are capable of operating all critical process equipment in the event of power failure.

3.0 New Water Supply Well Procedures

The Charter Township of Union received a Source Water Protection Grant through EGLE in 2022 that is being utilized to conduct preliminary test well investigations for a new well near the Mission Treatment Plant. The grant provided reimbursement of funding to the Township for a Well Study Report that was completed in 2021 that evaluated and recommended potential well site locations for a new Type I Production Well. Through this grant the Township has also begun field work including drilling, pump testing, monitoring and sampling, which will all be utilized to complete an aquifer analysis and groundwater modeling report. With initial site and aquifer analysis completed, the Township has already completed test well drilling approval through their EGLE district Engineer. The Test Well Approval Letter and the Adverse Resource Impact Determination are provided in the Appendix. This work will include the construction of 6" test well, capacity testing and water quality sampling. This first step will be instrumental to determine the viability of a future water source.

General information on the proposed well site location, distance from the treatment plants, proximity to contamination, and relation to existing wells is provided in the attached Well Study provided in the Appendix.

Test well drilling and aquifer analysis with conversion to a production well are included within this *Project Plan*.

4.0 Alternative Analysis

4.1 Alternative 1: No Action

The "No Action" alternative would result in limitations on serving existing needs within the Township since the components of the system identified for improvements are both at, or near, available capacity and/or expected useful life.

4.2 Alternative 2: Optimum Performance of Existing Facilities

The existing water system is performing as well as it can and additional staffing, staff training, and operational changes are not likely to improve the performance of the system because the primary concerns are related to the capacity of the infrastructure. Therefore, this alternative was not considered further.

4.3 Alternative 3 : Construction Alternatives

4.3.1 Water Supply / Treatment

Perhaps the most critical issue facing Union Township is that of water source supply. Without adequate storage and distribution capacity is of little importance. Therefore, it is critical that viable alternatives are explored to ensure adequate volumes of treated water supply for the planning period and beyond. As stated previously in this report and other reports, the Township has made a significant investment to integrate the water system into a single service district with two (2) pressure zones for reliability and redundancy therefore alternatives related to separating the districts was not considered as it was not financially feasible. Two (2) scenarios are available to the Township for consideration with associated options to accomplish each. Discussion on proposed project description, costs and pros/cons in comparison for each are included:

Alternate 3, Option 1: New Type 1 Well, Transmission Line and Isabella Treatment Facility Expansion

The Isabella Treatment Facility was constructed in 2009 with design and construction provisions incorporated to accommodate a future expansion. The layout and configuration is arranged with respect to the site, building, mechanical and HVAC Installation to easily accommodate expansion for additional water supply main, iron removal filters and high service pumps. This work would include expansion of the plant to accommodate a filter room equipped with one (1) 800 GPM filter and plumbing for a future and high service pump room equipped with two (2) installation 400 GPM High Services Pumps, chemical feed, mechanical piping, and associated accessories.

As stated in Section 3, the new Type 1 Well location was identified based upon a feasibility study conducted in 2021. The location selected was based upon several parameters including areas of contamination, access to existing infrastructure and availability of property to name a few. The Figure below provides a summary with pros and cons. Site No. 2 was considered most ideal and was not further evaluated. The Transmission Line is required to transfer the potable raw water supply to the treatment facility prior to discharge to system.

Figure 16 – Potential Type 1 Water Well Locations

Site	Distance to Isabella WTP	Demographics	Costs	Pros	Cons
No. 1 Crawford Road	2.8 mile	-20.2 Acres -Ag Zoned		-Accessible Site with amenities (water / electric) -Outside known areas of contamination -Best ARI rating -No nearby well interference	-Far away from Isabella Treatment Facility -Requires property purchase and long transmission line -Most costly option
No. 2 5076 S Mission Road	1.7 miles	-14 Acres -Neighborhood Service Zoned	-	-Accessible Site with amenities (water / electric) -Twp owned parcel -Passing ARI rating -Outside known areas of contamination -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Potential nearby well interference -May not produce large withdrawal up to 300 GPM
No. 3 4795 Mission Road	1.5 mile	-29.6 Acres -Neighborhood Service Zoned	-	-Accessible Site with amenities (water / electric) -Twp owned parcel -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Failing ARI Rating -Potential nearby well interference -Potential contamination within isolation zone -May not produce large withdrawal up to 300 GPM
No. 4 5120 Isabella Road	0.1 mile	-49.6 Acres -Rural Buffer Zoned	-	-Close proximity to Isabella Treatment Facility Accessible Site with amenities (water / electric) -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Failing ARI Rating -Potential contamination within isolation zone within watershed -Aquifer capacity limited per EGLE -Clearing and Grubbing Required
No. 5 5556 Deerfield Road	1 mile	-10 acres (min) -Rural Buffer zoned	-	-Close proximity to Isabella Treatment Facility Accessible Site with amenities (water / electric) -Outside known areas of contamination -Passing ARI rating -No nearby well interference	-Requires property purchase and water / electric transmission installation -More Costly

Alternate 3. Option 2: New Type 1 Well, Transmission Line and Meridian Treatment Facility Expansion

The Meridian facility was constructed in 1988 with modifications implemented in 2005 to replace the existing filters. The building 1,200 Square feet and is of pole-building style construction. The facility is currently capable of accommodating treatment of the existing wells but has no capacity within the building to accommodate an expansion and therefore a new building would be required. Although the new Type 1 well location is closer and would reduce the length of the transmission, site piping sizes and configurations prove challenging due to proximity to neighboring municipal wells and potentially be restrictive.

4.3.1.1 COSTS OF ALTERNATIVES

The cost of the construction of all alternatives is detailed in the table below.

Figure 17 – SUPPLY / TREATMENT ALTERNATIVES COST SUMMARY

Alternative	Description	Capital Cost
Alternate 1	No Action	N/A
Alternate 2	Optimization of Existing Facilities	N/A
Alternate 3, Option 1	Type 1 Well / Isabella Treatment Facility Expansion	\$6,399,050.00
Alternate 3, Option 2	Type 1 Well / Meridian Treatment Facility Expansion	\$8,229,900.00

4.3.2 Water Distribution and LSL Investigation / Replacement

The water distribution system piping and storage network was analyzed using WaterCAD V10. The system was analyzed for existing and future conditions to determine where deficiencies exist as well as the optimal corrective actions. Criteria for determining system problems include the need to accommodate peak hourly flows while maintaining pressures in excess of 35 psi, and the need to provide fire flows during maximum day water demands while maintaining at least 20 psi in the system. This alternative proposes the following:

- There is a need for a raw water transmission line between the Isabella and Mission Treatment Plants to create added redundancy / reliability to the system. As components of the system are taken offline for cleaning, repairs, and replacement this would provide the ability for any well to receive treatment and send to the system at either site.
- With future land use changes, there is a need for a water main loop to be added between Pickard Rd and Broadway Rd along Summerton Rd to create adequate pressure to increase reliability within the service area. As provided in the Appendix, the Areas of Potential Future Land Use Changes indicate expansion and growth near Enterprise Park. To support this development and land use changes, the Township must install a water main connecting Pickard Road to Broadway Road to provide adequate water pressures and supply.
- Lead Service Line replacement including further investigation and replacement of assumed 466 service lines.

There are no construction alternatives to water main and LSL replacement and no action will leave aging infrastructure that is more prone to breaks.

4.3.2.1 COST OF ALTERNATIVES

The cost of the construction of all alternatives is detailed in the table below.

TABLE 18 – DISTRIBUTION ALTERNATIVES COST SUMMARY

Alternative	Description	Capital Cost
Alternate 1	No Action	\$0.00
Alternate 2	Transmission Main, Water Main Loop and LSL	\$4,583,600.00

4.4 Regional Alternatives

The concept of regionalization between the Township and the City of Mount Pleasant has been evaluated in the past. Due to existing operations and infrastructure capacity challenges, it was determined to not be cost effective to pursue. The City and Township jointly pursued and conducted an evaluation in 2019 to evaluate this. Substantial infrastructure costs would be required to be implemented and would also incur additional operations and maintenance costs. The improvements proposed were presented to be completed in phases with Phase I costing approximately \$15 Million and Phase II incurring an additional \$30 Million. This alternative will not be investigated further.

4.5 Monetary Evaluation

The minimizing of the long-term cost of the overall system, and that of the individual user, has been the focus of Union Township in providing service to their users. Therefore, in the past, an emphasis has been placed on developing an infrastructure that will produce an end cost to the user that is manageable, stable and supporting a well maintained system, well into the future.

4.5.1 Sunk Cost

Sunk costs associated with this project may include investments in the current Water System that will support the expanded future use, including piping systems, electrical systems, buildings, land cost, planning costs and supporting utility installation. Sunk cost also includes preparing the project plan and previous studies completed to research these issues.

4.5.2 Present Worth

Total present worth =

Capitol cost + O&M + Replacement – (present worth of salvage at end of 20 years)

Present Worth Analysis for the water supply, treatment, storage, and distribution systems can be found in the Appendix.

4.5.3 Salvage Value

Monetary evaluation period is 20 years

Salvage period is:

Conveyance (pipes, etc) – 50 years

Treatment, tanks, booster stations, well fields – 30 to 50 years

Process Equipment – 20 years

Auxiliary Equipment – 15 years

Detailed description of salvage value of all water system components can be found in the Appendix.

4.5.4 Escalation

Excessive growth is not anticipated, therefore land acquisition not be considered as selection criteria.

4.5.5 Interest During Construction

Interest during construction is anticipated to be less than four years. Interest costs during construction are tabulated and included in the Appendix for Reference.

4.5.6 Mitigation Costs

No alternatives provided should contain potential environmental impacts. For the purpose of this analysis, we assume there are no mitigation costs for any of the alternatives.

4.5.7 User Costs

Currently the Township provides water service to approximately 6,204 users. The current rate structure is being reviewed and will be adjusted if necessary. The debt incurred, along with the O & M costs expected under each alternative will dictate the annual cost to the system. That cost, along with the number of hook-ups and users will dictate the end cost to each user. To date, the Township has been able to keep the quarterly user charges stable and supplement through hook-up fees. It is the goal of the Township to continue this method to fund project costs.

The user charge system is currently in place and is designed to provide revenue to pay for O & M costs and debt retirement. This user charge is reflective of maintaining a current quarterly charge of \$60.02/quarter for 0-15,000 gallons and \$2.41 per thousand gallons thereafter. The quarterly user charge is for operation and maintenance system fees, as well as capital debt charges per user as of January 1, 2023. This project would add an additional 8.5%, equating to a \$6.00 increase in base charge per REU per quarter to capital debt charges per user for the system.

4.5.8 Project Delivery Method

The proposed project will follow traditional Design-Bid-Build mechanisms.

4.6 Environmental Evaluation

The environmental effects of the recommended community water system improvements are minimal, in regard to negative impacts. The environmental impacts to result from supply, treatment and distribution will be temporary and construction related with used of proper soil erosion control measure. There will be no permanent environmental impacts with the storage and distribution aspects of this project.

The increase in source water withdrawal has the potential to present negative environmental impacts that could impact regional groundwater supplies. The Township has worked continuously with their EGLE District Engineer to evaluate potential environmental impacts with all possible well site locations.

The Well Study Section 4, e. Historical Aquifer Testing Results outlines the characteristics of surrounding aquifers to the Township. The proposed well will be located near the Mission Treatment Facility which as demonstrated favorable results and potential to provide additional capacity through aquifer testing and is anticipated to have minimal adverse resource impacts.

4.7 Technical Considerations

4.7.1 *Sufficient Pumping Capacity*

Upon review, it is apparent the wells and treatment both are the limiting component with respect to capability to meet the maximum daily demands for the entire service district including both lower pressure zones. There is capacity with raw water supply and respective treatment to meet the existing demands however with not be able to meet future demands based upon current projects and upgrades are needed.

4.7.2 *Standby Power*

Permanent standby generators and automatic transfer switches are located at each treatment plant and booster station within the Townships Water System. The Township also maintains additional portable generators to utilize with equipment failure.

4.7.3 *Wells and Treatment Processes*

Each Treatment Plant providing water to the customers of the service area has at a minimum two (2) well units provided for each treatment process for redundancy and reliability purposes.

4.7.4 *Storage Volume*

Storage volume is adequate to meet the next 10 years of growth. Within the next 10 years as growth continues the need to begin planning for upgrades to the storage infrastructure should be a priority.

4.7.5 *High Volume Users*

The Townships highest water user is the Soring Eagle Water Park and Hotel. With the proposed improvements in this project, there will be no anticipated effects on design flows and pressures due to this customer because of the system parameters already in place.

4.8 New / Increased Water Withdrawals

The proposed well 12 site underwent a Part 327 SSR Pre-screening process. The screening included an Adverse Resources Impacts evaluation that was performed reflecting the groundwater as a source, in a glacial aquifer, at a depth of 280 ft and a pumping rate of 400 gpm for 24 hours per day, to reflect a worst case scenario of the new well. The analysis resulted in Zone B: Passing and providing there were no findings of significant impact. Additional information is provided in the Appendix.

5.0 Selected Alternatives

- Alternative No. 3, Option1: Water Supply / Treatment
- Alternative No. 3: Water Distribution & LSL

5.1 Water System Improvements

5.1.1 Supply

Raw Water (Source)

In an effort to be proactive the township retained GFA in 2021 to conduct a Type I Well Feasibility Study to investigate feasible well locations. The study cited 4 plausible locations for a new water supply along with research recommendations and cost alternatives for the Township's consideration. As with the other wells, iron removal is anticipated, and provisions are proposed for the water to be treated. This project proposes the installation of a 12-inch Well No. 12 rated at 400 gpm or greater at a depth no greater than 280 ft, to be located at a new well site that has already undergone initial EGLE site investigation and is anticipated to cause no adverse impacts on surrounding wells.

Treatment / Pumped

It is recommended to install one (1) 800 GPM horizontal pressure filter (2 cells) capable of supplementing the treatment of the three (3) existing wells onsite, and new water supply well 12. The existing building requires expansion of the filter room to accommodate up to two (2) 12' diameter pressure filters and associated piping. The system operations and exterior piping including distribution and backwash are already in place to accommodate. Treatment capacity at the Isabella Site would increase from 1,500 GPM to 2,300 GPM.

Upgrades of the existing high service pumps at the Isabella Treatment facility would also be needed and would be rated consistent to match the treatment filters rated capacity to avoid the potential for a restriction to send water to system (pumped). Additional capacity should be added to match the rated capacity of 1,500 GPM (existing filters) and maximum of 2,350 GPM to account for the gravity filter removal. To accomplish this, it is recommended to expand the pump house room to accommodate the installation of two (2) additional pumps, same capacity, and model as the existing high service pumps for consistency and ease of maintenance. The original facility design was constructed to accommodate such expansion including the pipe terminations. This project will be able to be staged with filters and pumps installed as needed with the ability to meet demand and storage requirements with time.

5.1.2 Distribution

Based upon conversations with the Township, it is their top priority to provide a direct connection between the Isabella and Mission Treatment Facilities as one currently does not exist. A dedicated transmission line to allow for the distribution of raw / finished water between the two (2) systems would create added redundancy / reliability in the system. Specifically as components are taken offline for

repairs, cleaning, replacement then would provide the ability for any well to receive treatment and send to system at either site. Additionally the improvements will allow for the ability to provide a central treatment facility for raw water within the system in the future.

There is also a need for a water main loop to be added between Pickard Rd and Broadway Rd along Summerton Rd to create adequate pressure and increase reliability within the service area. As provided in the Appendix, the Areas of Potential Future Land Use Changes indicate expansion and growth near Enterprise Park. To support land use changes in the area, the Township must install a water main loop to provide adequate water pressures and supply.

Thirdly, the SDWA and the Michigan Lead and Copper Rule require all municipal water systems to inventory and replace any lead or copper service lines operational to customers. Based upon DSMI inspections completed by the DPW there are no known service lines in the system that need to be replaced.

5.1.3 Water Conservation

Continual monitoring of the volume of water supplied to the users in the Service District is suggested and implementation of water conservation is detailed in the current Township Water Ordinance in the event demands do exceed the supply, pumping and/or storage capacities to keep reserves available for emergencies and incurred costs manageable.

5.2 Design Parameters

The water system treatment processes are not proposed to change with this project, treatment will continue to be provided through continuous carbon regeneration pressure filters and disinfection through chemical additives. The pressure filters produce residual solids during backwash of the media that is disposed into backwash holding tanks, and secondary effluent is further treated through backwash seepage lagoons. The backwash tanks periodically require cleaning, and the residual solids are transported to a landfill for subsurface disposal. The Charter Township of Union Water System Improvements Map is included in the Appendix.

Water main sizes were analyzed using Water CAD. Sizes were selected that would supply the required flow and maintain minimum required pressures. All designs parameters will follow state guidelines and be constructed according to the Township's standardized Technical Specifications. All projects will meet local and state water distribution standards. Pressures are projected to remain above 35 psi during normal operating conditions and 20 psi during emergency conditions. All proposed water mains will be at least 8 inches in diameter. Existing fire hydrants on water main will be removed and replaced if in poor / non-working condition.

5.3 Useful Life

The useful life of the assets proposed with this project are estimated by manufacturer recommendations and are expected to exceed 20 years.

5.4 Water and Energy Efficiency

Meter Calibration: Accurate metering of water for each well and each treatment facility help to determine output, track user demands, monitor production, and is required for many functions for water treatment. Maintaining the meters accuracy ensures the data collected and used is reliable.

Annual Water Audit: The purpose of an annual water audit is to determine the overall input-output accountability of the system, monitor the usage levels of qualitatively different consumers, gauge the effectiveness of conservation measures already being implemented, and gather other system performance data. It is suggested that Union Township and the City of Mount Pleasant partner to perform an audit on a regular or random basis. This may prove useful for the recognition of irregular usage patterns and may serve to identify leaks, malfunctions, or other system problems.

Public Participation: Based upon the historical records, there is significantly more water usage during the summer months attributed primarily to irrigation. In the short term, implementation of a system wide water ban and/or schedule for users could be put in place to limit the usage. In the long term, although it has proven to generate a substantial amount of revenue for the Township, there should be consideration to enforce large irrigation users to install a non-potable well in lieu of using the municipal water system. This may make a significant impact on the Townships' volume of water consumption peak usage months.

5.4.1 Water Conservation

Implementation of water conservation is detailed in the current Township Water Ordinance in the event demands do exceed the supply, pumping and/or storage capacities to keep reserves available for emergencies and incurred costs manageable.

5.5 Schedule for Design and Construction

A tentative schedule is as follows:

Design Bidding	Preliminary – Final Design	Fall 2023 – Spring 2024
	Water Source / Treatment	March 2024
	Water Storage	March 2024
	Water Distribution	March 2024
Construction	Water Source / Treatment	May 2026
	Water Storage	May 2027
	Water Distribution	May 2028

5.6 Cost Summary

FIGURE 19 – SELECTED ALTERNATIVES COST SUMMARY

Project	Construction Cost	Contingency (25%)	Legal, Admin, Financial	Engineering Services	Total
Supply / Treatment	\$4,237,750.00	\$1,059,400.00	\$254,300.00	\$547,600.00	\$6,399,050.00
Distribution	\$3,035,500.00	\$758,900.00	\$182,100.00	\$607,100.00	\$4,583,600.00
Total	\$7,273,250.00	\$1,818,300.00	\$436,400.00	\$1,454,700.00	\$10,982,650.00

5.6.1 Cost to Users

The user costs were developed using the construction cost estimate for the capital project cost. Costs were amortized for the loan period and were divided over the 30-year planning and loan period. These costs were then divided by the existing users (billed customers) on the Townships' system. The estimated monthly user cost for this project is \$6.00 (estimated 8.5 percent increase) and therefore it is expected the actual user costs will increase because the current user rates are insufficient.

5.6.2 Residential Water Usage

The Figure 15 represents the overall water system usage projections for the next 20 years with residential flows of 168 gallons per day per REU based on historical usage, with an average household size of 2.34 the average flow per day per capita is 72 gallons per day.

5.6.3 Capital Expenditures

All water system capital expenditures and user fees are detailed in the Appendix.

5.6.4 Operation & Maintenance

The Operations and Maintenance costs are included in the Operating Budget, included in the Appendix.

5.6.5 Repair & Replacement Budget

The Repair and Replacement Budget is included in the Present Worth Analysis, refer to the Appendix.

5.7 Implementability

The Charter Township of Union has the legal authority, capability, and willingness to plan, finance, build, operate, and maintain the water system improvements, including the selected alternative discussed above. The Township will solely own, operate, and finance the facilities to be built as part of the proposed project.

5.8 Disadvantaged Community

A Disadvantaged Community Status Determination Worksheet was completed, and the Charter Township of Union was determined to be a disadvantaged community.

6.0 Environmental and Public Health Impacts

The environmental effects of the recommended water supply, treatment, storage, and distribution are minimal in regard to negative impacts. The environmental impacts to result from implementing the proposed improvements will be temporary and construction related with use of proper soil erosion control measure. There will be no permanent environmental impacts with the selected alternative.

The “No Action” alternative could present negative environmental impacts that could lead to water system failure and public safety concerns. Implementing no improvements leaves the possibility of equipment failure and loss of supply water leading to a water emergency that would have negative impacts on social and economic factors of the community.

The environmental effects of the recommended water distribution system improvements are minimal, in regard to negative impacts. The environmental impacts to result from the selected alternative will be temporary and construction related with use of proper soil erosion control measure. There will be no permanent environmental impacts with the proposed project. There will however be positive environmental impacts such as improved reliability of supply and treatment reliability. As required by County and State regulations, a Soil Erosion and Sedimentation Control Permit will be acquired for the projects, if applicable. As with most utility related construction projects, it is expected that traffic will be rerouted to other streets during construction. The impact of traffic detours is expected to be minor. The construction dust and fumes will be minimized as much as possible

6.1 Direct Impacts

Direct impacts such as noise, dust control, and soil erosion control will be mitigated using general construction control measures during construction activities. Soil erosion control will be in accordance with the Michigan Soil Erosion and Sedimentation Control Act (Part 91, Act 451, P.A. 1994). Temporary erosion control measures will include the use of berms or ditches to divert stormwater runoff, where necessary, and the use of straw bales, filter fence, or sedimentation basins as needed to protect watercourses.

Dust control practices will include street sweeping as necessary on improved road surfaces, and the wetting of road surfaces if dust becomes a public nuisance. Noise control will consist of work restrictions during weekends, evening hours, and holidays. Because of the relative remoteness of the site, these restrictions may only apply to the (public) access roads and areas surrounding the site.

6.1.1 Construction Impacts

Construction is to occur in locations with existing infrastructure within publicly owned right-of-ways, easements, or Township owned property. The construction impacts will be minimal and limited to areas that have previously been cleared of trees and vegetation. No impacts to sensitive areas will be implemented through this project.

Construction method impacts: Construction activities include excavation on a 1:1 slope with the greatest trench depth being no more than 15 feet. There is anticipated to be potential for minimal local dewatering with the proposed improvements. Groundwater depth in the areas of construction ranges from 15-30

feet below grade, due to the depth of construction in relation to groundwater table depth, there will be no adverse impacts resulting from dewatering.

Traffic disruption impacts are anticipated to be very minor and of a temporary duration. No portions of the project will require road shut down. Dust control practices will include street sweeping as necessary on improved road surfaces, and the wetting of road surfaces if dust becomes a public nuisance. Noise control will consist of work restrictions during weekends, evening hours, and holidays. Because of the relative remoteness of the site, these restrictions may only apply to the (public) access roads and areas surrounding the site.

Due to construction occurring in areas with existing infrastructure, the initial assumption is that there are no endangered, threatened, proposed, or candidate species, or critical habitat occurring within the proposed project areas.

6.1.2 Operation Impacts

The proposed project will not impact the operations of the facilities during construction. Operational impacts will be minimal. The selected alternative does not change the existing technology or processes of the treatment plant. Operators are already well trained and have the capacity to manage the improvements.

Minor operational impact that will be associated with the project include noise for the surrounding residents, increased traffic, and dust. All these impacts will be minimized as much as possible throughout the project.

6.1.3 Social Impacts

Social impacts are largely reflected as user rates increase. This is a sensitive issue in any community. However, these increases will be evenly distributed and will affect all who are benefited by the system. The project will not include any social impacts on traffic, such as detours, relocation of businesses, employment changes, or lack of access to residences or places of business.

6.2 Indirect Impact

6.2.1 Development / User Charge

Indirect impacts are expected to be minor. Additional growth is likely in the service area, and development is consistent with the Township land use plan. The improvements will address the required improvements to maintain the existing users and allow availability for growth within the area.

6.2.2 Land Use

Land use is determined by the current zoning ordinance. It is not likely to significantly change in the future. The most significant change will be the availability and capacity to serve any additional development that comes to the Township.

6.2.3 *Air Quality*

No changes in Air Quality stemming from primary or secondary development from this project are anticipated. Any air quality issues associated with this project will be temporary in nature and limited to the time of construction.

6.2.4 *Changes to Natural Setting*

Preliminary assumptions would indicate that no threatened or endangered species exist within the project area and therefore will not be affected. These assumptions are based on the fact that construction is limited to sites with existing facilities.

6.2.5 *Cultural / Human Impacts*

Impacts on cultural, human, social, and economic resources are expected to be positive due to improved water supply and treatment systems. The only negative impact in this category would be increased user costs, which will be evenly distributed across the customer base being served by the system.

6.2.6 *Resource Consumption*

Resources consumption over the useful life of the treatment plant is not applicable for this project.

6.3 **Cumulative Impacts**

Cumulative impacts are expected to be minimal. Some development is expected, but any development falls within the Township's current land use plan and would most likely occur without the proposed project. Water quality degradation is not considered an issue; in fact, because of the facility's existence, water quality has most likely been improved by eliminating the possibility of system failure as capacity limits of the current system are reached. The Township will continue to work under the requirements of their operating permits and will stay in compliance with those requirements to assure this system will not adversely impact the environment. Construction impacts will be temporary in nature and of short duration. All disturbed areas will be restored at construction completion.

7.0 Mitigation

The environmental impacts, whether direct, indirect, or cumulative, are expected to be minimal. Structural mitigation measures are largely related to established soil erosion, noise, and dust control practices during construction activities, and discharge water quality during system operation. Nonstructural mitigation can be addressed by prudent planning and by participation in environmental studies with the objective of pollution prevention. Each of these mitigation issues are discussed in the section that follows.

7.1 Mitigation of Short Term Impacts

7.1.1 General Construction

On site mitigation measures will include established soil erosion, noise, and dust control practices during construction activities. Soil erosion control will be in accordance with the Michigan Soil Erosion and Sedimentation Control Act (Part 91, Act 451, P.A. 1994). Temporary erosion control measures will include the use of berms or ditches to divert stormwater runoff, where necessary, and the use of straw bales, filter fence, or sedimentation basins as needed to protect watercourses.

Dust control practices will include street sweeping as necessary on improved road surfaces, and the wetting of road surfaces if dust becomes a public nuisance. Noise control will consist of work restrictions during weekends, evening hours, and holidays. Because of the relative remoteness of the sites, these restrictions may only apply to the (public) access roads and areas surrounding the sites.

7.2 Mitigation of Long Term Impacts

One of the advantages of the selected alternative was the minimization of the potential for surface water contamination due to the production of a higher quality effluent. The long-term mitigation practices are discussed in this section.

7.2.1 General Construction

Construction activity in wetlands will be prohibited, this includes the disposal of spoils or driving vehicles within. No construction will be performed on property that contains wetlands. The use of silt fence or straw bales will be used as needed to contain sediment from construction disturbances.

Although it does not appear any construction will take place around wetlands or stream crossings, options to avoid disturbing these areas will be investigated, including directional drilling and bore and jack. There are no identified endangered/threatened species or habitats impacted through this project, though if encountered, appropriate mitigation and construction timing requirements will take effect.

7.2.2 Sitting Decisions

The protection of groundwater and surface water resources in the area will be paramount with this project.

7.2.3 Operational Impacts

The primary operational impact will be noise source from the mechanical treatment, which will be enclosed in buildings to minimize impacts

7.3 Mitigation of Indirect Impacts

7.3.1 Master Plan and Zoning

The Charter Township of Union 2018 Master Plan outlines Agricultural Preservation as a priority and specifies limiting sewer and water extensions to areas designated as such in order to control direct development or displacement of this land. The Master Plan also required vegetated buffers from all wetlands, streams, lakes, and rivers to protect water quality and prevent deterioration. Goal No. 1 of the plan is “Preserve and protect key natural and agricultural resources”. This includes protecting significant, sensitive natural amenities, coordinating utility expansion in a way that encourages development along existing arterial roadways and on vacant or underutilized sites first, and preserve areas suitable for farming and agriculture related uses.

The Township’s building codes, performance standards, specific ordinances, or limitations on certain uses to address increased associated construction nuisances will be appropriately followed.

7.3.2 Ordinances

The Township currently oversees and enforces control of stormwater and NPS pollution where new construction is occurring. This is enforced through Ordinance 90 of 2023.

7.3.3 Staging of Construction

The staging of proposed construction activities will happen in two phases as follows:

- 1 Phase I – Supply / Treatment System Improvements
 - a. Installation of Well 12
 - b. Construction of Isabella Treatment Facility Improvements
- 2 Phase II – Distribution System Improvements
 - a. Mission to Isabella Transmission Main
 - b. Summerton Road Water Main Loop
 - c. Lead Service Investigation / Replacement

Phase I of the project will be bid out as two (2) separate contracts that will consist of all work to be completed at the proposed well site and Isabella Treatment Facility.

Phase II of the project will be bid out as two (2) separate contracts that will consist of all work to be completed on the distribution system. The contractors awarded the project may determine if each project will occur simultaneously, or at different times.

8.0 Public Participation

8.1 Public Meeting

A Public Notice was advertised on May 8th, 2023, for a Township Board Meeting to be held on May 24th, 2023, for discussion and comment on the Notice of intent to apply to Michigan State Revolving Funds Drinking Water Grant Program for the proposed alternatives. This meeting included discussion and presentation on the alternatives provided through this Project Plan.

8.2 Public Meeting Advertisement

The Township held a public meeting related to the DWSRF loan on May 24th, 2023, which was published 15 days prior to the meeting. The advertisement was published in the Morning Sun Newspaper, during this time of advertisement, the project plan was available for review by the community at the Township offices and on the Township website (<http://www.uniontownshipmi.com/>). A copy of the Advertisement and the Affidavit of publication can be found in Appendix.

8.3 Public Meeting Summary

A draft copy of the meeting minutes from the public meeting is provided in the Appendix. The following is noted:

- A PowerPoint Presentation was given, and a copy of the slides is included in the Appendix.
- List of all attendees is note in the meeting minutes however no public was present in person or via zoom.
- No specific concerns were raised during the meeting, only general questions and answers.
- No written comments were received during the public notice period.

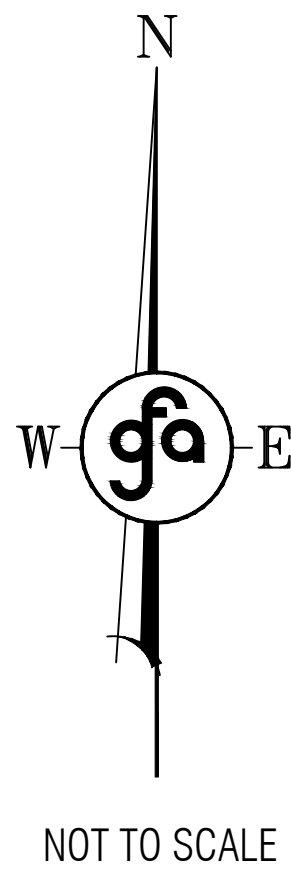
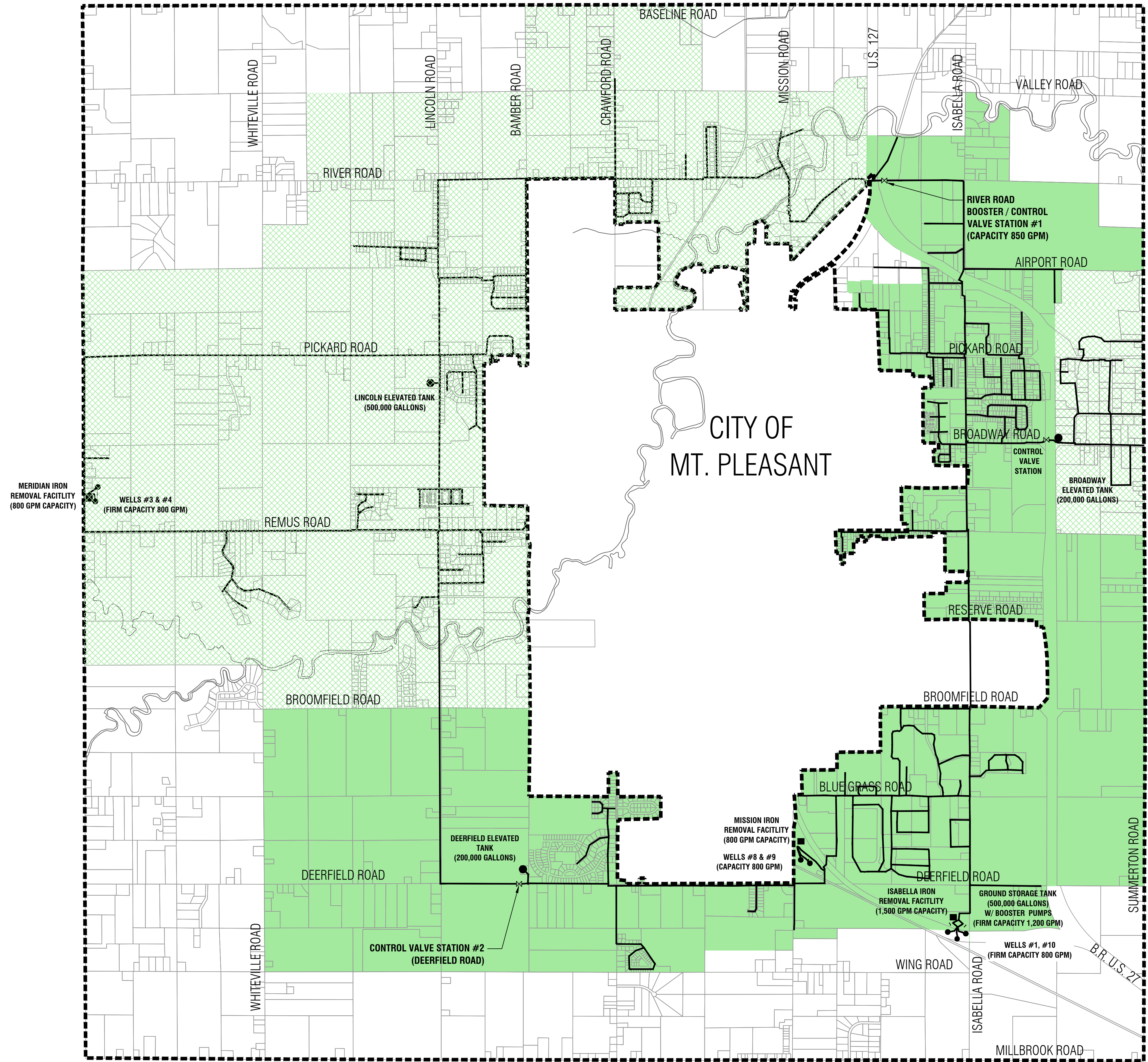
CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX A



Existing Water System Service District (EAST SIDE) Charter Township Of Union, Isabella County



LEGEND

-  UPPER PRESSURE ZONE
-  LOW PRESSURE ZONE
-  UNION TOWNSHIP LIMITS
-  EXISTING WATERMAIN

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

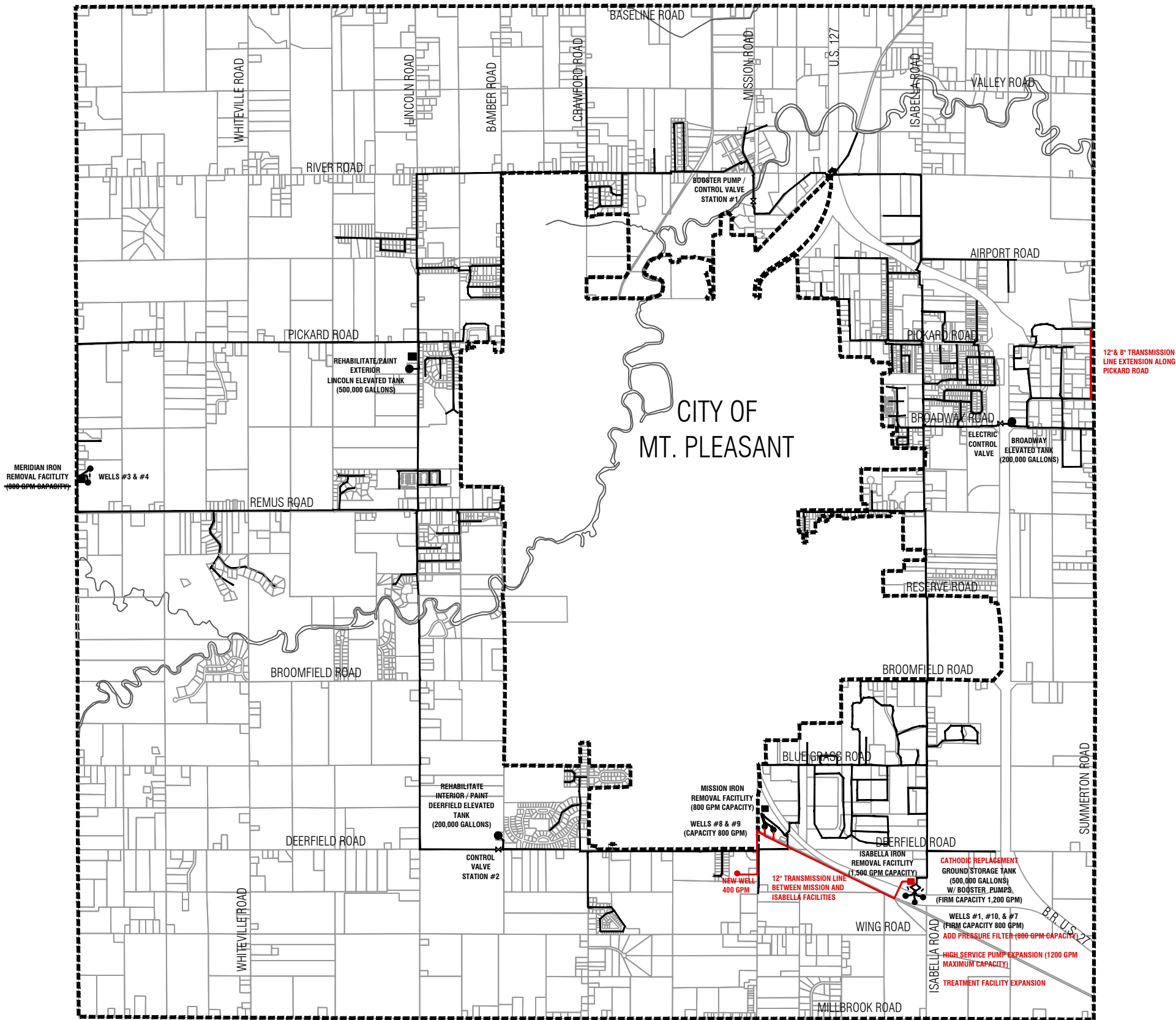
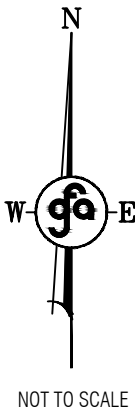
DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX B



Proposed Water System Infrastructure Improvements Map

Charter Township Of Union, Isabella County



- LEGEND**
- UNION TOWNSHIP LIMITS
 - EXISTING WATERMAIN
 - PROPOSED IMPROVEMENTS

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

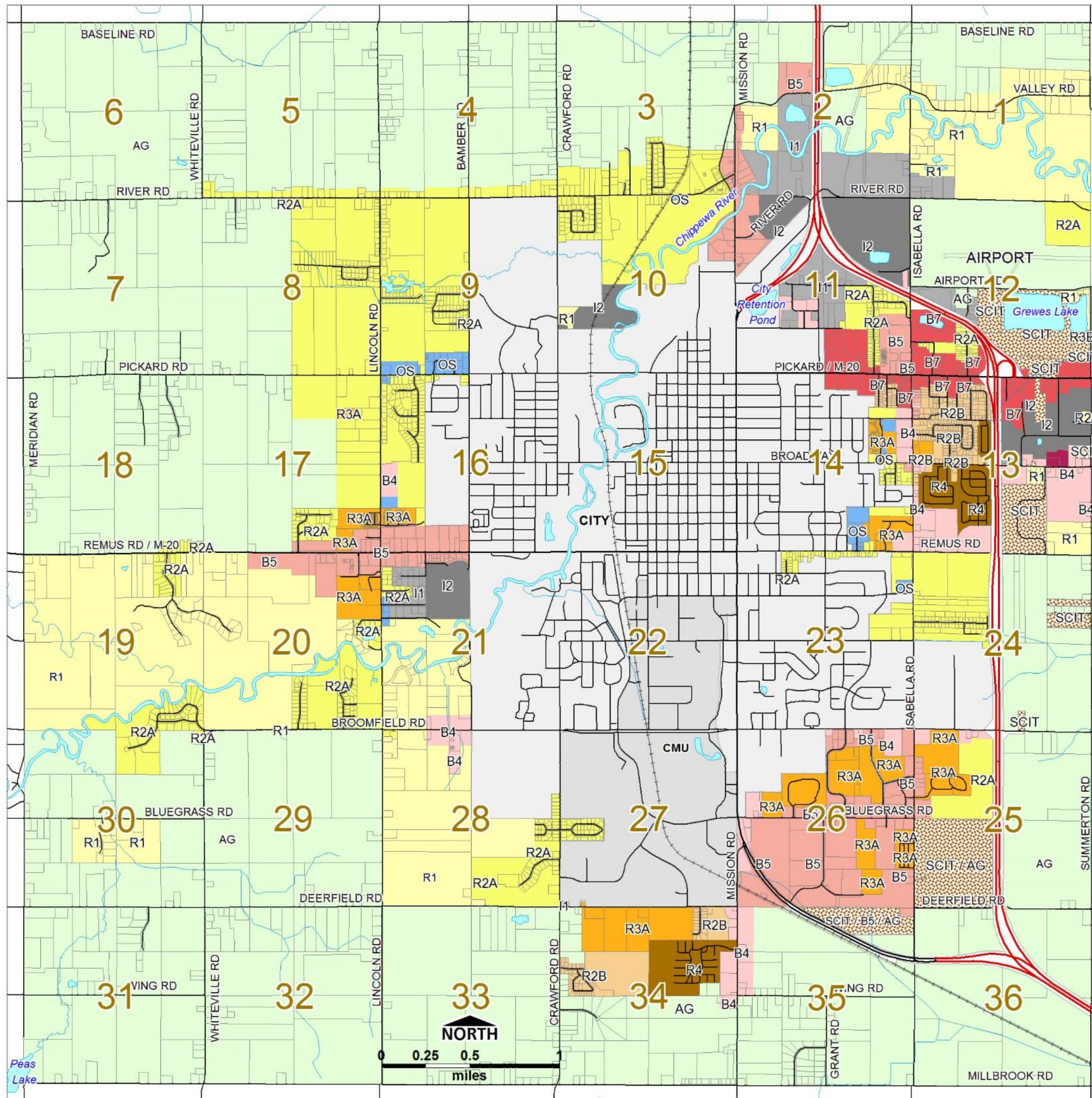
APPENDIX C



Zoning Map of the Charter Township of Union

T14N, R04W
Isabella County, Michigan

With Amendments Through
Ordinance No. 22-04



CHARTER TOWNSHIP OF UNION ZONING MAP - Through Ordinance No. 22-04

- AG, Agricultural District
- R-1, Rural Residential District
- R-2A, One- and Two-Family, Low-Density Residential District
- R-2B, One- and Two-Family, Medium-Density Residential District
- R-3A, Multiple-Family Residential District
- R-3B, Medium-Density Multiple-Family Residential District
- R-4, Mobile Home Park District
- B-4, General Business District
- B-5, Highway Business District
- B-7, Retail and Service Highway Business District
- I-1, Light Industrial District
- I-2, General Industrial District
- OS, Office Service District
- PUD, Planned Unit Development District
- SCIT, Saginaw Chippewa Indian Tribe Trust & Fee Lands
- CITY, City of Mt. Pleasant
- CMU, Central Michigan University

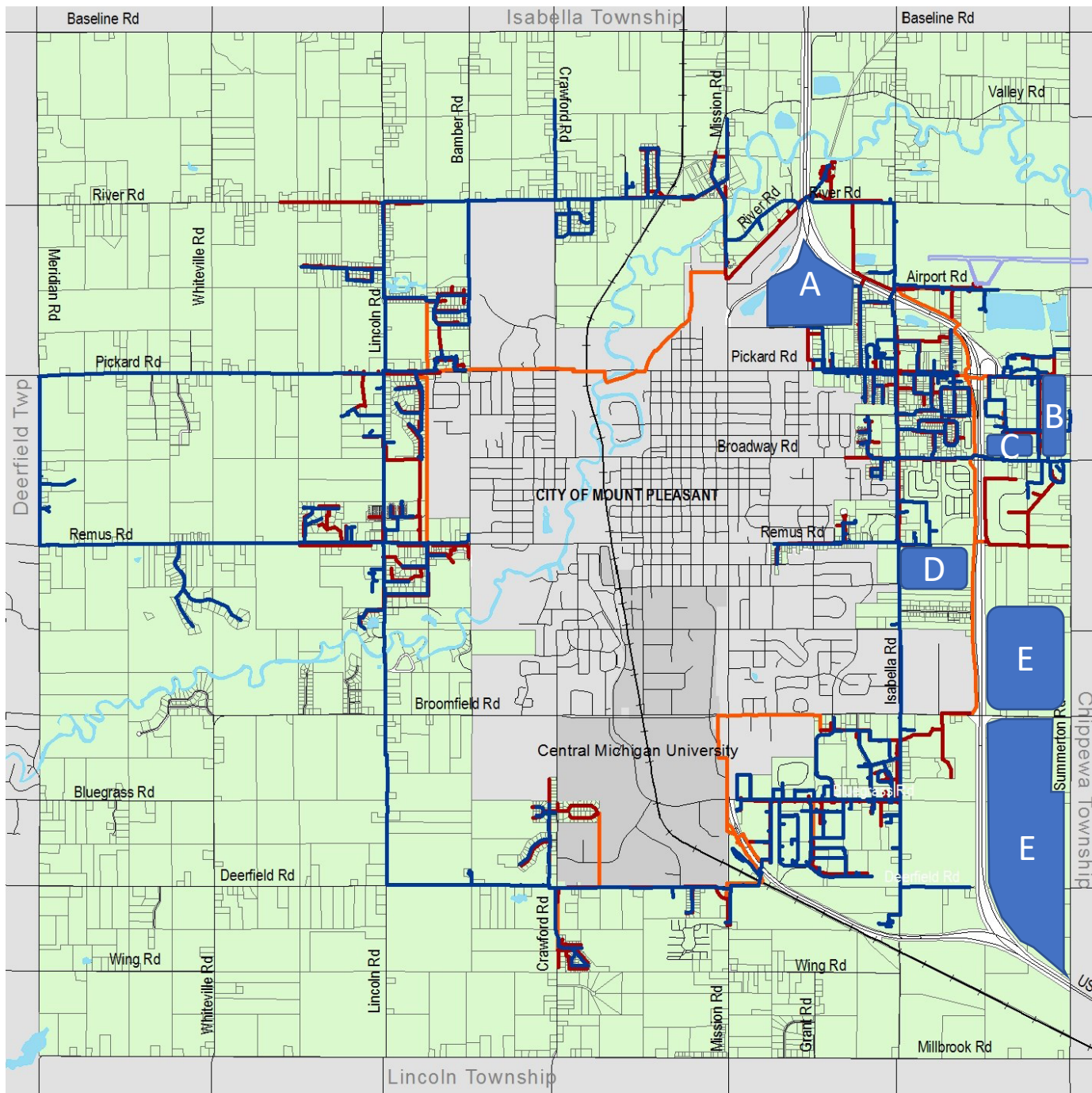
Map Date: September 30, 2022

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX D





AREAS FOR POTENTIAL FUTURE LAND USE CHANGES

A. Corporate Dr.-N. Packard Rd.-E. Airport Rd.

Area is currently zoned I-1 & B-4, with 20 acres along the east side zoned R-2A (1&2 Family Residential, Low Density). Proximity/access to US-127 makes this a good candidate for expanded industrial/business park development. The 20 acres will be evaluated for change to Industrial/Employment in an updated Master Plan.

B. Enterprise Park – S. Summerton Rd. Frontage

Area is current zoned I-2, with a couple of small lots zoned R-2A. Served with public water but needs improved sewer infrastructure to support growth. Proximity/access to US-127 makes this a good candidate for expanded industrial/ business park development.

C. Enterprise Park – E. Broadway Rd. Frontage

Area is current zoned I-2, B-4, and PUD (Prestige Center Assisted Living). 3+ acres of vacant land on east half of the PUD lot would be desirable location for further expansion of Prestige Center senior/elderly housing, but additional sewer capacity is needed to support this use (potential for 160 or so senior apartments).

D. Vacant Land Surrounding the New County Jail

31 acres on SE corner of E. Remus Rd. & S. Isabella Rd. plus vacant land on the County Jail site to the east. Currently planned/zoned residential but the new Jail development makes a change likely. Proximity/access to US-127 makes this a good candidate for expanded industrial/business park development.

E. E. Broomfield Rd. East of US-127

Currently planned Rural Buffer and zoned AG (Agricultural). Water and sewer are relatively close to the site. Proximity to US-127 and potential for new interchange makes this an excellent candidate for a large industrial development – land with these characteristics is far too rare in Michigan.

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX E





GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
BAY CITY DISTRICT OFFICE



LIESL EICHLER CLARK
DIRECTOR

November 5, 2020

Ms. Kim Smith
Union Township
2010 South Lincoln Road
Mt. Pleasant, Michigan 48858

WSSN: 6725
County: Isabella

Dear Ms. Smith:

SUBJECT: Union Township Water System Sanitary Survey (Survey)

This letter confirms the Department of Environment, Great Lakes and Energy's (EGLE's) staff meeting with Ms. Kim Smith and Mr. Shawn McBride, on October 13, 2020, to conduct a Survey of the Union Township Public Water System, (Township) and to present the final findings, discuss areas for improvement, and identify timelines for corrective action where appropriate. The purpose of a Survey is to evaluate the water supply system with respect to the requirements of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399). It is also an opportunity to update EGLE's records, provide technical assistance, and identify potential risks that may adversely affect drinking water quality. Enclosed, is a copy of the Sanitary Survey Report (Report) for your reference.

The following table summarizes EGLE's final findings from the Survey of the water system:

Survey Element	Findings
Source	No Deficiencies/Recommendations
Treatment	Recommendation Made
Distribution System	Recommendation Made
Finished Water Storage	Recommendation Made
Pumps	No Deficiencies/Recommendations
Monitoring & Reporting	Recommendation Made
Management & Operations	No Deficiencies/Recommendations
Operator Compliance	No Deficiencies/Recommendations
Security	Recommendation Made
Financial	No Deficiencies/Recommendations
Other	No Deficiencies/Recommendations

No deficiencies of Act 399 were identified at the time of the Survey. Thank you for your efforts in maintaining compliance with the Township's water system.

Recommendation:

Recommendations are suggestions the public water supply should consider, to enhance its operations and services, and to avoid future deficiencies.

During the Survey, the following recommendations were identified:

1. Treatment:

The chlorine injection points in the treatment plants are located in the upper half of the pipe. This is not recommended because if the fittings on the injection quill leak the chemical runs onto the piping, destroying the paint and leading to corrosion problems inside the treatment plant. The next time work is done inside the treatment plants the chemical injection point should be moved to the lower half of the pipe, preferably in the 4 or 8 o'clock position. This will cause any chemical leaks to run off the injection quill fittings and onto the concrete.

The use of scales would likely improve the tracking of chemical applications and give a more accurate reading than the marks on the side of the day tanks.

2. Distribution:

This office recommends that all water utilities initiate a Valve Exercise Program that requires all valves to be inspected and operated at least once every three years. This would ensure that the water system is able to isolate areas of the water system when necessary for repairs or construction. Properly operating distribution components are essential for providing safe, reliable water to a water system's customers.

The Township should develop written procedures for isolating, repairing, and disinfecting water main breaks.

3. Finished Water Storage:

To avoid potentially expensive repairs, it is recommended that ground storage tank (GST's) are inspected at least every five years. Based on the information that we have; the Isabella Ground Storage Tank hasn't had an inspection since it was constructed in 2010. EGLE recommends having the tank inspected by the end of the year.

The overflow screens on each of the Elevated Storage Tanks (EST) should be replaced with size 24 mesh corrosion resistant screen. The overflows should also have a counter weighted flap valve installed. This is a recommendation based on the updated 2018 edition of the 10-States Standards.

Currently the overflow on the Deerfield Tank is plumbed into the ground and runs out of the side of the hill where the tank is located. The overflow should be reconfigured so that the overflow pipe terminates between 12 and 24 inches above the ground surface, with a 24 mesh screen and a counterweighted flap valve. The overflow should also discharge over an inlet structure or splash pad, to avoid the erosion of the foundation.

The tank certification form (enclosed) needs to be filled out for every elevated and ground storage tank in the system and returned to this office by **December 15, 2020**.

4. Monitoring and Reporting:

Iron concentration measurements should be reported in the Monthly Operations Report. Measurements should include the results taken daily at the plant tap and monthly at the raw water tap.

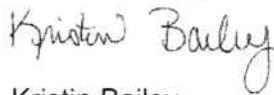
5. Security:

The Township should consider improving security and safety as listed below:

- a. The Lincoln EST should have a fence installed around it.
- b. The Deerfield and Lincoln EST should have an entry alarm to ensure the protection of the drinking water supply.

If you have any questions, please feel free to contact me at the phone number listed below, or by email at BaileyK11@michigan.gov.

Sincerely,



Kristin Bailey
District Engineer
Field Operations Section
Drinking Water and Environmental Health Division
989-280-1291

Enclosure

cc/enc: Mr. Shawn McBride, Union Township Water Superintendent

Sanitary Survey of Community Water Supply - Review Summary

Water Supply: Union Township

County: Isabella

Evaluator: Kristin Bailey

WSSN: 06725

District: 21

Date: 10/13/2020

Category	Comment	N/A	NotEv	NoD/R	Rec	Def	SigDef
Source							
Construction & Maintenance				x			
Standby Power				x			
Isolation				x			
Source Water Protection				x			
Capacity				x			
Treatment							
Disinfection	Chlorine injection points should be adjusted				x		
Fluoride		x			x		
Phosphate Addition				x			
Softening		x					
Iron/Manganese Removal				x			
Arsenic Removal		x					
Pretreatment		x					
Filtration (gravity or membranes)				x			
C*T		x					
Other	Recommend using scales for all chemicals				x		
Distribution System							
Interconnections w/ Other WS				x			
Hydrants & Valves	Valves should be exercised regularly				x		
Service Lines & Metering				x			
General Plan				x			
Cross Connections				x			
Construction & Maintenance	Need SOP for isolating/repairing/disinfect main breaks				x		
Capacity				x			
Finished Water Storage							
Construction & Maintenance	Inspections should be completed every 5 years				x		
Controls	Overflow/Vent screens should be #24 mesh, need cert form				x		
Capacity	Deerfield EST overflow needs to be reconfigured				x		
Pumps (All Pumping Facilities)							
Construction & Maintenance				x			
Controls				x			
Capacity				x			
Monitoring & Reporting							
Bacteriological Monitoring				x			
Chemical Monitoring				x			
MOR or Annual Pumpage Report	Iron Concentration should be reported on MORs				x		
Consumer Confidence Report				x			
Analytical Capabilities				x			
System Management & Operations							
Owner Responsibility				x			
Capacity Development				x			
Reliability Study				x			
Operations Oversight				x			
Permits				x			
Operator Compliance							
Operator Certification				x			
Technical Knowledge & Training				x			
Security							
Emergency Response Plan				x			
Site Security (Fences, Alarms...)	Lincoln EST needs a fence, ALL EST - entry alarms				x		
Financial							
Rates				x			
Budget & Capital Imp. Plan				x			
Other		x					

N/A - Not Applicable

Rec - Recommendations Made

NotEv - Not Evaluated

Def - Deficiencies Identified

NoD/R - No Deficiencies/Recommendations Made

SigDef - Significant Deficiencies Identified

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX F



CHARTER TOWNSHIP OF UNION

Water Reliability Study

November 2022



Engineering • Surveying • Construction
Services • Contract Operations

123 West Front Street Traverse City Michigan

<http://gfa.tc>



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SECTION 1: EXECUTIVE SUMMARY

1.1 INTRODUCTION

Gourdie-Fraser has had the pleasure of providing engineering, surveying, and inspection/material testing and general consulting services to Union Township for decades. From the beginning, we have played a key role in the development of their municipal water system starting with the design, permitting, and inspection of the first wells, treatment plant and distribution piping located on Isabella Road to service users to Pickard Road back in 1986.

Gourdie-Fraser has always looked out for the Township's best interests and is looking forward to assisting them with their future pursuits. With that being said, the emphasis of this report is to assess the current Charter Township of Union infrastructure, and to present any viable capital improvements that will ensure the quantity and quality of water available to meet current and expanded service area needs for the next twenty years.

1.2 WATER SERVICE AREAS

At the end of 2021 there was 6,204 REUs (Residential Equivalent Units) that are serviced by the public water system. The water system is comprised of one (1) primary Service District and functions as two (2) district pressure zones. There is one (1) upper and two (2) lower pressure zones within the district each with their own distinct pressures and are equipped with separate supply, treatment, storage and distribution infrastructure.

Approximately 9,008 total benefits are projected to be served by the Union Township water system in the next 20 years. The benefit projections are based upon historical growth trends and also take into consideration new development anticipated to occur that will require water service. The values are summarized below in Table 1-1.

Table 1-1. Anticipated Benefit Count within the Union Township Water System

	Benefits
East Service District: Upper Pressure Zone	
Current	4,963
1-5 years	496 (additional)
6-10 years	546 (additional)
11-20 years	1,201 (additional)
Total:	7,206
East Service District: Lower Pressure Zone (West Side)	
Current	1,241
1-5 years	124 (additional)
6-10 years	137 (additional)
11-20 years	300 (additional)
Total:	1,802
TOTAL WATER SYSTEM USERS	
Current	6,204
1-5 years	620 (additional)
6-10 years	683 (additional)
11-20 years	1,501 (additional)
TOTAL:	9,008

1.3 WATER SYSTEM DEMANDS AND CAPACITY

Beyond evaluation of the existing system, the future demands for the water service areas were projected to determine potential future deficiencies. Population projections have been used in combination with historical records of benefit counts to determine these demands. The existing and projected demands are outlined in Section 5, Water Consumption and Usage, in this report. In turn, the volume of water required for supply and storage to the existing and projected systems, capable of meeting the existing and projected usage demands, were determined. The supply capacity (firm capacity) requirement for each service district was determined using the maximum daily demands, as required for areas with existing storage facilities. The storage capacity requirement for the entire service district and each pressure zone were determined using peak hour, fire, and emergency demands. The existing and projected storage and supply capacities are outlined in Section 6, Water Supply and Storage Capacities, in this report. The tables below, Table 1-2 and 1-3, provide summaries of the findings in comparison to existing available supply and storage capacities.

Table 1-2. Summary of Existing Storage vs. Required Additional Storage

Service Area	Existing Storage	Existing Required Additional Storage	1- 5 Years Required Additional Storage	6-10 Years Required Additional Storage	11-20 Years Required Additional Storage
	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>
East Side Service District: Upper Pressure Zone and Lower Zone #2	1,200,000 ^{2,3}	(300,577)	(195,302)	79,331	175,535
East Side District: Lower Pressure Zone #1	200,000	0	0	0	0

Table 1-3. Summary of Existing Firm Capacity¹ vs. Required Additional Capacity

Service District	Existing Firm Capacity	Existing Required Additional Firm Capacity	1-5 Years Required Additional Firm Capacity	6-10 Years Required Additional Firm Capacity	11-20 Years Required Additional Firm Capacity
	<u>gpm</u>	<u>gpm</u>	<u>gpm</u>	<u>gpm</u>	<u>gpm</u>
East Side Service District (includes all zones)²					
<i>Source – Wells</i>	1,600	(343)	189	368	761
<i>Treatment</i>	1,500	(367)	288	467	860
<i>Pumped – High Service</i>	2,900 ⁴	(1,643)	(1,111)	(932)	(539)

¹ Based upon evaluation of all the existing supply components, the wells were the limiting restriction (least) and used for basis of comparison to demand

² Assumes Meridian Treatment Facility is offline (backup only) and all water supplies are from Mission/Isabella

³ Installation of River Road High Service Pump overcomes pressure differential and entire Lincoln Tank Volume is included ⁴ Assumes River Road High Service Pump is included in the Pumped Firm Capacity

Review of the summary illustrates that the system has adequate supply and treatment capacity for only the next 5 years and is a priority. With respect to storage capacity, implementation of improvements to increase supply capacity will be needed in the next 10 years and planning for additional storage should begin within the next 5 years. Recommendations and associated cost estimates have been provided in the Appendix to address these deficiencies and are summarized below.

1.4 FIRE FLOWS

Available fire flows were determined for the system with the aid of a computer model using average daily and maximum day demands as input data for the model. The computed fire flows were conducted using adequate values for the particular use type. The model yielded adequate values for 93% of the system with the proposed Capital Improvements to create a single service district. Recommended improvements to address all deficiencies, improve reliability and associated cost estimates have provided in Section 8, Capital Improvements of this report.

1.5 CAPITAL IMPROVEMENTS

The following are capital improvements and recommendations for the respective timelines to be completed. The purposes of the capital improvements are to increase available capacity and reliability to the system. Detailed opinion of probable construction costs and graphical representations can be found in the Appendix of this report.

Table 1-4. Summary of Proposed Improvements & Cost Estimates

PROJECT DESCRIPTION	TIMELINE	COST
<u>Supply</u>		
• Inspection, Testing & Maintenance of Wells	~Initial (0 - 5 Year)	~\$49,700.00
• New Well rate at 800 GPM (increase supply capacity)	~Initial (0 - 5 Year)	~\$1,500,000.00
• Isabella Treatment Site: High Service Pump Expansion (increases pump capacity)	~ Initial (0 - 5 Year)	~\$1,144,440.00
• Well #3 & #4 Replacement	~Long Term (5 - 20 Year)	~\$475,200.00
• Isabella Treatment Facility Expansion	~ Initial (0 - 5 Year)	~\$4,070,000.00
• Inspection, Testing & Maintenance of Wells	~Long Term (5 - 20 Year)	~\$49,700.00
<u>Storage</u>		
• Routine Tank Inspection (all 4)	~Initial (0 - 5 Year)	~\$22,000.00
• Isabella Ground Tank: Replacement of Protective Cathode	~Initial (0 - 5 Year)	~\$33,000.00
• Routine Tank Inspection	~Long Term (5 - 20 Year)	~\$22,000.00
• Isabella Treatment Site: 500,000 gallon ground storage tank	~Long Term (5 - 20 Year)	~\$2,195,000.00
<u>Distribution</u>		
• Routine Calibration of Master Meters / Control Valves	~Initial (0 - 5 Year)	~\$20,000.00
• Lead & Copper Service Line Replacement / Hydrant Replacement	~Initial (0 - 5 Year)	~\$1,287,000.00
• Isabella / Mission Road Treatment Facility: Transmission Main for Reliability & Redundancy	~Initial (0 - 5 Year)	~\$1,239,900.00
• Pickard Road Transmission Main Extension	~Initial (0 - 5 Year)	~\$717,130.00
• Routine Calibration of Master Meters / Control Valves	~Long Term (5 - 20 Year)	~\$20,000.00

SECTION 2.0: INTRODUCTION

2.1 PURPOSE

The Charter Township of Union, Isabella County, Michigan has retained their consulting engineers to conduct a Water System Reliability Study in accordance with the current requirements set forth by the Michigan Safe Drinking Water Act (SDWA) under Part 399 including 2010 Amendments to Rule 1203 and Rule 1601-1606 as they pertain to Water Reliability Studies. The intent of the study is to assist the Township with planning in order to continue to provide exceptional quality and quantity of safe drinking water to its existing and future users.

The Water System Reliability Study will present information that reflects the capacity and performance of the existing water system and determination of present and projected water demands. This study will also address possible deficiencies in the system and provide recommendations to the Township to improve the reliability of their water system. The following specific items are provided:

Reliability Study

Population and residential equivalent unit (REU) count for existing and projected 5, 10 and 20 year:

- Water production and consumption data and trend analysis for existing and 5-, 10- and 20-year projections including:
 - Monthly and annual production totals for water purchased
 - Monthly and annual pumpage totals for water supplied to all service districts
 - Annual usage totals for each REU in all service districts
- An evaluation of the current water system operations for existing, and 5-, 10- and 20-year projected deficiencies

General Plan

Existing

- An existing inventory of infrastructure by size, capacity, material, and age
- Service area boundary maps
- Hydraulic analysis of the distribution system showing pressure & fire flow contours under Maximum Daily Demand

Future

- Service area boundary maps for existing and future
- Comprehensive Capital Improvements Plan (CIP) to ensure a more sustainable water system and associated cost estimates for 5- and 20-year planning
 - Includes associated cost estimates for materials, construction, and engineering services
 - Hydraulic analysis of the distribution system showing pressure & fire flow contours under Maximum Daily Demand

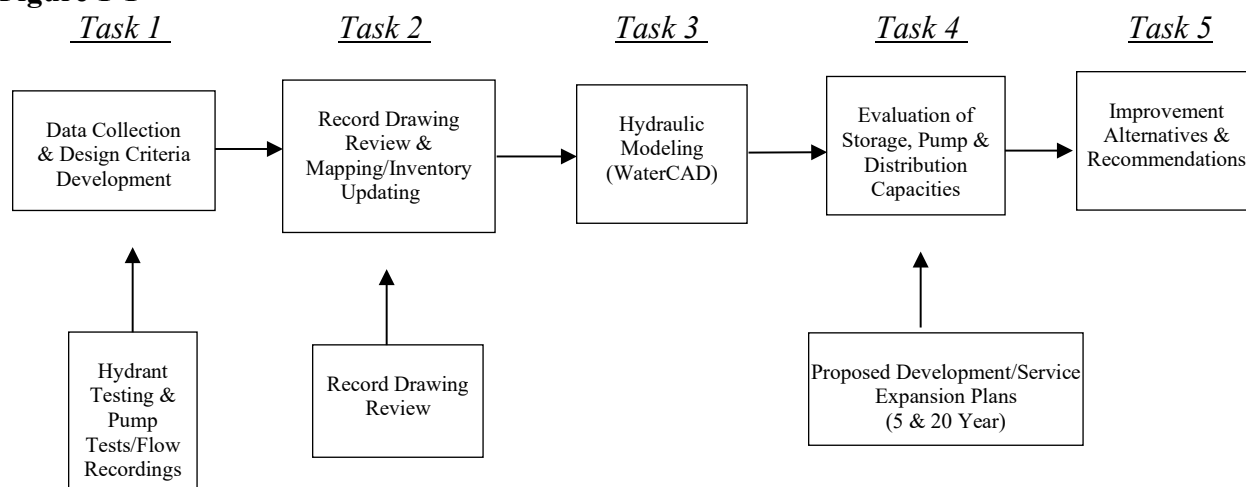
2.2 OBJECTIVE AND SCOPE

The objectives for this water study are threefold:

- Development of design criteria: The Township is ready to grow in accordance with their Comprehensive Land Use Plan and Zoning Ordinances. In order for the staff to guide new development, they will need a solid understanding of how the existing system operates and if it can accommodate this growth.
- Continued Water System Hydraulic Model updates: A “live” system model is an important tool for assuring planned improvements have the desired effect and that new development won't have unintended consequences.
- Continued CIP updates: In a growing community a carefully prioritized CIP helps ensure that infrastructure is in place before new demands create additional stress.

To achieve these objectives, the scope of work is defined by the following tasks as shown below in Figure 1-1. The tasks are discussed in the subsequent sections of this report.

Figure 1-1



2.3 REGULATIONS

The Charter Township of Union as an owner and operator of municipal water system must adhere to the requirements set forth by the Michigan Safe Drinking Water Act (SDWA) under Part 399 which are enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE). To comply the Township is required to regularly monitor, sample, and report to the State on essential items, including:

- Water Reliability Studies: Required under the Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE), specifically amendments to Rules 1203 and 1601-1606, Water Reliability Studies and General Plans are to be completed every 5 years.
 - Status: Completed November 2022.

- Asset Management Studies: Required under the Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE). Required for communities that service populations over 1,000 people.
 - Status: Completed May 2019
- Emergency Response Plan: Required under the Michigan Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE), specifically amendments to Rules 1203 and 1601-1606
 - Status: Completed January 2020
- Risk & Resilience Plan / Emergency Response Plan: Required America's Water Infrastructure Act (AWIA) Section 2013 as enforced by the Environmental Protection Agency (EPA).
 - Status: Completed December 2021
- Lead and Copper Inventory: Implemented by the State of Michigan in June 2018. Rule elements include:
 - Completion of a Distribution System Material Inventory (DSMI) and submitted to EGLE by Township

2.4 PREVIOUS STUDIES

Gourdie-Fraser has historically prepared the Townships' Water Reliability Studies every 5 years as mandated by the Safe Drinking Water Act (SDWA) with the most recent submitted in September 2017.

The 2017 Reliability Study was performed to specifically evaluate the needs of Union Township as it pertained to their infrastructure's ability to meet existing and projected deficiencies relevant to the projected growth anticipated during that time. As part of this Water Reliability Study, the improvement projects recommended in the prior report was reviewed for implementation status and/or applicability to meet the now current and projected needs determined as presented in this report; refer to Section 3 for a summary.

In November 2021 the Township with the assistance of Gourdie Fraser completed a Type I Well Feasibility Study to research and evaluate potential future locations for a water supply source to meet the growing demands of the Township. The report identified viable locations, assessments of each location, cost estimates and next steps for consideration.

SECTION 3: DEMOGRAPHICS

In this report, we will highlight directions for water system expansion and improved reliability. A description of the existing and proposed expansions to the water service areas are described below and represented graphically on the Existing and Proposed Water Service District Maps located in the Appendix.

3.1 EXISTING WATER SERVICE AREAS

The Charter Township of Union is located within Isabella County, encompassing land around the City of Mount Pleasant. It is bounded on the north by Isabella Township, on the west by Deerfield Township, on the east by Chippewa Township and on the south by Lincoln Township.

The Charter Township of Union water distribution system construction began in the late 1980's initiated by the need for reliable potable water for domestic use. Growth in population and construction in select commercial and residential locations generated the need to expand the system through the years. Historically, the Charter Township of Union has been segregated into three (3) independent water districts. In 2010 the water system was reorganized and interconnected.

Presently the entire distribution system operates as one (1) primary centralized Service District named as follows for purposes of this report: The East Side District. It provides domestic and fire flows to a total of 6,204 benefits. The East Side District contains two (2) secondary lower pressure zones referred to as (#1) the Broadway zone and (#2) West Side Zone. The limits of have been defined by the pressure limitations of their primary infrastructure that supplies the users and is as follows:

- East Side: 45- 93 psi operating range
 - ◆ Lower Pressure Zone #1 (Broadway): 50 - 60 psi
 - ◆ Lower Pressure Zone #2 (West): 53 - 62 psi

The Broadway Zone was created in 2009 whereas the initiation of the West Zone occurred in 2013 with the installation of the Lincoln Road Loop and two (2) control valve stations. A pressure zone is defined as an area when under static conditions would have a common hydraulic grade line (pressure). This will be discussed in further detail in subsequent sections.

The municipal water utilities are operated by Township staff, the Department of Public Works (DPW), providing quality water to the residents, businesses, and industries within the limits of the Township. A description of the existing Service District is described below, and their corresponding service limits illustrated on the Existing Water Service District Boundary Map located in the appendices.

East Side Service District

Description

The East Side Service District was originally constructed in 1986 to serve the residential and commercial areas along Isabella Road. Over the past 30 years the district has aggressively grown and expanded and now provides the water supply (source, treated and pumped) to the entire system.

The East Side Service District receives its supply from the Isabella Road and Mission Road Treatment Facilities which in combination includes five (5) groundwater wells (No. 11, 10, 7, 8, and 9) with a total rated firm capacity of 1,600 gpm (2.304 MGD). Treatment for iron is performed prior to distribution through the use of continuous regenerating (CR) pressure filtration methods with a capacity of 2,700 gpm (3.89 MGD). A combination of pumped storage and gravity storage tanks equating to 950,000 gallons maintains the system pressures and provides the domestic and fire flow demands for all the users in the district.

Although a single district, operationally the East Side and currently functions as two (2) distinct pressure zones. The primary upper pressure zone operates gravity as dictated by a 200,000-gallon elevated Storage Tank (Deerfield Tank), which is located along Deerfield Road east of Lincoln Road and pumped storage as dictated by the 1,200 gpm firm capacity rated high service pumps that receive water from a 500,000-gallon ground storage tank (Isabella Tank), located at the Isabella Road Treatment Facility. The first lower pressure zone operates gravity as dictated by a 200,000-gallon elevated Storage Tank (Broadway Tank), which is located at the intersection of Broadway and US-27. The second lower pressure zone operates gravity as dictated by a 500,000-gallon elevated Storage Tank (Lincoln Tank), which is located south of the intersection of Pickard and Lincoln. The descriptions of each zone are provided below:

Upper Pressure Zone

The upper pressure zone services the majority of users encompassing 13.0 square miles within the district and provides the supply to the two (2) lower pressure zones. It is dominated by commercial and tall apartment complexes (student housing); therefore, this zone experiences a need for optimum operating pressures and large volumes of seasonal water use, driven by Central Michigan University. The available operating pressures of the high service pumps at the Isabella Road Treatment Facility in combination with the Deerfield Road elevated storage tank are able to accommodate this unique service area. The general topography of the area consists of elevations that range from 850 (USGS) to 750 (USGS).

Lower Pressure Zone (#1- Broadway)

The lower pressure zone services approximately 10% of the REUs in comparison to the upper pressure zone with its boundaries extending northwest of the lower pressure zone. This zone was created to accommodate the limitations of the Broadway Tank (shorter tank/lower pressures) yet utilize the benefits of onsite storage. The majority of the water users in the vicinity are medical facilities and the hospital which can consume significant amounts of water and/or have a significant need for emergency storage, therefore a small

service area was created through the use of an electric control valve to dedicate the storage volume to these users.

Lower Pressure Zone (#2- West Side)

Originally built in 1988, the Lower Pressure Zone #2 originally functioned as a stand-alone service district (West Side Service District) until 2013. The West Side is equipped with a Meridian Road Treatment facility which is comprised of two (2) groundwater wells (No. 3 and No. 4) with a rated capacity of 400 gpm (0.576 MGD). Treatment for iron is performed prior to distribution through the use of a continuous regenerating (CR) pressure filtration method with a capacity of 800 gpm (1.15 MGD). Both wells and treatment currently are utilized on an as needed basis to supplement the system during peak demand and/or emergency. The supply and treatment equipment are located at a common site known as the Meridian Road Treatment Facility which is located north of Remus Road along Meridian Road. A 500,000-gallon elevated water storage tank (Lincoln Storage Tank) located off of Lincoln Road just south of Pickard Road maintains the system pressures and provides storage volume to the users in the entire district.

As presented in the 2017 Water Reliability Study, the benefit was recognized to modify the system operations to meet the demands of the growing west side. Improvements to the system including installation of a watermain loop and control valves allowed the use of the East Side infrastructure to meet the demands of the entire system. The final phase of the project, the installation of a high service pump at the River Road Control building is permitted and scheduled to be completed in 2023 and will allow the east side to send water to the west side and vice versa once completed. The West Side supply and treatment infrastructure will be available to supplement the upper pressure zone as needed without restriction.

The Upper Pressure Zone #2 is the second largest encompassing approximately 10.5 square miles of land area within the Township. The general topography of the area consists of elevations that range from approximately 850 (USGS) to 750 (USGS). It is predominantly residential with some mixed commercial users and account for approximately 20% of the total REUS in the system (1,241). There is a large demand by both the residential and commercial users in this district as will be demonstrated in future sections of this report, specifically large volumes of water usage for private irrigation.

3.2 CAPITOL IMPROVEMENT PLAN (CIP) SUMMARY & UPDATE

From the time the 2017 Water Reliability Study was conducted, some improvements have occurred which included infrastructure upgrades and service area expansion.

Table 3-1. Updated Capital Improvements Plan

Project Description	Project Impact	Project Complete	Date
➤ Inspection, Testing & Maintenance of Wells	Maintenance and Reliability	Yes	2022
➤ River Road Control Valve Station – Booster Pump Installation	Increase reliability and transfer water from west to east without restriction	Currently in progress	Spring 2023
➤ Routine Tank Inspection (all 4)	Maintenance and Reliability	Yes	2021
➤ Isabella Ground Tank: Replacement of Protective Cathode	Maintenance and Reliability	No	
➤ Install new well and transmission main to Isabella Treatment Plant	Reliability, Redundancy and increase treatment and pump firm capacity	No*	
➤ Isabella Treatment Building Expansion: Filter and HS pump room	Reliability, Redundancy and increase treatment and pump firm capacity	No*	
➤ Calibration of Master Meters / Control Valves	Maintenance and Reliability	No	
➤ Deerfield Elevated Tank: Cleaning and painting	Maintenance and Reliability	Yes	2017
➤ Broadway Elevated Tank: Cleaning and Painting	Maintenance and Reliability	Yes	2021

*Feasibility study completed. Project funding being pursued.

3.3 PROJECTED WATER SERVICE AREAS

The anticipated potential growth within the system for the 5-to-20-year planning period will occur within the boundaries of the Township limits and have been designated as follows:

- Initial and Short Term (1 to 5 Year)
- Long Term Service Area (6 to 20 Year)

Based upon the discussions with Township staff there are no new sizeable developments in approval process and/or conceptual known at this time or in the near future. Projections applied during the 1 to 5 year timeframe are designed to include new developments and/or existing developments that have already begun their occupancy and slowly grown over the last several years. Therefore, the rate of growth for this time frame will include historical growth trends only due to lack of proposed developments. Projections applied during the 6 to 20 years are anticipated to be consistent with the historical REU growth trends and will be applied to service area respectively.

Existing & Future Service Areas:

The existing service district boundaries are designated by the limitations of the existing water main infrastructure that service those users. Expansions beyond these areas which represent the future service district are designated by the limitations of the Township boundaries with corresponding infrastructure expansions; refer to the Appendix for these maps.

There is a lot of uncertainty with performing growth projections for future developments beyond the available historical system user growth trends as maintained by the DPW billing department (Section 3.5) and census data (Section 3.4). This information was discussed with the Township, and it was their recommendation that the REU growth for Union Township shall be at a rate consistent to known historical trends and to be used as the core basis of design for this report in projecting the 5 to 20 year demands.

Boundary Expansion:

Although this report places emphasis on expansion of the water system within the confines of the Township boundaries to service users who specifically reside within Union Township, it should be mentioned there is always potential and capability to service communities contiguous to the Township limits which may include portions of Isabella, Chippewa, Lincoln, Deerfield Townships or even the City of Mount Pleasant. This may provide an additional revenue source for the Township, or another means of reliability in the event of an emergency. This will require future discussions with the appropriate political entities and may be under consideration for the future.

3.3 POPULATION PROJECTIONS

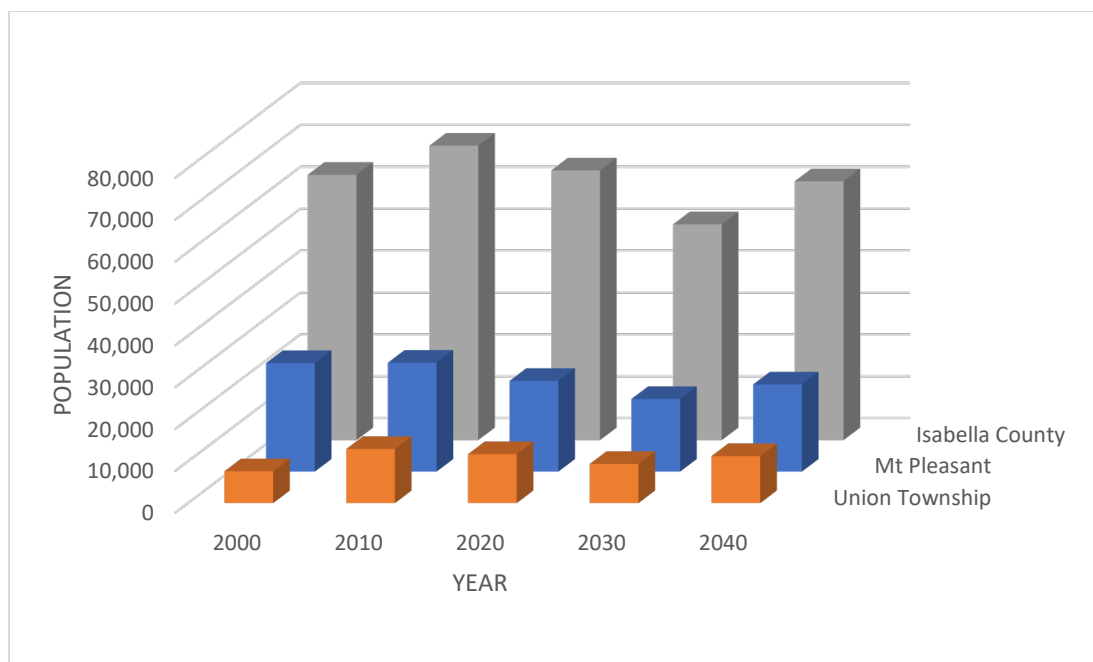
To assist in estimating the future water service needs for the Charter Township of Union, it is helpful to use population projections as a tool in evaluating initial intermediate and long-term water demands. The following table shows projections for the City of Mt. Pleasant, Union Township, and Isabella County.

Table 3-1. Population Trends and Projections

Service Location	2000	2010	2020	2030 ¹	2040 ¹
City of Mt. Pleasant	25,946	26,016	21,688	17,350	20,820
Annual Rate of Growth, %	1.14%	0.027%	-16.63%	-2.00%	2.00%
Union Township	7,615	12,927	11,699	9,359	11,231
Annual Rate of Growth, %	4.8%	6.98%	-9.49%	-2.00%	2.00%
Isabella County	63,351	70,311	64,394	51,515	61,818
Annual Rate of Growth, %	1.6%	1.1%	-8.41%	-2.00%	2.00%

Sources: U.S. Census Bureau

¹estimated figures



The above populations trends (Figure 3-1) detail continued and consistent growth within Union Township, with an average annual increase of 2.3% over the last 20 years. From 2000 to 2010 population increased by an annual rate of 6.98% a substantial decline at an annual rate of -9.49% from 2010 to 2020. Comparatively, Isabella County and the City of Mt. Pleasant have experienced an annual decline of around -8.4% to -16.6% in 2020. From 2010 to 2020 the population within the City of Mount Pleasant and Union Township has decreased significantly projections illustrating this trend to continue. Though data shows a decline in population of the area, for purposes of predicting water usage for the future, a growth rate of -2.0% and then 2.0% every 10 years was assumed as a means to be conservative.

3.4 BENEFIT COUNT PROJECTIONS

The following data represents more detailed information presenting the typical growth trends of actual water customers. The REU values were received from the Union Township Department of Public Works (DPW) spreadsheets from their permitting and billings department and are presented in the Table and Figure below.

Table 3-3. Typical Historical REU Count Trends

	2017	2018	2019	2020	2021
Total No. of REUs	5,702	6,497	6,320	6,353	6,204
Commercial	1,456	1,586	1,536	1,571	1,545
% Annual Increase		8.9%	-3.15%	2.28%	-1.65%
Residential	4,246	4,911	4,784	4,782	4,659
% Annual Increase		15.6%	-2.59%	-0.04%	-2.57%
Total REU Increase		795	-177	33	-149
Total % Annual Increase		13.9%	-2.72%	0.52%	-2.35%

Figure 3-2 Historical REU Count Trends

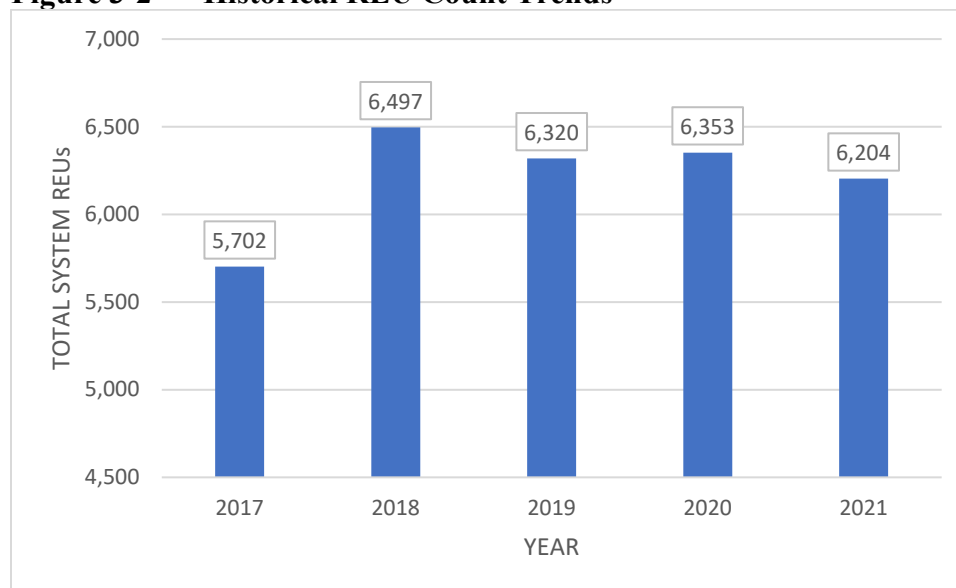


Table 3-3 and Figure 3-2 illustrates that Union Township has experienced some negative water system growth over the past 5 years that equates to an average of 2.33% increase annually. The decline in water system users between 2020 and 2021 is predominantly due to the COVID -19 global pandemic that mandated businesses close (including Central Michigan University) thus suspending in person attendance and subsequently many residents left the area and/or worked remotely. All data provided through REU analysis show that the growth decline in the most recent years correlates directly with the pandemic. Future anticipations are optimistic with new development presenting opportunities for growth which correlates with a need for water service.

A portion of these projected growth trends accounts for the availability of public water service to existing development and/or parcels in addition to the new development growth. There is currently no planned large scale developmental growth for the area, though it is expected that with the improving economy since the pandemic has tempered, the area will see growth patterns begin to increase again. With respect to time, undeveloped parcels will experience increased growth in direct proportion to the public water service that fronts them, i.e. the longer public water service is made available, the greater the potential for growth and consequently water usage.

While it is difficult to predict the future, it is certain there will be extended growth throughout. The following data in Table 3-4 represents more detailed information presenting actual REU counts within each service district for the current year and applying the average historical growth rate of 2.0% to account for 5-, 10- and 20-year growth.

Table 3-4. REU Count Projections

Service District	2021	2026 ¹	2031 ¹	2041 ¹
Upper Pressure Zone*				
No. of Benefits	4,963	5,459	6,005	7,206
Benefit Increase	N/A	496	546	1,201
% Annual Increase	N/A	2.0%	2.0%	2.0%
Lower Pressure Zone #2				
No. of Benefits	1,241	1,365	1,502	1,802
Benefit Increase	N/A	124	137	300
% Annual Increase	N/A	2.0%	2.0%	2.0%
TOTAL BENEFITS	6,204	6,824	7,507	9,008

¹estimated figures

*Includes the Lower Pressure Zone #1 (Broadway)

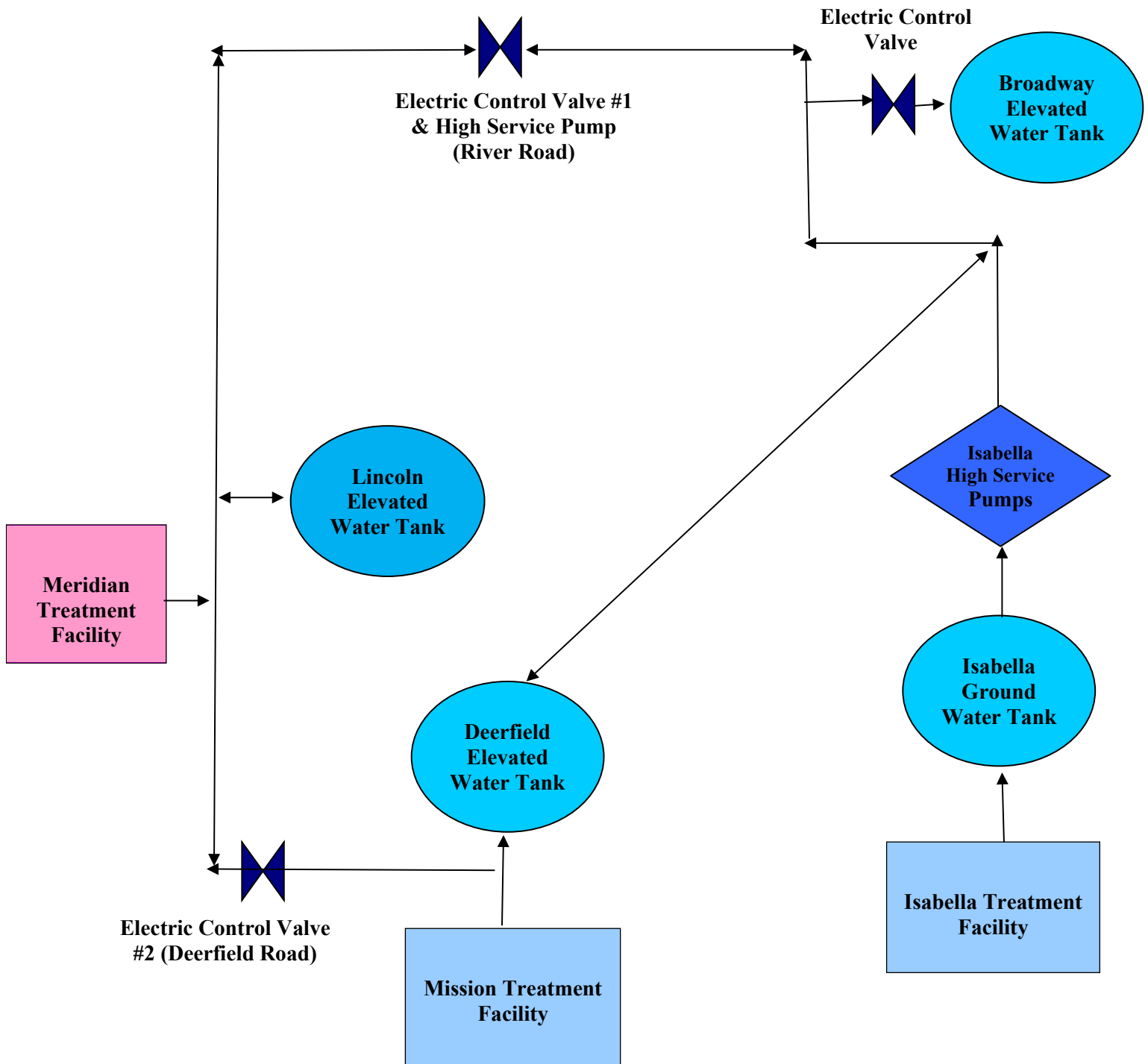
SECTION 4: WATER SUPPLY, TREATMENT, AND STORAGE FACILITIES

4.0 GENERAL

The Charter Township of Union water system construction began in the late 1980's and has expanded through the years with the growth in population. The sole water source is supplied by three (3) Treatment Facilities comprised of onsite Type I ground water wells (total of seven (7) wells), iron/manganese filtration and booster pumps to distribute water to the users.

Storage is provided by gravity as well as through pumping, including three (3) elevated tanks and one (1) ground tank with booster pumps to supply water and maintain system pressures for the users. This distribution infrastructure includes approximately 74 miles of piping. Details of each component are provided below in the respective subsections. A map illustrating the existing water system is provided in the appendices. The figure below shows a generalized representation of where the water is received from and where it is distributed to for the entire Union Township Water System:

Figure 4-1. Summary of Water Supply & Distribution



4.1 EXISTING WATER SUPPLY AND TREATMENT

The Charter Township of Union provides the treatment and supply of water for the water customers through the use of three (3) treatment facilities located throughout the Township. Each facility has onsite Type I water wells with each treated by continuous regeneration (pressure) filtration or a combination thereof. In addition, chemicals are added at each facility including Phosphate to maintain water quality and Sodium Hypochlorite (NaCl) for disinfection, to maintain chlorine residual levels, and to assist with iron/manganese oxidation throughout the Service District and each pressure zone in the distribution system.

Water Treatment, although not a requirement, is utilized to remove iron and manganese naturally occurring in the groundwater. Filtration is the preferred cost-effective method and entails filters, comprised of media, typically anthracite or combination to capture the suspended solids. Initially aeration and/or chemicals are introduced to supplement and oxidize the iron and manganese to assist with the removal process. Over time, backwashing is required to clean the media and restore the normal filtration rate. The existing types of treatment are described below.

- *Continuous Regeneration (Pressure) Filtration* – Pressure filters are typically used to allow high-rate operation and eliminate the need for re-pumping of filtered water.

The following tables summarize the water supply and treatment characteristics for the System.

Table 4-1. Union Township Water Well Characteristics

	East Side Service District						
	West Side Lower Pressure Zone		Upper Pressure Zone				
Location	Meridian Treatment Facility		Isabella Treatment Facility			Mission Treatment Facility	
Well I.D	Well No. 3	Well No. 4	Well No. 11*	Well No. 10*	Well No. 7	Well No. 8*	Well No. 9*
Year Drilled	1988	1987	2019	2014	2008	2011	2011
Year Upgraded	2012 / 2016 / 2020 / 2022	2016 / 2020 / 2021	N/A	N/A	2016	N/A	N/A
Upgrade Type	Cleaned, Televised, Pump & Motor Replacement	Cleaned, Televised, Pump & Motor Replacement	N/A	N/A	Cleaned, Televised Pump & Motor Replacement	N/A	N/A
Casing Diameter	12"	12"	12"	12"	12"	12"	12"
Depth	160'	125'	97'-0"	77'-9"	86'	71'	89'
Motor Depth	109'	85.6'	70'	49'	60'	60'	78.5'
Static Water Level (SWL)	23'	26.3'	8.2'	14'	16'-9"	4'	5'
Pump Motor	30 Hp	40 Hp	15 Hp	15 Hp	40 Hp	40 Hp	40 Hp
Permitted Capacity	380 gpm	380 gpm	396 gpm	400 gpm	700 gpm	400 gpm	400 gpm
Actual Capacity**	418 gpm	428 gpm	396 gpm	409 gpm	798 gpm	433 gpm	427 gpm
Aquifer Restriction	One (1) Well in operation at a time		1,100 GPM (Able to run only 2 wells at a time)			None	

*Well No. 8 & No. 9 Replacements for abandoned wells No. 5 and No. 6 respectively.

*Well No. 10 Replacement for abandoned well No. 2.

*Well No. 11 Replacement for abandoned well No. 1.

** Based upon recent testing completed in 2019

Table 4-2. Union Township Treatment Facility Characteristics

	East Side Service District					
	West Side Lower Pressure Zone		Upper Pressure Zone			
	Meridian Treatment Facility		Isabella Treatment Facility		Mission Treatment Facility	
Year Built	1988		1987		1987	
Year Upgraded	2005		2011		2006	
Type of Treatment	Fe Removal	Disinfection	Fe Removal	Disinfection	Fe Removal	Disinfection
Primary Method of Treatment	Continuous Regeneration (Pressure) Filtration	12.5% NaCl (liquid)	Filtration 2- Pressure	0.9% NaCl (Onsite generation system)	Filtration 1- Pressure	12.5% NaCl (liquid)
Supplemental Treatment Method	None		Aeration & PO ₄ addition to assist with inorganic removal		Aeration & PO ₄ addition to assist with inorganic removal	
Number of Units	2		2-Pressure w/2 cells each		2	
Supply From	Well No. 3 & No. 4 (Dedicated bypass)		Wells No. 11, 10 & No. 7 (Dedicated bypass)		Well No. 8 & No. 9 (Dedicated bypass)	
Treatment Capacity	800 gpm (Total) 400 gpm (per Unit)		1,500 gpm (Total) 375 gpm (per Cell)		400 gpm (Total) 400 gpm (per Unit)	
Backup Power Supply	Onsite Generator		Onsite Generator		Onsite Generator	

Union Township receives its water supply from the three (3) treatment facilities described above. Due to operational constraints of the treatment process, some of these facilities do not have the capability to provide the adequate pressures to distribute to the system. Additional infrastructure is needed to provide these pressures; therefore, service pumps are used. The operating pressures for the Service District and each respective pressure zone are dictated by the well / booster pumps in conjunction with gravity (ground or elevated) storage. Pressure zones are established when the primary infrastructure supplying the water cannot provide the adequate range of pressures between 35 to 90 psi to the user. An upper pressure zone is created when it is required to pump water in order to serve higher elevations and achieve pressures greater than 35 psi. Similarly, a lower pressure zone is created through valves and controls to serve lower elevations and achieve pressures less than 90 psi. The table below summarizes this infrastructure and their respective characteristics. Refer to the illustrations in the Appendix for details on the specific treatment processes for each treatment facility location.

Table 4-3. Summary of Booster Pump Characteristics

	East Side Service District				
	West Side Lower Pressure Zone	Upper Pressure Zone			
Location	Meridian Treatment Facility	Mission Treatment Facility	Isabella Treatment Facility		River Road Control Building
Supply From	Pressure Filters	Pressure Filter	Pressure Filter	Ground Storage Tank	East side
Supply To	Lincoln Tower/System	Deerfield Tower/Broadway Tower/System			West side
Year Built	N/A Wells/Pressure Filter provide adequate pressures to system users	N/A Wells/ Pressure Filter provide adequate pressures to system users	N/A Wells/ Pressure Filter provide adequate pressures to system users	2010	2023 (under construction)
Year Upgraded				N/A	N/A
No. Pumps				3 (total) 2-High Service 1-Fire Pump	1
Hp Rating				100/250	75
Pump Capacity (EA)				2-600 gpm (Ea) 1-1,500 gpm	850 gpm
Pump TDH (EA)				290'/340'	190'
Firm Capacity				1,250 gpm	N/A

4.2 EXISTING WATER DISTRIBUTION SYSTEM

The table below summarizes the water main characteristics for each Service District. The majority of system piping is composed of PVC (C900) ranging in size from 4-inch to 16-inch. The two most common sizes of distribution piping within the system are 8-inch and 12-inch, installed as development dictated requiring associated water main extensions. A more detailed piping inventory of the existing system is provided in the appendices.

Table 4-4. Existing Distribution System Characteristics

Length	Size	Material
22,347 LF	4-inch	C900 PVC/Ductile Iron
32,500 LF	6-inch	C900 PVC/HDPE DR11
178,568 LF	8-inch	C900 PVC/HDPE DR11
2,702 LF	10-inch	C900 PVC
152,419 LF	12-inch	C900 PVC
850 LF	16-inch	C900 PVC

4.3 EXISTING WATER STORAGE

Water Storage is a requirement for all systems that service more than 150 units to meet peak hour, fire suppression, and emergency demands. This storage is typically provided by one of the following two methods:

- *Gravity Storage* – Elevated or ground-based tank in which the hydraulic grade line is controlled by gravity.
- *Pumped Storage* – Booster pumps control the hydraulic grade line and receive water from a ground storage tank (suction side)

Traditionally for Union Township, all the existing storage facilities provide gravity storage to all their users, with the exception of the ground storage tank located at the Isabella Treatment Facility. This particular pumped storage operation is capable to provide equalization, fire, and emergency volumes to the East Side District in conjunction with the Deerfield Tower through the use of three (3) pumps. The pumps maintain constant pressure with Variable Frequency Drives. The existing storage facilities are described below.

Table 4-5. Summary of Storage Tank Facility Characteristics

	East Side Service District			
	West Side Lower Pressure Zone	Upper Pressure Zone		Broadway Lower Pressure Zone
	Lincoln Tank	Deerfield Tank	Isabella Tank	Broadway Tank
Supply From	Meridian Treatment Facility	Mission & Isabella Treatment Facility	Isabella Treatment Facility	Mission & Isabella Treatment Facility
Year Built	2001	1991	2011	1987
Last Inspection	2021	2021	N/A	2021
Type of Storage	Elevated Standpipe	Elevated Standpipe	Ground based	Elevated Standpipe
Available Volume of Storage, Gallons	500,000	200,000	500,000	200,000
Diameter	Varies	Varies	62'	Varies
Normal Operating LWL / HWL	26.5'/34' (942/949.5)	20'/29' (959.7/968.7)	1.5'/24' (787/809)	19'/25' (893/899)
Available Head Range, ft	37.5'	29'	23.8'	29'
Telemetry /Controls	SCADA (gravity based on demand & fill based on tank level - Open / closes Control Valve for Upper Pressure zone)	SCADA (gravity based on demand & fill based on tank level)	SCADA (pumped based on system pressure & Deerfield Tank level/fill based on tank level)	SCADA (open/closes Control Valve at base of tank)

4.4 PRESSURE DISTRICTS/ZONES

The Union Township Water System operates as one (1) Service District. This district is comprised of particular pressures established as dictated by the growth and infrastructure. It is important that water pressure in a consumer's residence or place of business be neither too high nor too low. The normal operating pressure range for water distribution systems is, as defined by the SDWA, 35 to 90 psi and a minimum of 20 psi during fire flow (emergency) conditions. These values further fluctuate depending on type of demand being experienced whether static (no water usage), Average Daily, Maximum Daily and Peak Hourly Demand. The Township strives to enforce these levels which have required the installation of pressure increasing/decreasing infrastructure and control valves over the years, thus creating in particular the three (3) distinct pressure zones in the Service District. The following table presents these along with current service elevations. Refer to the maps in the Appendix for the locations of the tanks and respective pressure zones.

Table 4-6. Pressure Zone Summary

Description		Hydraulic Grade Control	Maximum Service Elevation (35 psi)	Typical Service Elevation (35 – 90 psi)
East Side Service District	Upper Pressure Zone	Deerfield Tank/ Isabella Booster Pumps	875-885	700-840 (45-93psi)
	Lower Pressure Zone #1 (Broadway)	Broadway Tank	805-820	750-765 (50-60 psi)
	Lower Pressure Zone #2 (West Side)	Lincoln Tank	865-870	760-810 (53-62 psi)

SECTION 5: WATER USAGE AND DEMAND ANALYSIS

5.1 GENERAL

This section presents the analysis of the historic quantities of water pumped, treated, and supplied to the Union Township users. Analysis of this data allows for identification of the unique water use patterns that characterize both of the service districts and provides a basis of design for estimating future water demand.

The projection of future water demand is based upon a correlation to the residential equivalent units (REUs) assigned to each connection to the Township water system established by the Union Township Department of Public Works (DPW). These future demands projections provide the basis for assessing the adequacy of the existing supply, treatment, pumping, and distribution infrastructure and planning for future improvements.

5.2 DEFINITIONS

Water demand includes water delivered to the system to meet the needs of consumers, water supply for infrastructure maintenance, leakage, firefighting, emergencies, and any miscellaneous unaccounted water. Unaccounted water can result from system flushing, leakage, firefighting, meter inaccuracies, and other non-metered usage. Water demand varies seasonally with the lowest usage typically in winter months and the highest usage during summer months and with Central Michigan University in session. Variations in demand also occur with respect to time of day. Diurnal peaks typically occur during the morning and early evening periods, while the lowest usage occurs during nighttime hours. Water demands are described in the following terms and are referenced throughout this report:

Average Daily Demand (ADD) – Derived from data obtained from the Monthly Operating Reports (MORs) as measured by the DPW, this value is defined as the total volume of water delivered to the system over a year divided by 365 days. The average use in a single day expressed in gallons per day (gpd).

Maximum Day Demand (MDD) – This value is used to evaluate infrastructure capacity that produces and supplies water including wells, treatment processes and booster pumps that service areas with storage reservoirs and for sizing transmission/distribution mains. It defined as the largest volume of water delivered to the system in a single day (24-hour period), as measured by the Township DPW and reported on the Monthly Operating Reports (MORS), expressed in gallons per day (gpd). These values are usually highest typically occurs during the early and/or late summer months with the arrival of college students and concurrently with lawn irrigation.

Peak Hourly Demand (PHD) – This value is defined as the maximum volume of water delivered to the system in a single hour expressed in gallons per day (gpd) and is used to evaluate storage reservoir sizes. During peak hourly flows, storage reservoirs supply the demand in excess of the maximum day demand in addition to fire and emergency flows. The value is established from daily monitored tank levels that are collected by the Union DPW and then provides a correlation between PHD and ADD.

5.3 EXISTING WATER USAGE

Water System Usage:

The water system pumping, and usage records as recorded by Union Township DPW for the wells and booster pumps have been tabulated and are presented below. Table 5-1 through Table 5-3 present the total, average day, maximum day volumes of water pumped in million gallons for the period of January 2017 through December 2021. All data was extrapolated directly from the Monthly Operating Reports submitted to the EGLE. Refer to the Appendix for summaries of the reports.

Table 5-1. Total Annual Metered Treated Water Pumped in Million Gallons

Location	2017	2018	2019	2020	2021
Wells¹					
Meridian Treatment Facility					
Well No. 3 & 4	77.87	53.42	68.78	83.40	81.36
Isabella Treatment Facility					
Well No. 11*, 10* & 7	203.20	206.29	194.64	201.31	198.75
Mission Treatment Facility					
Well No. 8 & 9	76.23	101.63	103.52	96.61	90.71
TOTAL SOURCE¹	357.30	361.34	366.93	381.32	370.83
Booster Pumps¹					
Meridian Treatment Facility					
Well No. 3 & 4	77.87	53.42	68.78	83.40	85.28
Isabella Treatment Facility					
Booster Pump (off Storage Tank)	203.00	174.78	194.86	200.92	198.50
Mission Treatment Facility					
Well No. 8 & 9	76.23	101.63	103.52	96.61	98.42
TOTAL PUMPED¹	357.10	329.83	367.15	380.94	382.20

Table 5-2. Average Day Metered Water Pumped in Million Gallons

Location	2017	2018	2019	2020	2021	Overall Average Day (ADD)
Wells¹						
Meridian Treatment Facility						
Well No. 3 & 4	0.22	0.19	0.19	0.24	0.23	0.21
Isabella Treatment Facility						
Well No. 11*, 10* & 7	0.59	0.60	0.57	0.59	0.59	0.59
Mission Treatment Facility						
Well No. 8 & 9	0.28	0.28	0.29	0.27	0.27	0.28
TOTAL SOURCE¹	1.09	1.07	1.05	1.10	1.09	1.08
Booster Pumps¹						

Meridian Treatment Facility						
Well No. 3 & 4	0.21	0.18	0.19	0.25	0.23	0.21
Isabella Treatment Facility						
Booster Pump (off Storage Tank)	0.56	0.57	0.53	0.54	0.54	0.55
Mission Treatment Facility						
Well No. 8 & 9	0.27	0.28	0.29	0.26	0.27	0.27
TOTAL PUMPED¹	1.04	1.03	1.01	1.05	1.04	1.03

Table 5-3. Maximum Day Metered Water Pumped in Million Gallons

Location	2017	2018	2019	2020	2021	Maximum Day (MDD)
Wells¹						
Meridian Treatment Facility						
Well No. 3 & 4	0.72	0.92	0.63	0.74	0.54	0.92
Isabella Treatment Facility						
Well No. 11*, 10* & 7	1.00	0.77	0.81	1.21	0.75	1.21
Mission Treatment Facility						
Well No. 8 & 9	0.43	0.39	0.58	0.42	0.40	0.58
TOTAL SOURCE¹	2.16	2.08	2.02	2.38	1.97	2.38
Booster Pumps¹						
Meridian Treatment Facility						
Well No. 3 & 4	0.72	0.92	0.63	0.74	0.54	0.92
Isabella Treatment Facility						
Booster Pump (off Storage Tank)	0.99	0.83	0.81	1.22	0.78	1.22
Mission Treatment Facility						
Well No. 8 & 9	0.43	0.39	0.58	0.42	0.40	0.58
TOTAL PUMPED¹	2.15	2.14	2.02	2.38	1.72	2.38

¹Water Source & Pumped are the same for the Meridian and Mission Treatment Facilities. Water pumped from the wells are treated and instantly sent to system by the Pressure Filters or high service pumps. There is no onsite storage.

Isabella Site performs treatment and onsite ground storage facility that requires pumps to send to system and/or Deerfield Tower. The discrepancy in value between supply and production for this facility is due to delay in distribution.

*Well 10 was installed in 2014 as a replacement well for #2, 11 was installed in 2019 and replaced Well #1

Service District Usage:

Each pressure zone within the East Side Service District has their own unique water usage characteristics driven by type of users which impacts frequency, duration, and volume of water they use. Therefore, to effectively evaluate the Union Township Water System infrastructures' ability to accommodate current and future demands, each pressure zone must be treated independently from the other. Tables 5-4 and 5-5 provide the metered data in this format of actual water volume distributed to system.

Table 5-4. Service District Summary Average Daily Demand, Gallons per Day (GPD)

	2017	2018	2019	2020	2021	
Service Area	ADD	ADD	ADD	ADD	ADD	Overall Average
East Side Service District						
Lower Pressure Zone #2 (West Side)						
Wells No. 3 & 4	218,000	188,000	193,000	243,000	233,000	215,000
Upper Pressure Zone ³						
Supply: Wells No. 11*, 10*, 7, 8, 9 ^{1,3}	830,000	848,000	819,000	808,000	811,000	823,000
Pumped: Wells No. 8, 9, & Isabella Booster Pumps ^{1,3}	829,000	849,000	820,000	813,000	811,000	824,400
Total System²	1,047,000	1,036,000	1,013,000	1,056,000	1,044,000	1,039,200

*Well 10 replaced Well #2 in 2014, Well 11 replaced Well #1 in 2019

**Table 5-5. Service District Summary
Maximum Day Demand, Gallons per Day (GPD)**

	2017	2018	2019	2020	2021	
Service Area	MDD	MDD	MDD	MDD	MDD	Maximum Day
East Side Service District						
Lower Pressure Zone #2 (West Side)						
Wells No. 3 & 4	722,000	920,000	631,000	744,000	540,000	920,000
Upper Pressure Zone ³						
Supply: Wells No. 11*, 10*, 7, 8, 9 ^{1,3}	1,440,000	1,137,000	1,241,000	1,632,000	1,133,000	1,632,000
Pumped: Wells No. 8, 9, & Isabella Booster Pumps ^{1,3}	1,430,000	1,220,000	1,400,000	1,640,000	1,180,000	1,640,000
Total System²	2,150,000	2,140,000	2,031,000	2,384,000	1,720,000	2,384,000

Acronyms: ADD= Average Daily Demand, MDD = Maximum Day Demand

¹Water Supply and Production are the same for the Meridian and Mission Treatment Facilities. Water pumped from the wells are treated and instantly sent to system by the Pressure Filters or high service pumps. There is no onsite storage.

Isabella Site performs treatment and onsite ground storage facility that requires pumps to send to system and/or Deerfield Tower. The discrepancy in value between supply and production for this facility is due to delay in distribution.

²Sent to system for use (pumped)

³Includes Broadway Lower Pressure Zone as it receives its supply directly from the Upper Pressure Zone (Isabella / Mission Treatment Facilities). No means to directly meter volume of water used in the Broadway pressure zone.

Peaking Factors, Usage & Analysis:

Water usage typically varies with the seasons, days of the weeks, and hours of the day. These variations and their impacts on the distribution system are important considerations in determining adequate capacities of the distributing infrastructure. These variations are typically expressed as ratios to the ADD determined in Table 5-4.

Peaking factors are used to estimate the water demands occurring during peak hour events. For the most part, the DPW does have a viable means for monitoring their well, booster pump and storage tank operations on a daily/hourly through the use of their SCADA system, therefore peaking factors were able to be derived as described below. For evaluation of systems that provide storage volume for domestic and fire flow the following two (2) factors are needed:

- *Maximum Day Demand (MDD) Peaking Factor* typically has been determined from records obtained from the MORs. As stated previously the Township DPW performs daily readings of the wells and Isabella booster pump.
- *Peak Hour Demand (PHD) Peaking Factor* was established from determination of the average number of peak hours that occur during the maximum month of system usage. The value is established from examining the daily storage tank levels that are collected by the Union Township DPW. This data is presented on trending curves with plot diurnal curves of the respective tanks they fill and corresponding suction/discharge pressures of the station as well. The peaking factor is derived by dividing these average numbers of peak hours observed on the curves by a significant tank level drop into a 24 hour period.

Table 5-6 has been compiled to provide a summary of average, maximum day, and peak hourly demands and associated peaking factors for each pressure zone derived from historical data.

Table 5-6. Service District Water Usage Summary

Service Area	Actual Recorded Values			Design Values	
	Overall ADD (gpd)	Maximum MDD (gpd)	MDD/ADD	P.F. PHD/ADD	PHD (gpd)
East Side Service District					
Lower Pressure Zone #2 (West Side)					
Wells No. 3 & 4	215,000	920,000	4.28	6.00	1,290,000
Upper Pressure Zone ³					
Wells No. 11*, 10*, 7, 8, 9	823,000	1,632,000	1.98	6.00	4,938,000
Wells No. 8, 9, & Isabella Booster Pumps	824,400	1,640,000	1.99	6.00	4,946,400
Total System²	1,039,000	2,384,000	2.29	6.00	6,234,000

*Acronyms: ADD= Average Daily Demand, MDD= Maximum Day Demand, PHD= Peak Hour Demand, P.F. = Peaking Factor

¹Water Supply and Production are the same for the Meridian and Mission Treatment Facilities. Water pumped from the wells are treated and instantly sent to system by the Pressure Filters or high service pumps. There is no onsite storage.

Isabella Site performs treatment and onsite ground storage facility that requires pumps to send to system and/or Deerfield Tower. The discrepancy in value between supply and production for this facility is due to delay in distribution.

²Sent to system for use (pumped)

³Includes Broadway Lower Pressure Zone as it receives its supply directly from the Upper Pressure Zone (Isabella / Mission Treatment Facilities). No means to directly meter volume of water used in the Broadway pressure zone.

AWWA Standards suggest a recommended a MDD/ADD peaking factors ranging from 1.5 to 3.0. As observed from the information above, each pressure zone within the service district is consistent and correlates with historical Sanitary Surveys performed by EGLE. The value has dropped over the last 5 years and again attributed to reduction in growth which affects demand.

The entire service district has a mixed blend of residential and commercial use thus providing explanation to the slightly elevated MDD/ADD compared to industry standard which typically is more reflective of predominate residential usage. Service areas with mixed usage typically experience slightly more usage irregularities and seasonal variations. With respect to the West Side Lower Pressure Zone, although they have fewer commercial users in comparison to the other pressure zones within the service district, their high peaking factor is reflective of the type of use and not so much the type of user. This zone in particular experiences a noticeable difference in consumption during summer months as opposed to winter months attributed mostly to excessive irrigation. With the expansion of the Isabella Treatment Facility in 2011 and installation of watermain loop and control valves in 2014, the reliance of Meridian Supply /Treatment Facility to function as a primary supply has decreased and it operates more as backup during the high demand times. This is reinforced upon review of the monthly recordings performed by the Township DPW with spring, winter and fall months indicating decreased flow over the years from Wells #3 and #4.

AWWA Standards suggest a recommended a PHD/ADD peaking factors ranging from 2.5 to 5.0. However as anticipated, the same observations and conclusions are applicable as stated for the MDD/ADD comparison.

To present the information above in a different manner, the following Figures 5-1 & 5-2 are shown below to provide a graphical representation of the actual variance between MDD/ADD and PHD/ADD.

Figure 5-1. Average Daily (ADD) vs. Maximum Daily Demand (MDD)

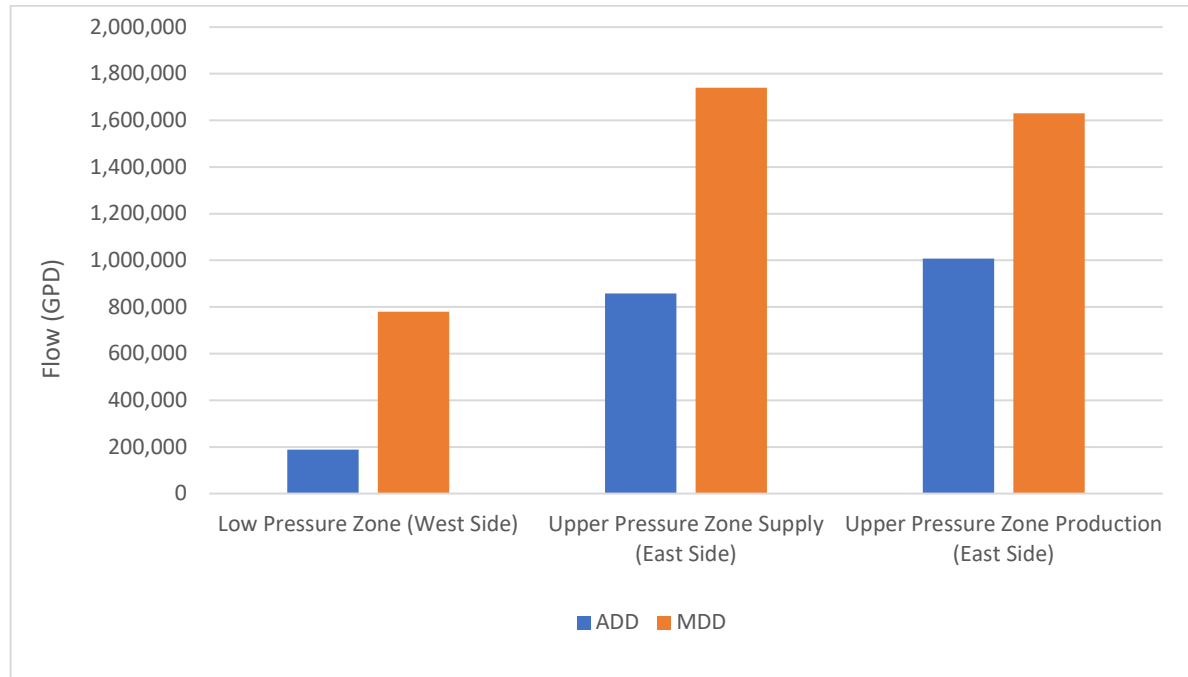
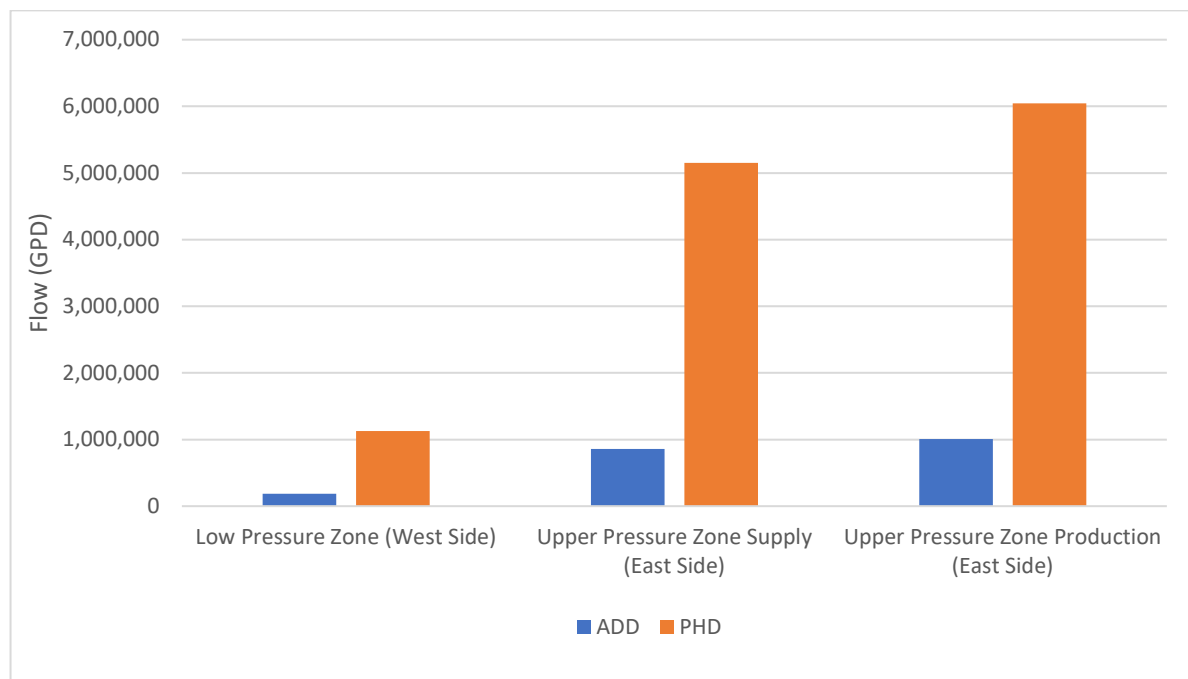


Figure 5-2. Average Daily (ADD) vs. Peak Hour Demand (PHD)



5.4 EXISTING WATER USER DEMANDS

An analysis of water user demand for the entire service district and each pressure zone is performed to estimate future water demand for planning purposes. This is accomplished first by establishing a design demand per user value using the historical 5 year benefit counts (Residential Equivalent Units - REUs) from Section 3 of this report in conjunction the corresponding ADD and MDD measured demands described above in Section 5.3. These design values are derived by dividing the respective water usage by the REU served with a value expressed in unit gallons per day per REU (gpd/REU). Tables 5-7 and 5-8 represents these computations.

Table 5-7. Service District Average Daily User Demand Summary

	2017			2018			2019			2020			2021			
Service Area	REU	ADD, GPD	GPD / REU	REU	ADD, GPD	GPD / REU	REU	ADD, GPD	GPD / REU	REU	ADD, GPD	GPD / REU	REU	ADD, GPD	GPD / REU	Design Demand
East Side Service District																
Lower Pressure Zone #2 (West Side)																
Wells No. 3 & 4	1,140	218,272	191.47	1,299	187,455	144.31	1,264	192,949	152.65	1,271	243,175	191.33	1,241	233,150	187.87	173.52
Upper Pressure Zone ³																
Supply: Wells No. 1, 10* 7, 8 & 9 ¹	4,562	829,415	181.81	5,198	848,021	163.14	5,056	818,978	161.98	5,082	808,472	159.09	4,963	811,372	163.48	165.90
Pumped: Wells No. 8, 9, & Isabella Booster Pumps ¹	4,562	828,919	181.70	5,198	848,953	163.32	5,056	819,589	162.10	5,082	812,518	159.88	4,963	810,684	163.35	166.07
Total System ²	5,702	1,047,191	183.65	6,497	1,036,408	159.52	6,320	1,012,538	160.21	6,353	1,055,693	166.17	6,204	1,043,834	168.25	167.56

Table 5-8. Service District Maximum Daily User Demand Summary

	2017			2018			2019			2020			2021			
Service Area	REU	MDD, GPD	GPD / REU	REU	MDD, GPD	GPD / REU	REU	MDD, GPD	GPD / REU	REU	MDD, GPD	GPD / REU	REU	MDD, GPD	GPD / REU	Design Demand
East Side Service District																
Lower Pressure Zone #2 (West Side)																
Wells No. 3 & 4	1,140	722,000	633	1,299	920,000	708.24	1,264	631,000	499.21	1,271	744,000	585.37	1,241	540,000	435.13	708.24
Upper Pressure Zone ³																
Supply: Wells No. 1, 10*,7, 8 & 9 ¹	4,562	1,700,000	373	5,198	1,650,000	317.43	5,056	1,670,000	330.30	5,082	2,130,000	419.13	4,963	1,620,000	326.42	419.13
Pumped: Wells No. 8, 9, & Isabella Booster Pumps ¹	4,562	1,700,000	373	5,198	1,220,000	234.71	5,056	1,400,000	276.90	5,082	1,640,000	322.71	4,963	1,180,000	237.76	372.64
Total System ²	5,702	2,152,000	377	6,497	2,140,000	329.38	6,320	2,031,000	321.36	6,353	2,384,000	375.26	6,204	1,720,000	277.24	377.41

¹Water Supply and Production are the same for the Meridian and Mission Treatment Facilities. Water pumped from the wells are treated and instantly sent to system by the Pressure Filters or high service pumps. There is no onsite storage. Isabella Site performs treatment and onsite ground storage facility that requires pumps to send to system and/or Deerfield Tower. The discrepancy in value between supply and production for this facility is due to delay in distribution.

²Sent to system for use (pumped)

³Includes Broadway Lower Pressure Zone as it receives its supply directly from the Upper Pressure Zone (Isabella / Mission Treatment Facilities). No means to directly meter volume of water used in the Broadway pressure zone.

Peaking Factors & Usage:

Using the values in Tables 5-7 and 5-8 and the design peaking factors from Section 5.3 (Table 5.6) are applied to the design ADD and MDD values to compute the respective design demand per user for average day, maximum day, and peak hour. This table is provided below. The peaking factors obtained from this data shall be used as design values to determine projected water demands.

Table 5-9. Service District Existing User Demand Summary

Service Area	Design ADD (gpd/REU)	Design MDD (gpd/REU)	MDD/ADD	P.F. PHD/ADD	Design PHD (gpd/REU)
East Side Service District					
West Side Lower Pressure Zone #2	173.52	708.24	4.08	6.00	1,041.15
Upper Pressure Zone¹	166.07	372.64	2.24	6.00	996.42
Total System	167.56	377.41	2.25	6.00	1,005.36

¹Includes Broadway Lower Pressure Zone as it receives its supply directly from the Upper Pressure Zone (Isabella / Mission Treatment Facilities). No means to directly meter volume of water used in the Broadway pressure zone. Pumped and NOT Supply value was selected as this is more reflected of system users / demand

5.5 UNACCOUNTED WATER

Union Township meters water use for all their customers. The difference between the quantity of water received from the three (3) treatment facilities as monitored by flow meters and reported on the MORs and distributed through the distribution system versus the quantity of water measured at the individual customer water meters (water sold) is unaccounted water. Table 5-10 below shows the status for the Township from the year 2021.

Unaccounted water is a combination of “apparent” water loss which results from inaccurate water meters or billing discrepancies and “real” water loss resulting from leakage, water theft, and authorized unbilled usage such as firefighting and main flushing. If there were no leakage in the system, all water meters were 100% accurate, and every drop of water used for firefighting and system flushing was measured, there would be zero unaccounted water. In reality every water system has a certain amount of leakage, water meters are not 100% accurate, and it is rare for every drop of water used in town to be metered and measured. Therefore, virtually every community water system has unaccounted water and typical industry standards are 5 to 15%.

Table 5-10. Summary of Unaccounted Water for year 2021

	2021
Total Water Treated (mgd)	381.42
Total Billing to Customers (mgd)	353.98
Percentage Unaccounted, %	7%

5.6 PROJECTED WATER USAGE AND DEMANDS

Water demand estimates for future years are determined by multiplying the current unit demand design values (gpd/REU) obtained from Table 5-9 by the projected number of future users in the water system. The water user projections and methods used to derive are presented in Section 3.

Table 5-11. Projected 2026 Water Usage (Initial):

Service Area	REU ¹	ADD (gpd)	MDD (gpd)	PHD (gpd)
West Side Lower Pressure Zone #2	1,365	236,861	966,744	1,421,164
Upper Pressure Zone ²	5,459	906,580	1,761,661	5,439,477
Total System	6,824	1,143,429	2,575,456	6,860,577

Table 5-12. Projected 2031 Water Usage (Intermediate):

Service Area	REU ¹	ADD (gpd)	MDD (gpd)	PHD (gpd)
West Side Lower Pressure Zone #2	1,502	260,633	1,063,772	1,563,800
Upper Pressure Zone ²	6,005	997,254	1,937,859	5,983,525
Total System	7,507	1,257,873	2,833,228	7,547,238

Table 5-13. Projected 2041 Water Usage (Long Term):

Service Area	REU ¹	ADD (gpd)	MDD (gpd)	PHD (gpd)
West Side Lower Pressure Zone #2	1,802	312,691	1,276,243	1,876,144
Upper Pressure Zone ²	7,206	1,196,705	2,325,431	7,180,230
Total System	9,008	1,509,380	3,399,722	9,056,283

¹Value based on calculations performed in Section 3.4: REU Count Projections.

²Includes Broadway Lower Pressure Zone as it receives its supply directly from the Upper Pressure Zone (Isabella / Mission Treatment Facilities). No means to directly meter volume of water used in the Broadway pressure zone. Pumped and NOT Supply value was selected as this is more reflected of system users / demand

These values are used in the next Section to evaluate the water system improvement needs over the 20-year planning period. Section 6 will review the following existing major infrastructure components within the Service District and the Water System as a whole and evaluate their available capacities to meet the existing and projected water usage demands. Section 8 will address deficiencies as applicable.

- Water Production (Wells) and Treatment
- Water Distribution (Pumping)
- Water Storage

SECTION 6: WATER SUPPLY AND STORAGE CAPACITY

6.1 GENERAL

The capacity and sizing of a water supply system are based upon the levels of water demand predicted over the planning period. Projections of future water demand are utilized to judge the adequacy of the current facilities and to determine the capacities required for any proposed improvements.

The objective of projecting demands into the future is not to necessarily construct larger facilities to support excessive water consumption, but rather to:

- Assess existing facility capabilities
- Identify any immediate deficiencies
- Recommend performance improvements
- Size new or upgraded facilities for anticipated (but reasonable) future water demands

6.2 WATER SUPPLY DEFINITION

The Union Township water supply is comprised of three (3) supply elements, raw water (source), treatment and finished supply (pumped). The evaluation of their capacity is limited to the smallest rated capacity of each of these. Their description and method for analysis is provided below. Diurnal flows such as peak hourly flows occurring for shorter periods each day to be met through the Townships' storage and distribution infrastructure and will be addressed in later Sections.

Raw Water (Source) Supply

The current source of supply for all of Union Township is provided by onsite Type I groundwater wells located at each of the treatment facilities. The capacity of this raw water supply is defined by the existing firm capacity of the wells. *Firm capacity* is the wells' ability to meet maximum daily demand with the largest pump out of service.

Treatment

Treatment is provided to the raw water supply through the use of pressure filtration or combination thereof. The capacity of the treatment process at each of the treatment facilities is established by the maximum allowable filtration rate or maximum allowable treatment rate with the largest filter out of service when less than four (4) filters are provided.

Finished (Pumped) Supply

The evaluation of the capability to provide finished water supply to system is defined by existing firm capacity. This supply is distributed to system either by well pump (treated by pressure filter), booster pump (treated by pressure filter) or booster pumps supplying water from a dedicated storage tank. *Firm capacity* is the pumps' ability to meet maximum daily demand with the largest pump out of service.

As with any method of water system infrastructure operations, there are zones that were created to allow for the overall Service District to expand providing water to more users and can create either upper or lower pressures. As is the case for both the lower pressure zones (#1 and #2), although the storage in the primary Upper Pressure Zone is not recognized for providing equalization, fire and emergency volumes to them, it does provide supply to the lower zones (Broadway and Lincoln Tank, respectively). These tanks are dedicated to their respective pressure zone and provide pressures and equalization, fire and emergency volumes to the users. Therefore, the evaluation of the supply infrastructure with respect to the existing and future demands is reflective of the entire district, including upper and reduced pressure zones. Evaluation of storage infrastructure will be reviewed separately.

6.3 EXISTING AND PROJECTED WATER SUPPLY CAPACITY

These values are summarized in Tables 6-1 through 6-4.

Table 6-1. Summary of Existing Firm Capacity vs. Maximum Day Demand

Service Area	Firm Capacity (gpm)	Firm Capacity (gpd)	MDD (gpd)	Excess Firm Capacity (gpd)	Excess Firm Capacity ⁴ (gpm)
East Side Service District⁵					
<i>Source – Wells 11*,10*,7,8 & 9¹</i>	1,600	2,304,000	1,632,000	627,000	467
<i>Treatment – Mission Filter & Isabella Filters²</i>	1,500	2,160,000	1,632,000	528,000	367
<i>Pumped – Mission Booster & Well (Pressure Filter) Isabella Booster (from tank)¹ River Road High Service⁶</i>	2,900	4,176,000	1,632,000	2,544,000	1,767

Table 6-2. Projected 2026 Water Supply Capacity (Initial):

Service Area	Firm Capacity (gpm)	Firm Capacity (gpd)	MDD (gpd)	Excess Firm Capacity (gpd)	Excess Firm Capacity (gpm)
East Side Service District⁵					
<i>Source – Wells 1,10*,7,8 & 9¹</i>	1,600	2,304,000	2,575,456	(271,456)	(189)
<i>Treatment – Mission Filter & Isabella Filters²</i>	1,500	2,160,000	2,575,456	(415,456)	(288)
<i>Pumped – Mission Booster & Well (Pressure Filter) Isabella Booster (from tank)¹ River Road High Service⁶</i>	2,900	4,176,000	2,575,456	1,600,544	1,111

Table 6-3 Projected 2031 Water Supply Capacity (Intermediate):

Service Area	Firm Capacity (gpm)	Firm Capacity (gpd)	MDD (gpd)	Excess Firm Capacity (gpd)	Excess Firm Capacity (gpm)
East Side Service District⁵					
<i>Source – Wells 11*,10*,7,8 & 9¹</i>	1,600	2,304,000	2,833,228	(529,228)	(368)
<i>Treatment – Mission Filter & Isabella Filters²</i>	1,500	2,160,000	2,833,228	(673,238)	(467)
<i>Pumped – Mission Booster & Well (Pressure Filter) Isabella Booster (from tank)¹ River Road High Service⁶</i>	2,900	4,176,000	2,833,228	1,342,772	932

Table 6-4 Projected 2041 Water Supply Capacity (Long Term):

Service Area	Firm Capacity (gpm)	Firm Capacity (gpd)	MDD (gpd)	Excess Firm Capacity (gpd)	Excess Firm Capacity ⁴ (gpm)
East Side Service District⁵					
<i>Source – Wells 11*,10*,7,8 & 9¹</i>	1,600	2,304,000	3,399,722	(1,095,722)	(761)
<i>Treatment – Mission Filter & Isabella Filters²</i>	2,300	2,160,000	3,399,722	(1,239,722)	(860)
<i>Pumped – Mission High Service (Pressure filter) & Isabella High Service (from tank)¹ River Road High Service⁶</i>	2,900	4,176,000	3,399,722	776,278	539

¹ Firm Capacity = Largest well, pump or filter taken out of service

² Maximum allowable filtration rate

⁴ Excess Firm Capacity= (Existing Firm Capacity - MDD). A negative value represents the station does NOT have adequate capacity to meet maximum daily demands of users within entire area it supplies.

⁵ Assumes Meridian Treatment Facility is offline and all water supplies are from Mission / Isabella to supply the upper and both lower pressure zones. Meridian wells are available only for backup / emergency

*Well 10 replaced well No. 4, Well 11 replaced well No. 1

⁶ Assumes River Road High Service Pump is operational and included in the firm capacity.

Summary:

Upon review of the information above, it is apparent the wells and treatment both are the limiting component with respect to capability to meet the maximum daily demands for the entire service district including both lower pressure zones. There is capacity with raw water supply and respective treatment to meet the existing and projected demands for the next 5 years of operation.

The system does however have the ability to provide raw water source to the 20 year projected demands on an as needed basis due to the installation of the River Road High Service Pump (to be completed 2023). The pump is intended to add reliability and redundancy to the water system, in case of emergency. [The high service pump is not intended for continual operation and there is no secondary (backup) pump to serve the system demands reliably. Therefore to be conservative, the River Road pump capacity is only added to the pumped capacity analysis, and not in source and treated capacity analysis.]

The need to begin planning and upgrades to the source and treatment infrastructure will need to occur immediately. Conversely, there is ample capacity with pumped water supply to meet the existing and projected demands for the next 15 to 20 years. Although some of the components are aged and replacement is required to ensure continuous reliable operation, particularly the components at the Mission Treatment Facility. Recommendations and associated cost estimates have been provided in the Appendix to address these deficiencies, maintenance and replacement as applicable.

6.4 WATER STORAGE DEFINITION

For all supply infrastructure capacities to be sized for maximum day demand rates, each service district must be provided its own required amount of equalizing storage based on their demand patterns. Storage within the distribution system permits the source of supply to produce water at a constant rate and hold reserve supply for peak demands. The principal functions of distribution storage are:

- Equalizing storage (sometimes termed operational storage)
- Fire storage
- Emergency storage

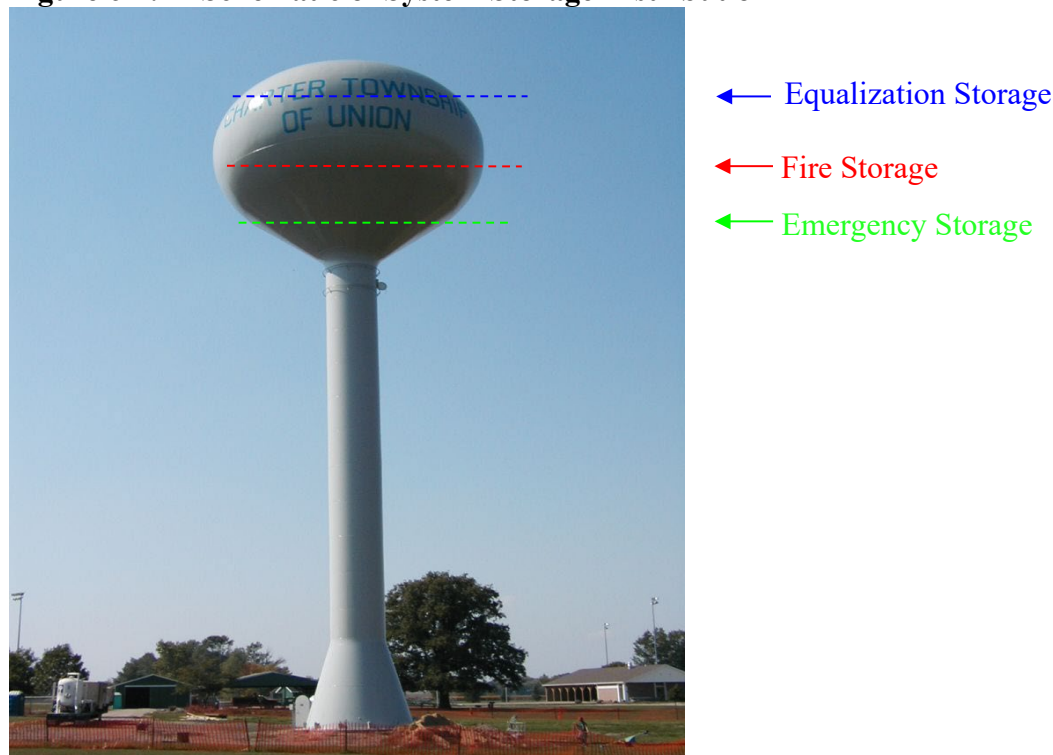
The total storage volume necessary to provide for equalization storage, fire flow storage, and emergency storage is defined as (Mays, 2000):

$$S = V_{eq} + V_{ff} + V_e \quad (6.01)$$

Which then becomes

$$S = \left[(V_p - V_k) \times \frac{4h}{d} \right] + V_f^u + V_e^r \quad (6.02)$$

Figure 6-1. Schematic of System Storage Distribution



¹Lincoln Tower (Lower Pressure Zone #2) 500,000 gallon ground storage tank

Equalization (EQ) Storage:

Equalization storage is directly related to the volume of water necessary to meet peak demands. This storage volume improves and stabilizes system pressures. Over the course of a 24-hour day, there are significant diurnal variations in the water demand, therefore this storage is intended to

make up the difference between the peak demand and the system's available supply or firm capacity. The values are determined by evaluating the diurnal demand variations from the chart records that monitor the respective tanks they fill, refer to Section 5. This data was used to derive a peaking factor for determining peak hour demand to allow a determination of how much it exceeded firm capacity.

Fire (FF) Storage:

The Michigan State Insurance Services Office (ISO) prescribes that the water system should be sized to deliver the required fire flow during maximum day demand for an assigned duration applied to development and building characteristics common for the various land use types for each Service District.

The necessary fire storage for the Union Township Service District is based on the following assumptions:

- The fire storage volume will be the best representing for the designated general use that district.
- Only one (1) fire will occur within a water district on any given day.
- The design fire flow will occur during maximum day demand.
- The transmission pipeline network will have the capacity to transfer the fire flow rates from the storage location to any point within the water district.

Therefore, the following flows have been assigned:

- East Side Service District (including Lower Pressure Zones)
Residential and Commercial Blend, minimal Industrial
1,500 gpm for 2 hours = 180,000 gallons

Emergency (EM) Storage:

Emergency storage is used to satisfy system demand during an event that disrupts supply. Such supply disrupting events might include temporary source contamination, equipment failure, power supply interruption, and pipeline breaks. The criteria for determining the needed emergency storage volume are more subjective than for equalizing or fire storage. They depend on assumptions about supply system dependability, emergency durations, consequences of supply disruption, and public response during an emergency. With only one (1) source of supply, there might be many components, the failure of which might disrupt the entire supply. When assessing the storage volume, it is acceptable to assume minimal demands. The recommended volume for the district is based upon assuming the largest water main in the district is broken and will require one (1) hour for repairs and the system loss experienced during the time would be equivalent to what the respective water main can discharge. Therefore, the following have been assigned for the Service District:

- East Side Service District (including the Lower Pressure Zones)
50,000 gallons
- Lower Pressure Zones #1 and #2 Only
20,000 gallons

6.5 EXISTING AND PROJECTED WATER STORAGE CAPACITY

The storage for the service district is recognized as either gravity or combination gravity/pumped storage and provide pressures and volumes for domestic, fire protection and emergency to the users. As stated above in Section 6.2, the East Side Service District supplies water to two (2) lower pressure zones. Both zones in this district have their own storage tank that provides equalization, fire and emergency volumes to them. Therefore, the capabilities of the current storage facilities to meet existing and projected storage demands must be evaluated independently. These values are summarized in Tables 6-5 through 6-8.

Table 6-5. Required Existing Equalization Storage

Service District	Existing Firm Capacity ²	Peak Hour Demand ³	Required EQ Storage ¹
	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>
East Side Service District⁵			
Upper and Lower #2 Pressure Zone ^{2,5}	2,304,000	6,320,540	669,423
Lower Pressure Zone #1 Only (Broadway) ⁵	N/A	N/A	N/A

Table 6-6: Required Equalization Storage – 1 to 20 Year

Service District	2026			2031			2041		
	Existing Firm Capacity ²	Peak Hour Demand ³	Required EQ Storage ¹	Existing Firm Capacity ²	Peak Hour Demand ³	Required EQ Storage ¹	Existing Firm Capacity ²	Peak Hour Demand ³	Required EQ Storage ¹
	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>	<u>gallons</u>
East Side Service District⁵									
Lower Pressure Zone #1 Only (Broadway) ⁵	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper and Lower #2 Pressure Zone ⁵	2,304,000	6,952,186	774,698	2,304,000	7,648,016	890,669	2,304,000	9,177,212	1,145,535

Table 6-7: Summary of East Side District Upper and Lower Pressure Zone #2 Storage Volume Required

	East Side			
	Existing	2026	2031	2041
	<u>GPD</u>	<u>GPD</u>	<u>GPD</u>	<u>GPD</u>
Equalization Storage	669,423	774,698	890,669	1,145,535
Fire Suppression	180,000	180,000	180,000	180,000
Emergency	50,000	50,000	50,000	50,000
TOTAL	899,423	1,004,698	1,120,669	1,375,535
AVAILABLE STORAGE ^{4,5}	1,200,000	1,200,000	1,200,000	1,200,000
EXCESS STORAGE	300,577	195,302	(79,331)	(175,535)

**Table 6-8: Summary of East Side Service District Lower Pressure Zone #1 (Broadway)
Storage Volume Required**

	Broadway Side			
	Existing	2026	2031	2041
	<i>GPD</i>	<i>GPD</i>	<i>GPD</i>	<i>GPD</i>
Equalization Storage	N/A	N/A	N/A	N/A
Fire Suppression	180,000	180,000	180,000	180,000
Emergency	20,000	20,000	20,000	20,000
TOTAL	200,000	200,000	200,000	200,000
AVAILABLE STORAGE⁴	200,000	200,000	200,000	200,000
EXCESS STORAGE	0	0	0	0

¹Calculation based on equation (6.02). Peak hours based upon actual chart recordings of diurnal patterns for existing tank fill/empty cycles with values as follows:
Deerfield/Lincoln Tank = 4 average peak hours

²Firm capacity of raw water supply (wells) was used since determined to be limited restriction

³The value for the Peak Hour demands are those calculated as presented in Section 5, Table 5-6 with peak hour values based upon chart recordings of the diurnal pattern for the existing tank fill/empty cycles

⁴Required Total Storage = Equalization + Fire Flow + Emergency

⁵Assumes Meridian Treatment Facility is backup only and all water supplies are from Mission/Isabella single Treatment Sites. Broadway Tank is excluded due to elevation/control valve constraints and cannot supply water back to the system. Lincoln Tank is included along with Deerfield/Isabella Tank because a reverse flow control valve was installed in 2013/2014 and allowed supply of water to east.

⁶Installation of River Road High Service Pump overcomes pressure differential and entire Lincoln Tank Volume is included, allowing water to move west to east unrestricted to overcome 8 psi differential.

Summary:

The East Side Service District including the upper and lower pressure zones has adequate storage volume to meet the demands for the next 10-year time frame based upon the current growth projections and usage. Particular to the Upper / Lower Pressure Zone #2, although the system functions and is considered one (1) Service District, there was some pressure differentials that caused a restriction to the Township to have full access to all their storage volume infrastructure. This restriction will be eliminated with the installation of a high service pump that is scheduled to be operational by spring of 2023, which will allow water to be sent from east to west and will allow the Township to have full access to all their storage infrastructure in the case of emergency. The River Road High Service Pump was included in the storage volume analysis in Table 6-7.

Within the next 10 years as growth continues the need to begin planning for upgrades to the storage infrastructure should be a priority. Recommendations and associated cost estimates have been provided in the Appendix to address these deficiencies.

SECTION 7: COMPUTER MODELING ANALYSIS

7.1 OVERVIEW

As part of the water system study for Union Township, a computer modeling program, WaterCAD, Version 10.0 was used to evaluate the reliability and effects of future improvements on the existing system. The standard computational process for the program utilizes the Hazen Williams Equation which relates the flow of water in a pipe with the physical properties of the pipe and the pressure drop caused by friction influence. The model is then used as a tool to provide analysis hydraulic situations imposed on the existing system to manipulate operations and achieve the desired results, including:

- Determining system static and operating pressures under average, maximum and peak hour demands
- Determining available fire flows under average, maximum and peak hour demands
- Determining the systems response under average, maximum and peak hour demands during an instantaneous point in time (steady state)

To accomplish this modeling, information such as pipe diameter, length, pipe roughness (“C” coefficient), system demands at specific locations, pump information, flow demands, and the location and elevation of booster stations, storage tanks, and pressure reducing stations were entered into the model. Data from the 2017 Water Reliability Study was used and updated to account for subsequent water main extensions and facility improvements.

Calibration:

With assistance from Department of Public Works staff, recent hydrant test data were made available as conducted by the Township DPW Staff. This test is typically performed by opening one (1) hydrant and measuring the flow volume with a pitot tube while measuring static and residual pressures on a second nearby hydrant. This field data was incorporated into the model as a method to calibrate to ensure accuracy in comparison to the actual water system operations. The WaterCAD Water calibration tool was utilized, and additional hand calibration was performed to refine model results. This is done by performing adjustments to the pipe roughness Coefficients (C-factors) which for this system ranged between 100 and 150, dependent upon material and age of pipe. As shown in Table 7-1, modeled results were, on average, within 5 percent of the actual field measurements and based on past experience, models with calibration results within this range in comparison to actual field results are considered accurate and reliable for this level of system planning.

Table 7-1. Fire Flow Data, Field vs. Modeled Results

Location	Flowing Hydrant Flowrate (gpm)	Residual Pressure (psi)		Variance (%)
		Field Measured	Calibrated Model Result	
1# 2300 Lincoln Rd.	836	60	69	13%
2# 4512 Blue Grass	916	70	77	10%
3# 3176 St. Andrew Drive	836	56	67	18%
4# 2600 Summerton	802	56	55	2%
5# 4101 River Rd.	869	78	79	1%
6# 2727 River Rd.	885	72	75	4%

7# 3110 Rogers Street	960	69	75	8%
8# Encore Blvd.	869	70	79	12%
9# Remus Road	869	60	64	6%

Demand Allocation:

The existing and 5 and 20 year projected water system average (ADD) and maximum daily (MDD) demands computed from Section 5 were used in the computer model. Initially, an evaluation of the largest users in the Service District was performed based upon billing records obtained from the Union Township billings. The findings are provided in the Table 7-2 and were input into the hydraulic model. The remaining existing and projected demands were distributed equally to the junction nodes.

Table 7-2. Largest Township Users

Location	REU Count	ADD (gpm)²	MDD/ADD Peaking Factor¹	MDD (gpm)
SOARING EAGLE WATER PARK & HOTEL	237	27.65	2.29	63.32
SZ MT PLEASANT APARTMENTS	151	17.62	2.29	40.34
CROSSINGS ON BROADWAY	129	15.05	2.29	34.46
JAMESTOWN RCS EQUITIES	121	14.12	2.29	32.33
PIERCE PROPERTY MANAGEMENT, LLC	118	13.77	2.29	31.53
VILLAGE DEERFIELD	110	12.83	2.29	29.39
PRINCETON MANAGEMENT	109	12.72	2.29	29.12
CWP WEST CORP	99	11.55	2.29	26.45
SZ MT. PLEASANT TOWNHOMES	93	10.85	2.29	24.85
L.D.H.A.L.P. SPRINGBROOK	70	8.17	2.29	18.70
PLEASANT RIDGE PARTNERS LLC	66	7.70	2.29	17.63
SZ MOUNT PLEASANT APTS EAST LLC	57	6.65	2.29	15.23
HEALTH MID MICHIGAN	56	6.53	2.29	14.96
INNS MID MICHIGAN	48	5.60	2.29	12.82
BROADWAY ACRES MHP LLC	47	5.48	2.29	12.56
ISABELLA VILLAGE MHP	47	5.48	2.29	12.56
SZ MT. PLEASANT TOWNHOMES LLC	46	5.37	2.29	12.29
OLIVE GARDEN #4471	39	4.55	2.29	10.42
MP NOTE, LLC	37	4.32	2.29	9.89
HOME DEPOT USA	37	4.32	2.29	9.89

¹2.29 was utilized consistent with Section 5 for entire system analysis

²ADD was computed using 168 gpd/REU as obtained from Section 5

Fire Flow Analysis:

The Safe Drinking Water Act (SDWA) requires that a hydraulic analysis under existing and future peak demand conditions be performed. For systems with existing and/or projected need for water storage volumes for fire suppression, this peak demand occurs when fire flows coincide with maximum day demands. Therefore, the Service District was evaluated by its ability to provide its established fire flows rate during maximum day demand at the minimum residual pressure of 20 psi. Design fire flow rates were developed using criteria established by the Insurance Services Office (ISO) applied to development and building characteristics common for the various land use types as discussed in Section 6. From these computations, WaterCAD generated available fire flow contours which were overlaid onto the Union Township Water System Maps and are presented in the Appendix.

7.2 DATA ANALYSIS

The computerized model is capable of evaluating system performance under several different scenarios in order to identify deficiencies with the existing system and under future conditions. Recommendations for improvements were made based on the system's ability to operate efficiently during critical peak demand conditions equivalent to the maximum daily demand (MDD) plus fire flow conditions. The model evaluated the existing system capabilities, storage and supply capacity needs, as evaluated in Section 6, with respect to the existing and projected users demands reflected in Section 5. In addition the proposed (5 year and 20 year) improvements were incorporated with respect to the corresponding projected user demands. As analyzed previously in this report several options were reviewed.

Below is the list of the model scenarios that were run in order to identify deficiencies with the existing system and under build-out conditions.

- Existing
 - 2021 maximum daily flow – operating pressures
 - 2021 maximum daily flow – available fire flow
- ◆ Proposed 5 Year and 20 Year w/Capital Improvements
 - 2026 maximum daily flow – operating pressures
 - 2026 maximum daily flow – available fire flow
 - 2041 maximum daily flow – operating pressures
 - 2041 maximum daily flow – available fire flow

Existing System Deficiencies:

Maximum Daily Demands (MDD)

This analysis was performed to ensure the minimum criterion of 35 psi operating pressure was provided under firm capacity conditions (largest pump taken offline). Based on modeled results, MDD conditions can be met while maintaining a system pressure of 35 psi and greater throughout the system with the current infrastructure in place. The operating pressure at each junction within the Service District is provided in a spreadsheet in the Appendix. The spreadsheet is sorted from highest to lowest pressures. The pressures below 35 psi presented on the spreadsheet are indicative of locations either on the suction side of pumps or at the fill junction to an elevated tank (no users are serviced at these locations) therefore pressures below 35 psi are to be anticipated.

Available Fire Flows

This analysis computed available fire flow demands for each junction within the system. Included in the Appendix is an available fire flow contour map and available pressures/fire flow at each junction within the Service District provided in a spreadsheet for the existing conditions system simulation. Each node within the District is regulated by a specific junction which controls the pressure and is used for establishing a baseline pressure to be maintained for computing available fire flows. The minimum residual pressure of 20 psi is maintained compliant with the SDWA. Review of the hydraulic model report indicated that the water system as a whole is capable to provide 93% of the entire service area the required fire flow

demand. The areas deficient are attributed to the large amount of dead-end mains, specifically 8-inch and smaller. A summary of results are as follows:

- East Side Service District (Required 1500 gpm)
 - Upper Pressure Zone has on average 3,669 gpm @ 20 psi ranging in values from 889 gpm to 12,000 gpm
 - West Lower Pressure Zone has on average 3,170 gpm @ 20 psi ranging in values from 220 gpm to 15,000 gpm
 - Broadway Lower Pressure Zone has on average available fire flow of 4,543 gpm @ 20 psi ranging in values from 3,800 gpm to 8,000 gpm

Proposed System with Capital Improvements:

Maximum Daily Demands (MDD)/Available Fire Flow Results

Initial (1 to 5 year) and Long Term (6 to 20 year) improvements as recommended in Section 8, were integrated into the hydraulic model with the corresponding projected demands for the system. Below are the average results provided for available fire flow presuming the improvements are performed. The district and each pressure zone had minimal fluctuations in available fire flows directly related to variations in populations and demands. Please note that none of the capital improvements applied were for upsizing of existing mains and/or looping to increase the quantity of water available for fire protection.

- 1) Initial 1 to 5 Year – 93% of service area meeting required Fire Flows.
 - Upper Pressure Zone will have an average available fire flow of 3,681 gpm (an increase of 12 gpm)
 - West Lower Pressure Zone will have an average available fire flow of 3,285 gpm (a increase of 115 gpm)
 - Broadway Lower Pressure Zone will have an average available fire flow of 4,815 gpm (an increase of 272 gpm)
- 2) Long Term 6 to 20 Year – 94% of service area meeting required Fire Flows.
 - Upper Pressure Zone will have an average available fire flow of 3,701 gpm (an increase of 20 gpm)
 - West Lower Pressure Zone will have an average available fire flow of 3,258 gpm (a decrease of 27 gpm)
 - Broadway Lower Pressure Zone will have an average available fire flow of 5,364 gpm (an increase of 549 gpm)

Included in the Appendix are the available fire flow and operating pressure contour maps and spreadsheets with each junction value for existing and proposed 5 and 20 year simulations.

SECTION 8: PLANNING, RECOMMENDATIONS & COST ESTIMATES

8.1 SUMMARY

This Section evaluates water system improvement needs over the 20-year planning period due to the projected growth and corresponding increases in water demand presented in the previous sections of this report. This growth will require expansion of system capacity and improvements to ensure the ability to deliver potable water and fire protection for the Union Township water customers. Additionally, public infrastructure components will continue to age and degrade over time potentially requiring improvements to remain functional and reliable. The purpose of this section is to present alternatives for the major infrastructure components along with analysis and cost estimates that will aid with making an informed decision on how the Township wishes to proceed into the future.

The 20-year projected water demands presented in Section 6 are used to size the needed improvements. For the purposes of this study, the major infrastructure components are divided into the following areas with breakdowns of the cost estimates included in Appendix B of this report:

- Supply (Source, Treatment & Pumped)
- Water Storage
- Distribution
- General System Improvements/Upgrades

8.2 SUPPLY DEFICIENCIES & ALTERNATIVES

Supply

Perhaps one of the most critical short-term issues facing any municipality is that of source water. Without the existing well capacity, adequate storage and distribution capacity of its' own infrastructure is of little importance. Therefore, it is critical that protection of the existing water source and adequate capacity for treatment avenues for a future additional water well are explored to ensure adequate volumes of supply for the planning period and beyond. Detailed Opinion of Probable Construction Costs are provided in this report and located in Appendix B.

Initial and Short-Term Periods (1-5 years)

Based upon the findings of the report and water modeling, the existing capacity of the water supply (source, treatment and pumped) were identified as being currently sufficient. However after next 5 years with increased growth and demand the raw water supply and respective treatment that services the entire system will initially be deficient by approximately 189 gallons per minute (gpm) and 288 gpm, respectively with an ultimate need of 761 gpm and 860 gpm to meet the projected 20 year demands for the system. Requirements of the SDWA state that the firm capacity of the system must be capable to meet the maximum demands, meaning the largest well taken offline. Therefore to meet this criterion the most cost effective initial option would be the installation of a new 800 gpm water supply to meet initial need of 400 gpm (6-10 yr) and long term needs of 800 gpm (10-20yr).

Effective 2023 they system will have access to increased capacity with the implementation of a booster pump installed at River Road Control Valve station; providing a reliable means for water to move both east and west without restriction. This also allows the Township to account for the full storage volume of the Lincoln Elevated Tank. The implementation of the 850 gpm booster pump installed in the River Road Control Valve station provides the necessary capacity to meet the 20 year projected demands as a reliability or backup during high demands. Though, as previously discussed in Section 6, the River Road booster pump is intended for reliability and redundancy, not for required system operations, thus was only included in the pumped firm capacity not source or treatment routinely. This analysis and implementation of the River Road Control station into the pumped firm capacity provides the necessary capacity to meet the 5 year projected demands for source water, the 10 year projected demands for treated water, and the 20 year projected demands pumped water. These capacities were accounted for when analyzing capital improvement project for the purpose of planning and long term demands of the system.

Secondly, Maintenance, inspection and/or testing have been completed with no current upgrades recommended at this time. This should be continued on a routine basis and conducted a minimum of every 5 years. It is recommended the Township continue its practice of well inspection and maintenance on a recurring schedule.

Raw Water (Source)

In an effort to be proactive the township retained GFA in 2021 to conducted a Type I Well Feasibility Study to investigate feasible well locations. For this report it is assumed an 800 gpm well shall be installed near the Mission Treatment Facility site with the intent for the well to be installed in a second encountered aquifer to avoid interference with the existing wells. The study

cited 4 plausible locations for a new water supply along with research recommendations and cost alternatives for the Township's consideration. However, there are other sites available and aquifer testing will need to be conducted to verify. As with the other wells, iron removal is anticipated, and provisions are proposed in Section 8.4 to allow for the water to be treated at Mission or Isabella Treatment Facilities for flexibility and increased reliability. It shall be noted that in 2008 the State of Michigan implemented a groundwater adverse resource impact known as the Withdrawal Law requiring wells installed in the State of Michigan that use more than 100,000 gpd in a 30 day period are to be evaluated for impact to fish populations in surface waters. In this situation since additional withdrawal would be required, the Township would be responsible to comply with this law.

1. Routine Inspection, Testing & Maintenance of Wells.....\$47,000.00
2. New Well rated at 800 gpm (including transmission main)\$1,493,900.00

Treatment / Pumped

Although the implementation of the booster pump in the River Road Control Valve Station provides the necessary supplemental capacity to meet the 20 year demands, additional infrastructure upgrades should be considered and strongly recommended to ensure reliability in the system as infrastructure ages. Including:

~The original 1986 gravity filters in the original treatment facility at the Isabella and Mission Sites have been removed along with process piping. Below ground piping to the tank / system were installed with the expansion in 2009 to accommodate installation of additional treatment filter(s) in this location. It is recommended to install one (1) 800 GPM horizontal pressure filter (2 cells) capable to supplement the treatment of the three (3) existing wells onsite, new water supply well and water supply from Mission Site (Wells #8 or #9). It is presumed the existing building requires expansion to accommodate two (2) 12' diameter pressure filter and associated piping. The system operations and exterior piping including distribution and backwash are already in place to accommodate. Treatment capacity at the Isabella Site would increase from 1,500 GPM to 2,300 GPM.

~Upgrades of the existing high service pumps at the Isabella Treatment facility are recommended to have them rated consistent to match the treatment filters rated capacity to avoid the potential for a restriction to send water to system (pumped). Additional capacity should be added to match the rated capacity of 1,500 GPM (existing filters) and maximum of 2,350 GPM to account for the gravity filter removal. To accomplish this, it is recommended to expand the existing filter room and pump house room to accommodate the installation of one (1) additional filter plus piping for spare (future) and three (3) additional pumps, same capacity, and model as the existing high service pumps for consistency and ease of maintenance. The original facility design was constructed to accommodate such expansion including the pipe terminations. This project is able to be staged with filters and pumps installed as needed with ability to meet demand and storage requirements with time.

1. Isabella Treatment Facility: Removal and Installation of new 800 gpm Pressure Filters, Room Expansion, and associated Appurtenances\$4,070,000.00
2. Isabella Treatment Facility: High Service Pump and Room Expansion

.....	\$1,144,440.00
3. Inspection, Testing & Maintenance of Wells	
.....	\$47,000.00

Long-Term Period (5-20 years)

Major upgrades are identified in the long-term 5 – 20 year period, in addition to continued monitoring and maintenance of existing raw water (source) equipment. With the implementation of the booster pump in the River Road Control Valve Station, Wells 3 and 4 are now more accessible and utilized. These wells are at and/or nearing their useful life and replacement will be necessary in the next 10 years. Replacement of Wells #3 & #4 will include upsizing the wells from 8” to 12” casings.

1. Well #3 and Well #4 Replacement	\$475,200.00
--	--------------

8.3 STORAGE DEFICIENCIES & ALTERNATIVES

Initial and Short-Term Periods (1-5 years)

Based upon the findings of the report and water modeling, the existing capacity of the water storage facilities were identified as currently sufficient. With the implementation of the Booster Pump in the River Road Control Valve station, the system is provided with access to the full storage volume of the Lincoln Elevation Tank. This addition of 250,000 gallons provides the Township with adequate storage to meet the next 10 year projected demands with a shortage of only 70,000 gallons. This will be further discussed in the Long Term Period below but at this time no improvements to storage are proposed.

Inspections on all three elevated water storage tanks is routinely performed with all corrective repairs implemented and in good working order. Routine inspection / maintenance should also be continued and conducted a minimum of every 5 years. Costs for maintenance items and routine inspections are itemized below.

1. Routine Inspection of All Storage Tanks\$22,000.00

Long-Term Period (5-20 years)

Based upon the findings of the report and water modeling, the existing capacity of the water storage facility are sufficient to meet the projected 10 year demands for the community. With the booster pump installation there does still present a 357,000 gallon shortage to meet the 20 year demands. However, this is a moving target and should be used for planning purposes only. It is recommended the Township consider storage improvement options. The most economical and practical to consider at this time would be the addition of another ground storage tank at the Isabella Treatment Site. Proposed expansion of the high service pumps is proposed in the supply section of this report (above) to account for pumped capacity and allow ability to send more water to system from the ground tank. Furthermore, the Township has the space and site piping established to accommodate.

Secondly, continued monitoring and maintenance of existing equipment will be required and adequate to continue operations, costs for maintenance items are itemized below:

1. Routine Tank Inspections\$22,000.00
2. Isabella Treatment Facility: Installation of 500,000 Gallon Ground Tank\$2,195,000.00

8.4 DISTRIBUTION DEFICIENCIES & ALTERNATIVES

The water distribution system piping and storage network was analyzed using WaterCAD V10. The system was analyzed for existing and future conditions to determine where deficiencies exist as well as the optimal corrective actions. Criteria for determining system problems include the need to accommodate peak hourly flows while maintaining pressures in excess of 35 psi, and the need to provide fire flows during maximum day water demands while maintaining at least 20 psi in the system. Deficiencies in pipe capacity such as inadequate pipe size and/or lack of sufficient looping (dead ends) create restrictions which prevent proper flow to fire hydrants or excessive pressure drops during peak demands. The following deficiencies / recommended improvements:

Low Pressures Upgrades

The entire system performed adequately with pressures greater than 35 psi and further analysis was not performed.

Available Fire Flows during maximum daily demands

Specific areas reflected in the hydraulic model that demonstrated fire flow deficiencies experienced significant improvement with the proposed Capital Improvements implemented.

Initial and Short-Term Periods (1-5 years)

Based upon conversations with the Township, it is their top priority to provide a direct connection between the Isabella and Mission Treatment Facilities as one currently does not exist. A dedicated transmission line to allow for the distribution of raw / finished water between the two (2) systems would create added redundancy / reliability in the system. Specifically as components are taken offline for repairs, cleaning, replacement this would provide the ability for any well to receive treatment and send to system at either site. Additionally the improvements will allow for the ability to provide a central treatment facility of raw water within the system in the future.

Secondly, the SDWA and the Michigan Lead and Copper Rule require all municipal water systems to inventory and replace any lead or copper service lines operational to customers. Based upon DSMI inspections completed by the DPW there are no known service lines in the system that need to be replaced. For budgeting and planning purposes, 466 leads have been identified as unknown and final inventory to confirm is to be completed by 2025. It is recommended that the Township may need to replace 150 service lines per year. Costs for the improvements are itemized below:

1. Mission & Isabella Treatment Facility: Raw / Finished Water Transmission Main
.....\$1,239,900.00
2. Routine Calibration of Master Meters / Control Valves
.....\$20,000.00
3. Pickard Road Transmission Main Extension
.....\$717,130.00
4. Lead & Copper Service Line Replacement / Hydrant Replacement
.....\$1,287,000.00

8.5 WATER CONSERVATION

In the meantime, while discussions and decisions take place on how and when to proceed with the improvements listed in the previous sections, continual monitoring of the volume of water supplied to the users in the Service District is suggested and implementation of water conservation should be considered in the event demands do exceed the supply, pumping and/or storage capacities to keep reserves available for emergencies and incurred costs manageable. These include:

Meter Calibration: Accurate metering of water for each well and each treatment facility help to determine output, track user demands, monitor production, and is required for many functions for water treatment. Maintaining the meters accuracy ensures the data collected and used is reliable.

Initial and Short-Term Periods (1-5 years)

1. Meter Calibration\$20,000.00

Long-Term Period (5-20 years)

1. Meter Calibration\$20,000.00

Annual Water Audit: The purpose of an annual water audit is to determine the overall input-output accountability of the system, monitor the usage levels of qualitatively different consumers, gauge the effectiveness of conservation measures already being implemented, and gather other system performance data. It is suggested that Union Township and the City of Mount Pleasant partner to perform an audit on a regular or random basis. This may prove useful for the recognition of irregular usage patterns and may serve to identify leaks, malfunctions, or other system problems.

Public Participation: Based upon the historical records, there is significantly more water usage during the summer months attributed primarily to irrigation. In the short term, implementation of a system wide water ban and/or schedule for users could be put in place to limit the usage. In the long term, although it has proven to generate a substantial amount of revenue for the Township, there should be consideration to enforce large irrigation users to install a non-potable well in lieu of using the municipal water system. This may make a significant impact on the Townships' volume of water consumption peak usage months.

SECTION 9: FUNDING OPTIONS & PLANNING

9.1 PROJECT FUNDING OPTIONS

Public facilities improvements are often expensive and have a significant financial impact on a community. The impact varies depending on the size of the project to be undertaken, the size of the community, the funding scenario, the amount of existing debt that a community is carrying, and other factors. Most communities are unable to finance major infrastructure improvements without some form of financial assistance. There are a number of potential funding sources for which the Township could look to for funding assistance and support when undertaking public water system improvements including governmental funding agencies, lending institutions, or other means. These sources include local, state, federal, private, and public alternatives. This section will seek to provide a brief description of some of the potential funding sources that may be of use to Union Township.

Local Funding Sources:

Local funding sources include all funding sources that utilize the local community as “the bank” or fund provider. A brief summary of various potential funding sources is provided below.

- **Revenue Bonds.** Revenue bonds are repaid through a municipality’s revenue stream or by user rates. The full faith of the issuer is not behind revenue bonds; therefore, the interest rate on revenue bonds is generally higher. One advantage of revenue bonds is that they do not require voter approval and can be solicited by the Township or through Isabella County.
- **Benefit Charges.** These are a one-time capital cost charged to new customers to aid in upsizing facilities for growth and to help pay off existing debt. The disadvantage of using Benefits for infrastructure investment would be that the revenue stream varies with the economy and with the development market. As such, it is not reliable. Also, projects often have to be funded through other means as Benefits are often not collected until after an improvement is constructed and customer connections have occurred.
- **Special Assessment Districts.** SADs are appropriate funding mechanisms for projects that benefit a limited and defined area. SADs work well when the required improvements benefit a limited number of users and do not provide a system wide benefit or a benefit to a larger group of customers. Under a SAD, improvement costs are distributed to customers based on a defensible methodology such as front footage of the property being served.
- **Borrowing from Existing Township Funds.** This method may be the most applicable and beneficial for a community such as Union Township, who may have available funds in their water and sewer accounts to borrow from. This method works well because the Township has the flexibility to establish their own terms of repayment and is able to capture the interest rates on the note.

State Funding Programs:

The State of Michigan offers various programs for funding public water system projects. The various programs offer grants, loans, and combinations of the two. A brief summary of the state programs complete with information about where more information can be obtained for each program is provided below. The most efficient way to obtain feedback from the state funding agencies and determine funding availability, terms, and requirements is to schedule a meeting with the funding agencies to discuss the Townships project needs and to discuss the funding options that may be available through their individual programs.

- **Safe Drinking Water Revolving Loan Fund (Michigan Department of Environmental Quality, DWRf)** The Michigan Department of EGLE, Drinking Water Program offers a funding program that is funded by grants from the EPA. With new federal legislature the 2023-2024 FY funding round will have an additional one-time influx of approximately \$1.1 billion in grant dollars through the Infrastructure, Investment and Jobs Act, and the American Rescue Plan Act. These grants are used to fund a revolving loan program that offers low interest loans to water providers. Interest rates vary depending on the circumstances in the community but currently the average is 2% interest for moderate income communities. In some cases, the program offers a “principal forgiveness” element that resembles a grant of up to \$250,000. The Township has submitted their Notice of Intent and are making plans to apply to DWSRF to finance select CIP projects in the 2024 funding cycle. Information on the SDWRLF program can be found at michigan.gov.
- **Michigan Community Development Block Grant (CDBG)** The Michigan Economic and Community Development Department administers a grant program for public water systems with funding originating from the US Department of Housing and Urban Development. Funding through this grant program is generally in the form of grants of \$1-million and under and is focused on communities meeting specific low income standards. Grants can be used for planning, design, and construction of new facilities. Information on the CDBG program can be found at hud.gov. Based on typical qualification requirements, it is unlikely that Garfield Township will qualify for CDBG.

Federal Funding Programs:

The federal government provides support to state and local agencies in many forms. Some of the state programs discussed above receive their funding from federal resources. Other programs are available directly through federal agencies. A brief description of these federal resources is provided below.

- **Rural Development (USDA)** The USDA Rural Development (RD) offers a variety of grant and loan programs to aid water and wastewater systems as they upgrade and implement infrastructure improvements and is focused on communities meeting specific income and /or user fee schedule standards. Grants, loans, and other support are available through RD. The amount of assistance available and terms varies on a case by case basis. Based on typical qualification requirements, it is unlikely that Union Township will qualify for USDA RD. Additional information on the funding programs available through RD can be found at usda.gov.

9.2 SCHEDULING AND FUNDING PLAN

Overall, the Union Township does have some substantial system upgrades that are needed in the near future (1 to 5 years) and need to begin to formulate a funding plan to fund these Priority Projects which are considered to be the most critical projects in the Capital Improvements Plan (CIP). This section shall provide a brief description of the funding plan for the highest priority projects and for the other priority project groups in the CIP.

The secondary priority projects anticipated to be needed in the Long Term (6 to 20 years) will be undertaken as funding availability and need dictates. Funding alternatives for later projects will vary and should be determined on a case-by-case basis. Combinations of loans, grants, and existing Township funds for capital improvement projects using water revenues will certainly be part of the funding scheme for future projects. The Township is considering pursuing the Drinking Water Sate Revolving Fund through EGLE to assist with the immediate drinking water infrastructure needs of the system. They have submitted their Notice of Intent prior to the November 1st deadline for 2024 funding.

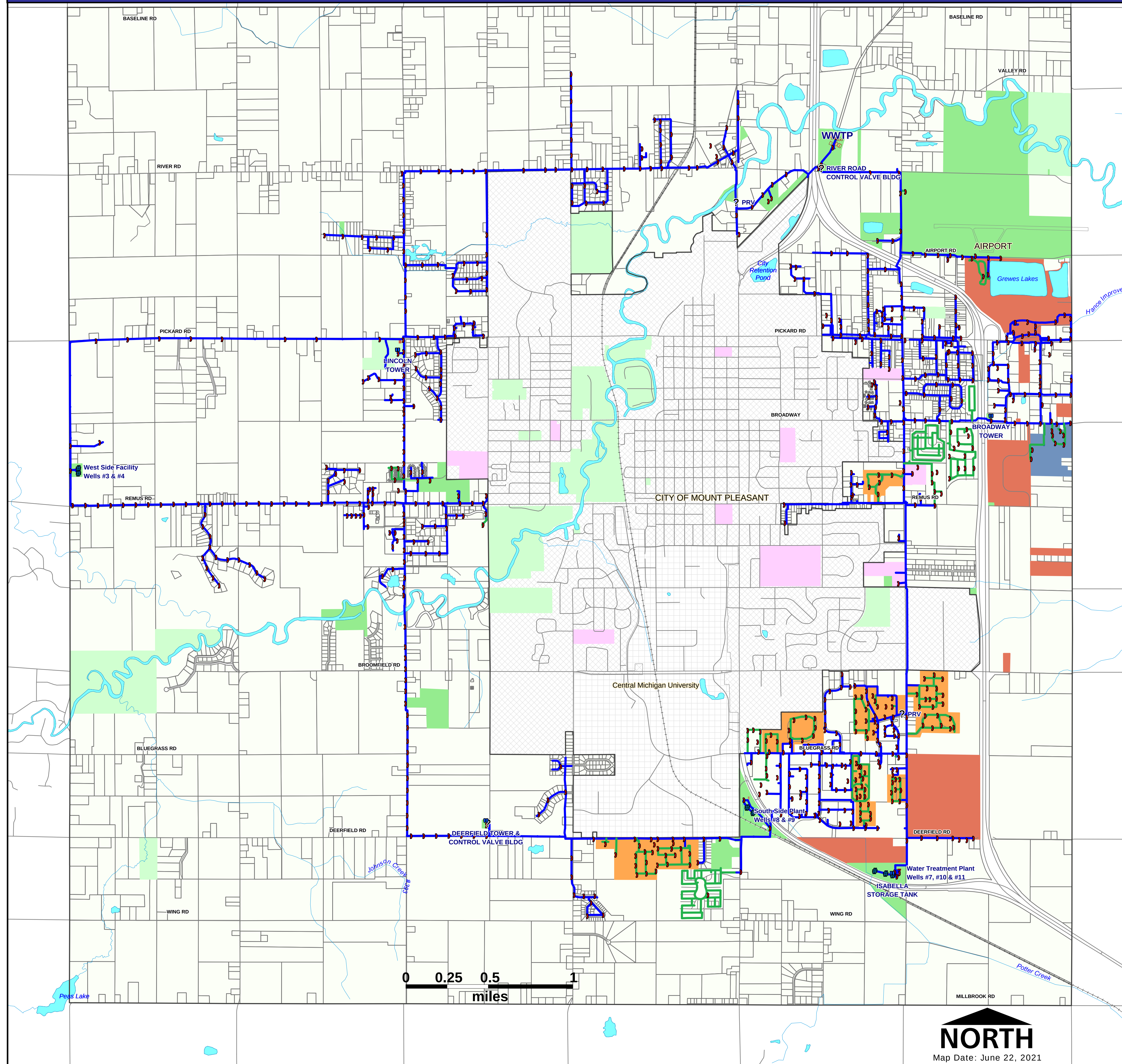
As the Township prepares to undertake other project priorities in the future, planning and costs should be updated for inflation and market changes along with some research to determine what funding programs are available, the availability of grants, and other funding assistance.

APPENDIX A

Water System Maps



UNION TOWNSHIP WATER DISTRIBUTION SYSTEM

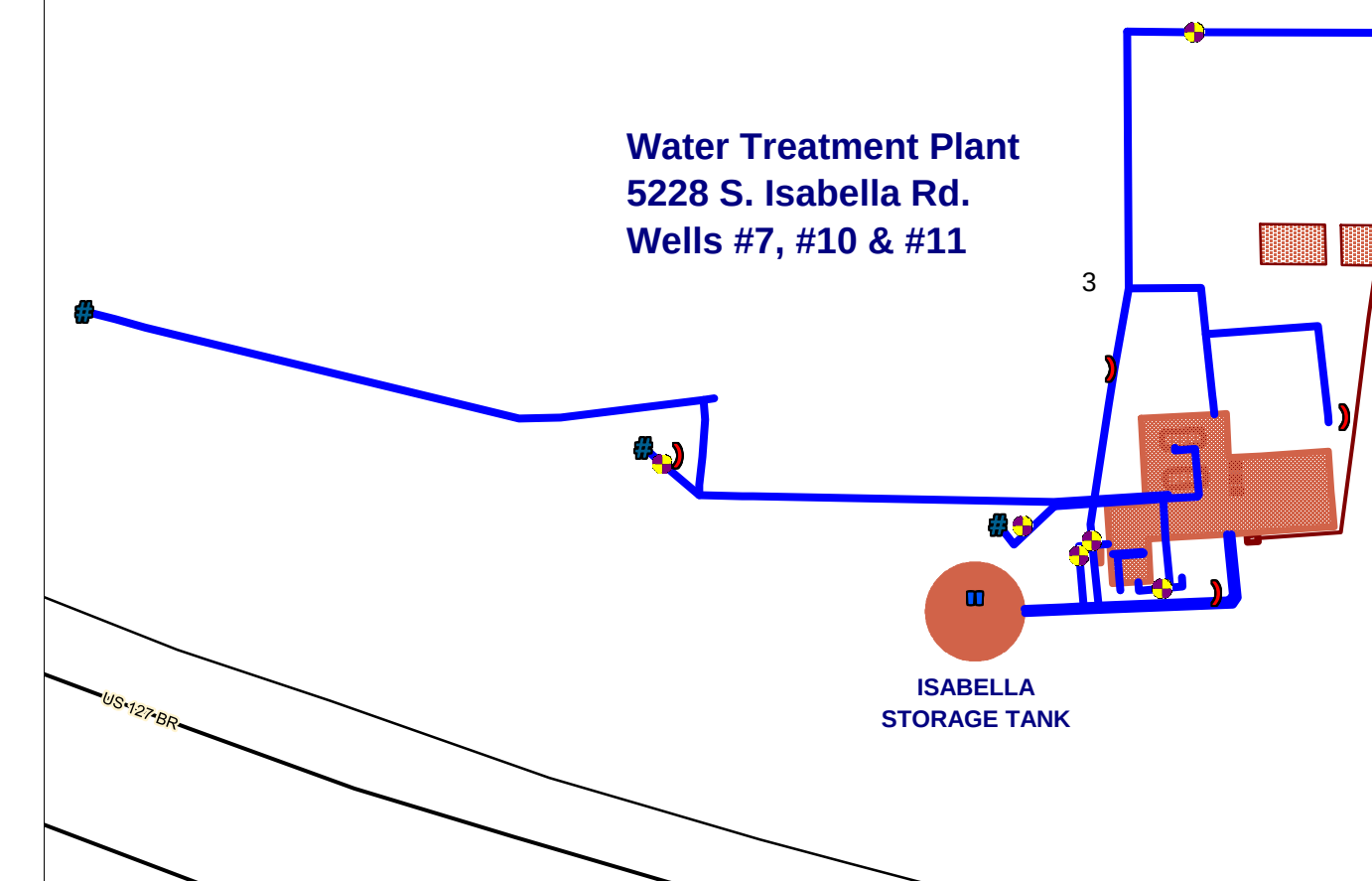


General Plan: Charter Township of Union T14N, R4W Isabella County, Michigan

Water System Legend

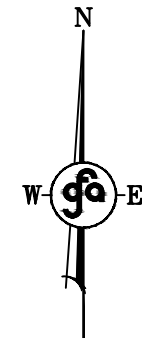
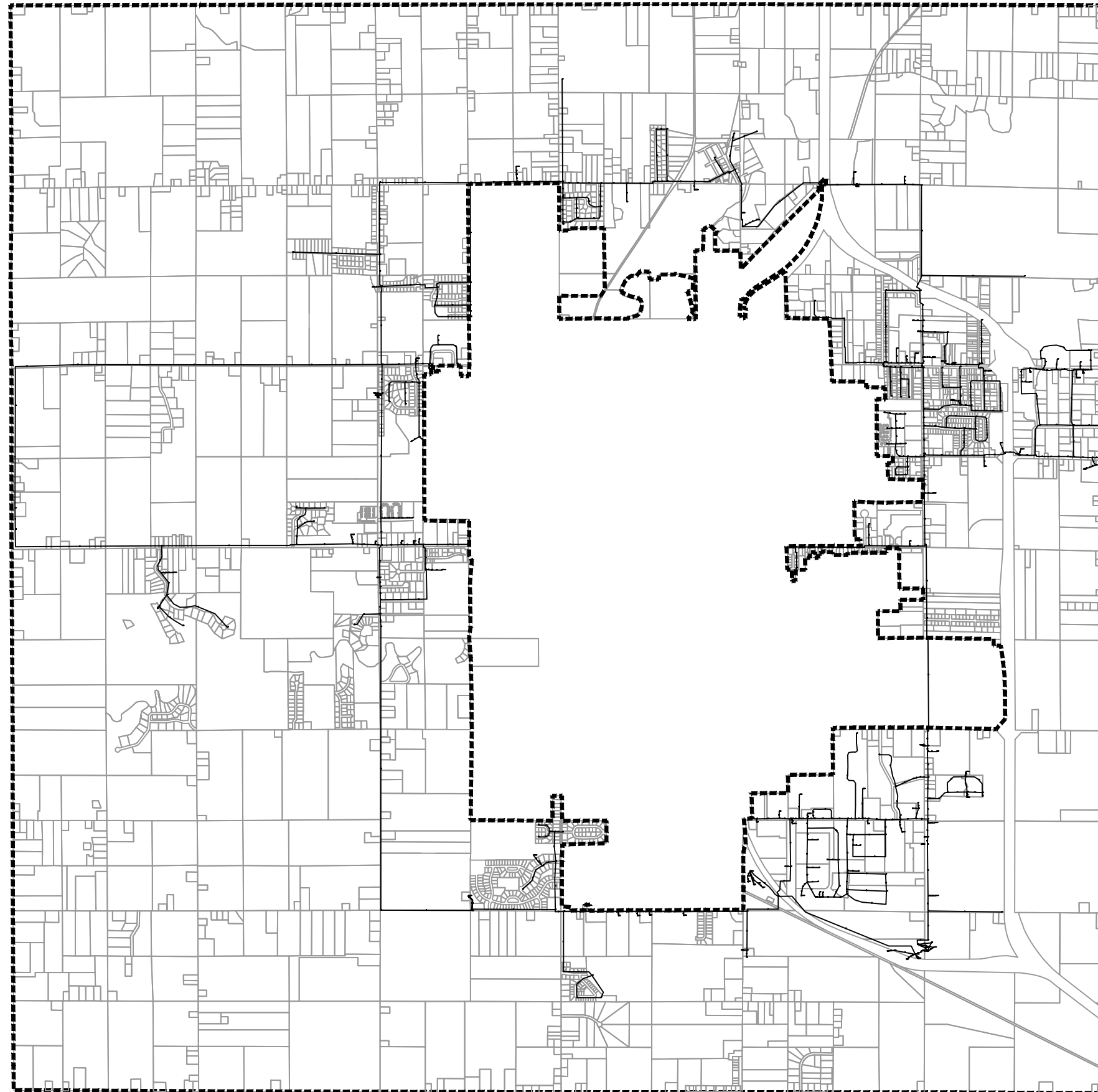
- Township Watermain
- Private Watermain
- Water Tank or Tower
- Water Production Well
- Pressure Reducing Valve (PRV)
- Hydrant - 729 Total
- Park
- School
- Mid Michigan College
- City / Township / County Property
- Saginaw Chippewa Tribal Trust & Fee Lands
- Apartment Complex
- River, Creek, or Drain
- Lake or Pond
- Central Michigan University
- City of Mt. Pleasant
- Township Parcel

Union Township Water Treatment Plant Detail



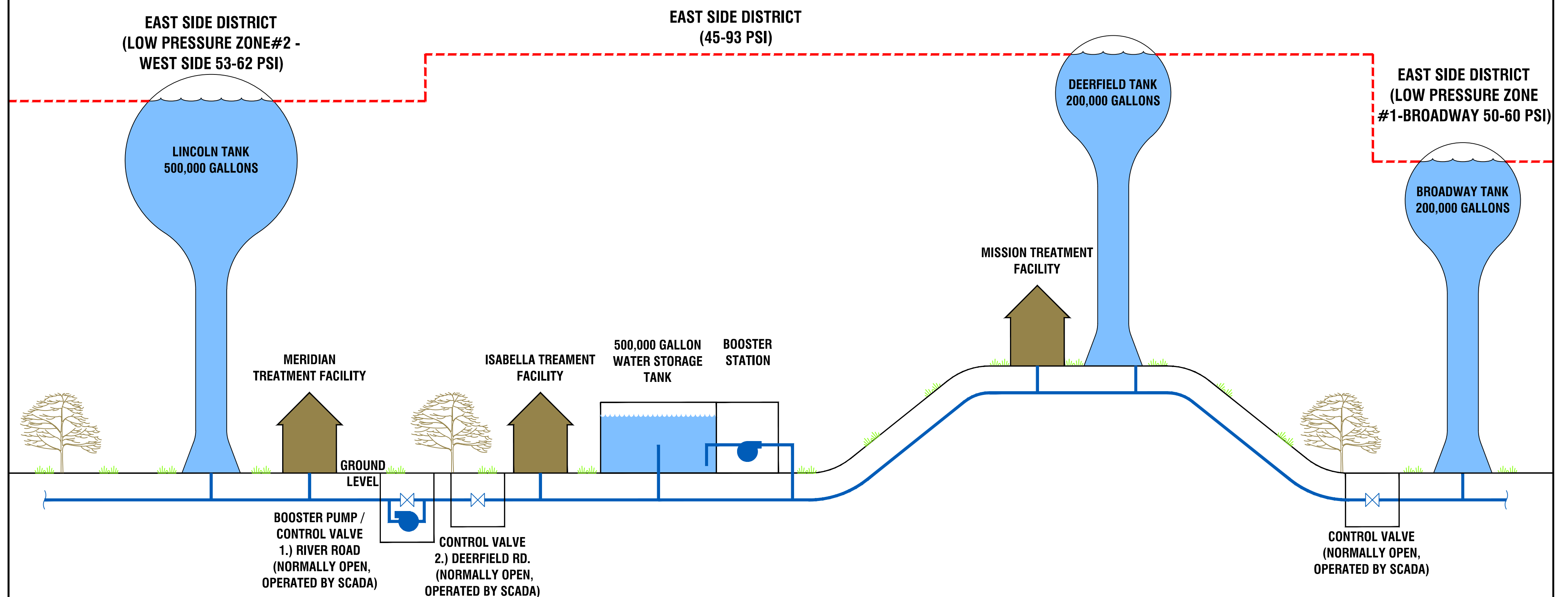
WaterCAD Node Map

Charter Township Of Union, Isabella County, Michigan



NOT TO SCALE

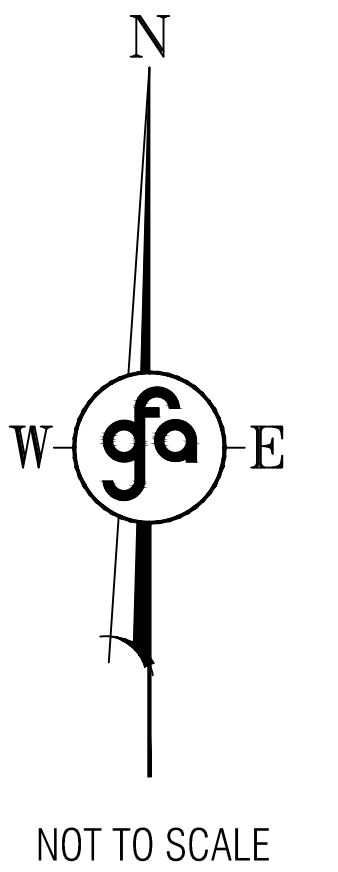
Charter Township of Union Existing Water System Operation Map



NOTE:
WEST SIDE LOW PRESSURE ZONE IS CONNECTED TO EAST SIDE SERVICE DISTRICT AT TWO SEPARATE LOCATIONS.
1) DEERFIELD ROAD
2) RIVER ROAD

FIGURE 2

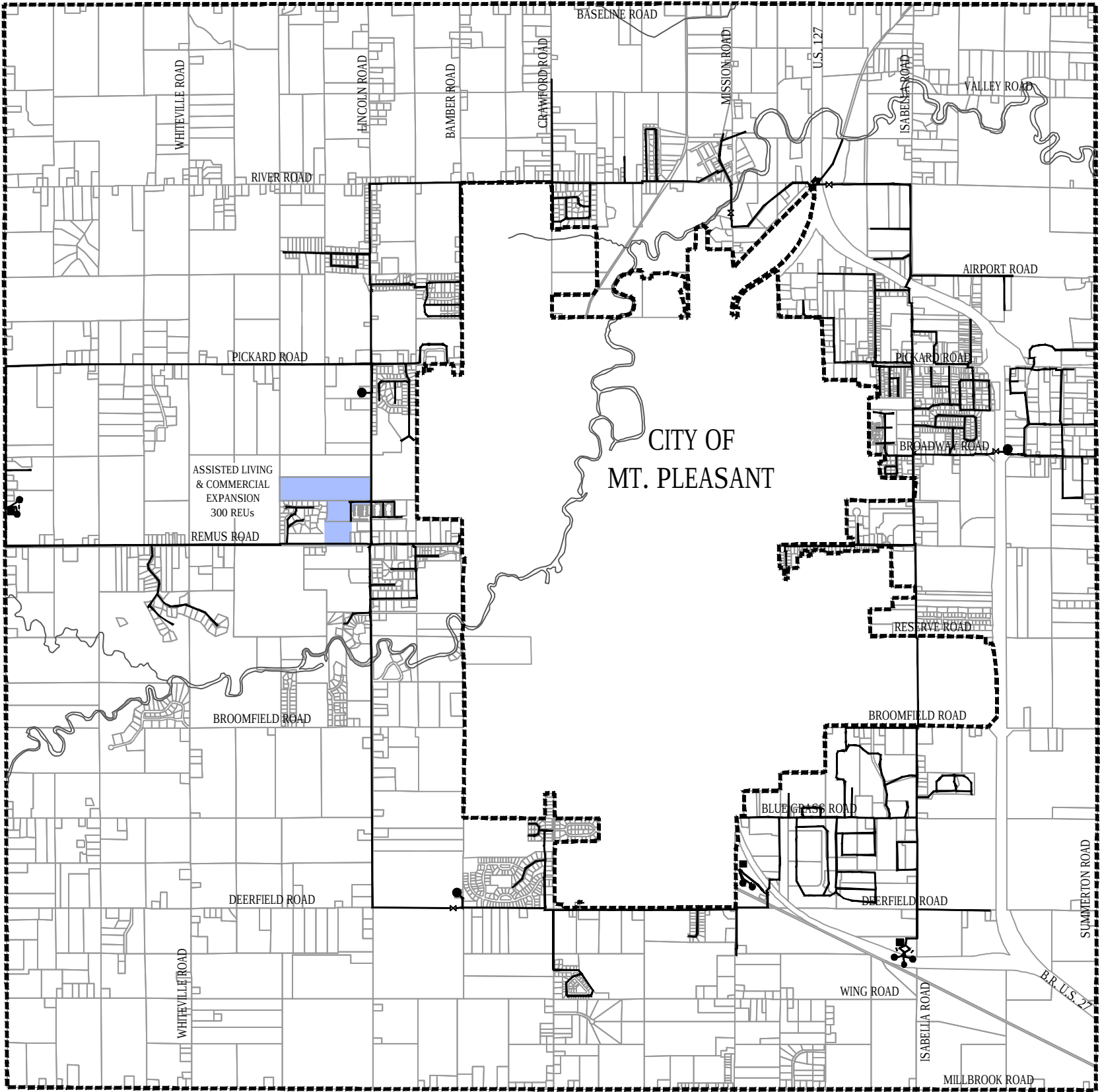
gfa Gourdie-Fraser



 UPPER PRESSURE ZONE
 LOW PRESSURE ZONE
 UNION TOWNSHIP LIMITS
 EXISTING WATERMAIN

FIGURE 3

Future Water Use Projections
Charter Township Of Union, Isabella County

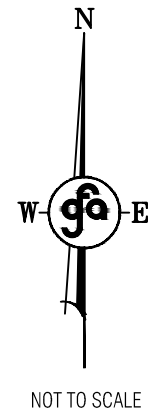
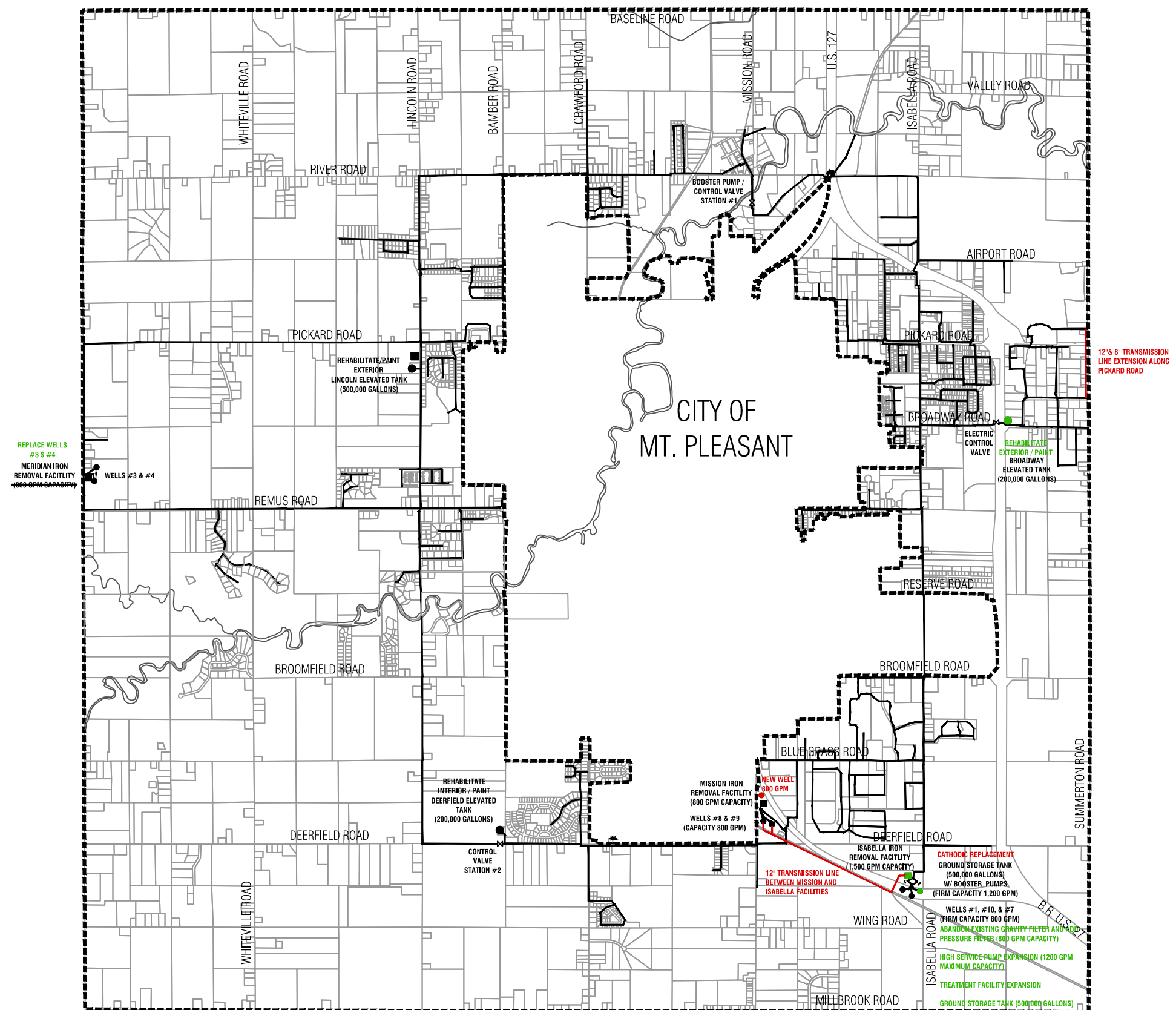


LEGEND

- 5 YEAR PROJECTION
- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN

FIGURE 4

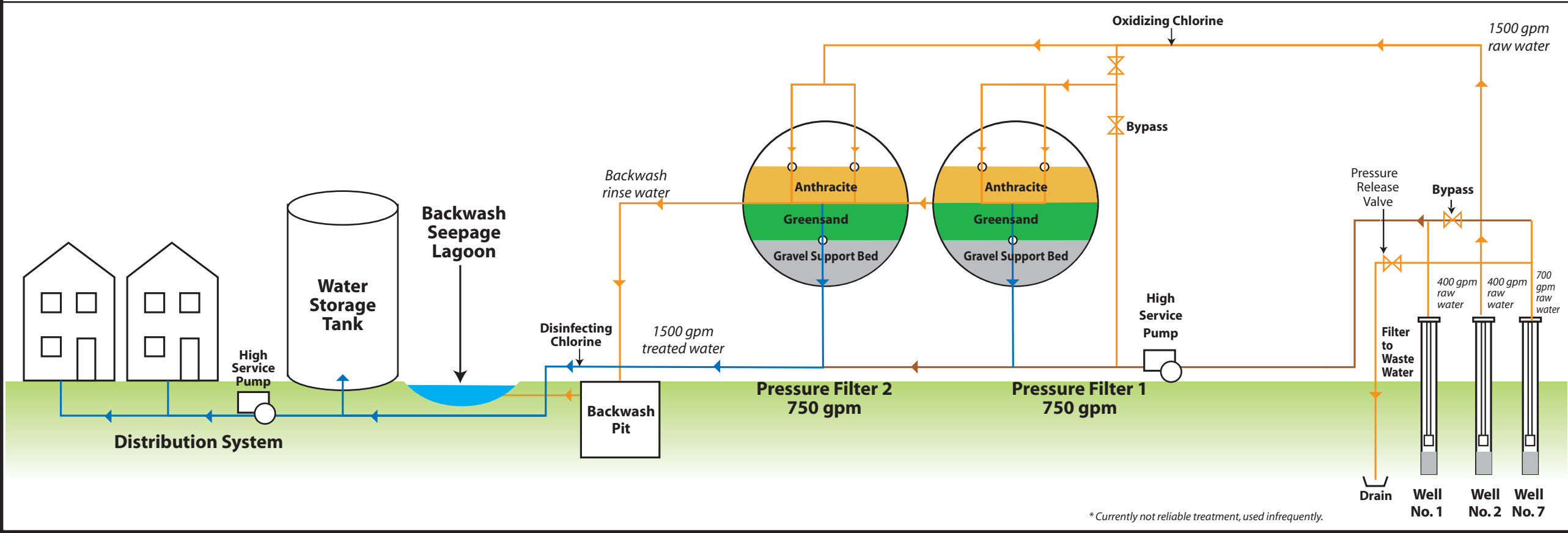
Proposed Water System Infrastructure Improvements Map
Charter Township Of Union, Isabella County



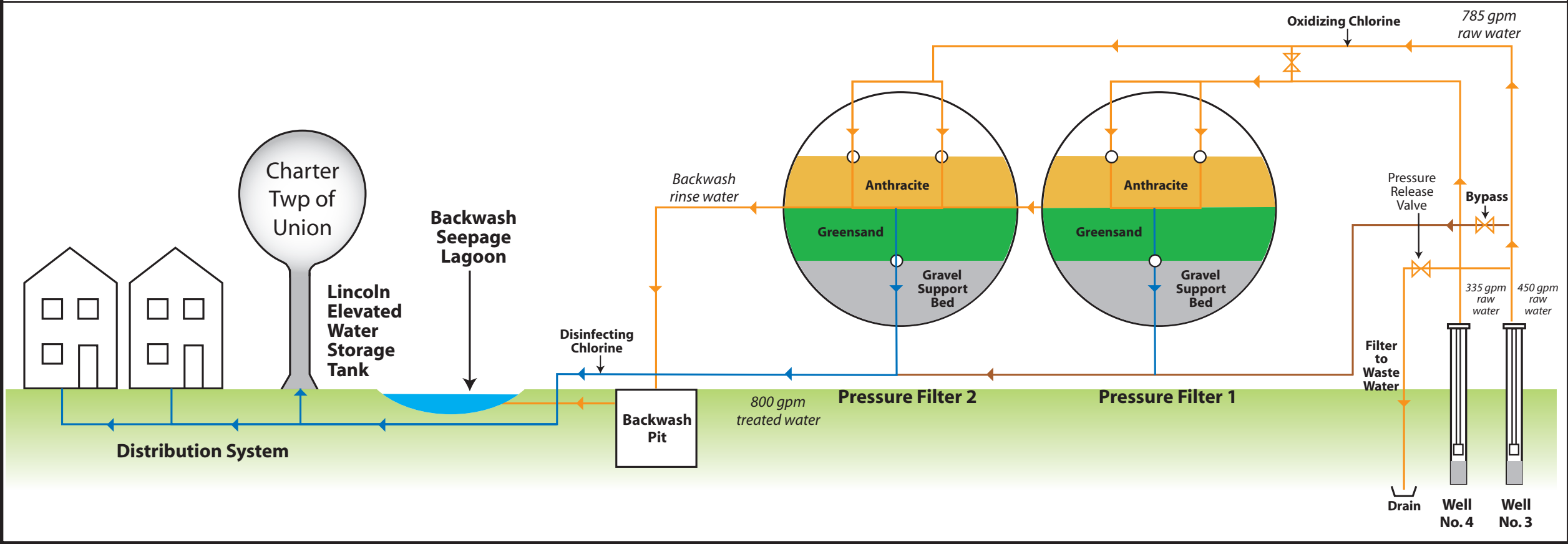
- LEGEND**
- UNION TOWNSHIP LIMITS
 - EXISTING WATERMAIN
 - 0-5 YEAR IMPROVEMENTS
 - 5-20 YEAR IMPROVEMENTS

FIGURE 5

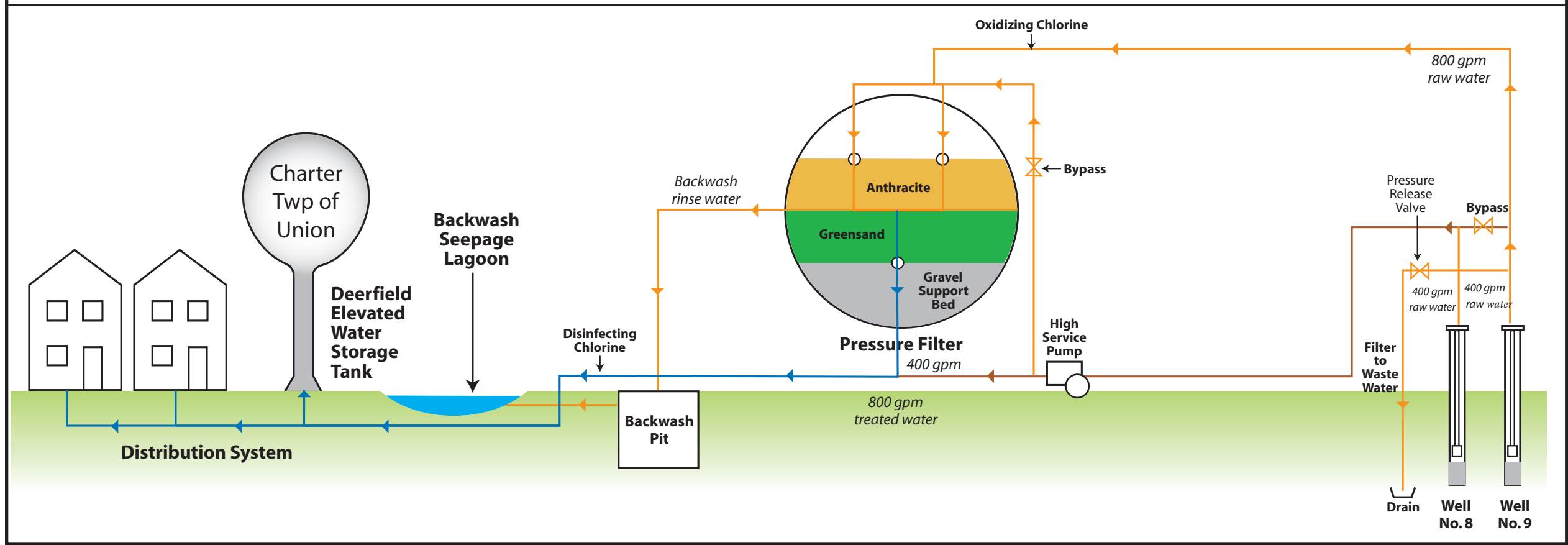
Existing Isabella Road Treatment System



Existing Meridian Road Treatment System



Existing Mission Road Treatment System



APPENDIX B

Opinion of Probable Construction Costs



OPINION OF PROBABLE CONSTRUCTION COSTS – NOVEMBER 2022

WATER SUPPLY

INITIAL PERIOD AND SHORT TERM: 1-5 YEAR IMPROVEMENTS

ITEM 1: INSPECTION, TESTING & MAINTENANCE OF WELLS

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1.	Inspection & Televising	EA	7	\$4,500.00	\$31,500.00
2.	Well Cleaning & Redevelop	EA	4	\$600.00	\$2,400.00
3.	Well Testing & Repairs (Overhaul)	EA	4	\$2,000.00	\$ 8,000.00
ESTIMATED CONSTRUCTION COST:					\$41,900.00
10% CONTINGENCIES:					\$5,000.00
TOTAL OF BID					\$46,900.00

ITEM 2: NEW WELL : UPGRADE CAPACITY

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.50	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	2000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	350	LF	\$ 32.00	\$ 11,200.00
PRODUCTION WELL					
PHASE I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
PHASE II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
PHASE III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	9,000	LF	\$ 85.00	\$ 765,000.00
2	Gate Valve & Box, 12"	9	EA	\$ 7,500.00	\$ 67,500.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$0.00
TOTAL ESTIMATED CONSTRUCTION COST					\$1,131,700.00
10% CONTINGENCY					\$113,200.00
DESIGN, ENGINEERING, CONSTRUCTION ADMINISTRATION					\$249,000.00
TOTAL OF BID					\$1,493,900.00

**ITEM 3: ISABELLA TREATMENT FACILITY: GRAVITY FILTER REMOVAL /
PRESSURE FILTER ADDITION**

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Removal and disposal of Existing filter, pumps, electrical, piping, fittings and valves	LS	1	\$150,000.00	\$150,000.00
2	12' Diameter Horizontal Pressure Filters (700 GPM Rated) including installation	LS	1	\$750,000.00	\$750,000.00
3	Existing Building, Roof Repair	LS	1	\$130,000.00	\$130,000.00
4	Room Expansion (50X50)	LS	SQFT	\$500.00	\$1,250,000.00
5	Piping, Valves, Fittings (new and salvaged)	LS	1	\$100,000.00	\$100,000.00
6	Flow Meter and Chemical Treatment Equipment (salvaged and reinstalled)	LS	1	\$75,000.00	\$75,000.00
7	Electrical and Instrumentation	LS	1	\$50,000.00	\$50,000.00
8	Backwash Lagoon Expansion	LS	1	\$115,000.00	\$115,000.00
9	Mobilization / Restoration	LS	1	\$20,000.00	\$20,000.00
ESTIMATED CONSTRUCTION COST:					\$3,203,500.00
10% CONTINGENCIES:					\$320,000.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$550,000.00
TOTAL OF BID					\$4,070,000.00

*Assumes existing gravity filter building is adequate in size to house new filter

ITEM 4: ISABELLA TREATMENT FACILITY: HIGH SERVICE PUMP ADDITION

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	High Service Pumps rated at 600 GPM / 290' TDH including installation	EA	3	\$80,000.00	\$240,000.00
2	Piping, Valves, Fittings	LS	1	\$75,000.00	\$75,000.00
3	Electrical / Instrumentation	LS	1	\$50,000.00	\$50,000.00
4	Pump Room Expansion (20 x 26') including HVAC / Electrical	SQFT	520	\$750.00	\$390,000.00
5	Variable Frequency Drives (100 Hp)	EA	3	\$25,000.00	\$75,000.00
6	SCADA Programming	LS	1	\$22,000.00	\$22,000.00
7	Mobilization / Restoration	LS	1	\$15,000.00	\$15,000.00
ESTIMATED CONSTRUCTION COST:					\$867,000.00

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	High Service Pumps rated at 600 GPM / 290' TDH including installation	EA	3	\$80,000.00	\$240,000.00
10% CONTINGENCIES:					\$86,700.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$190,740.00
TOTAL OF BID					\$1,144,440.00

LONG-TERM PERIOD: 6-20 YEAR IMPROVEMENTS

ITEM 1: WELL #3 & WELL #4 REAPLCEMENT

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
WELLS					
1	Aquifer Analysis (including monitoring well, testing and development)	LS	1	\$25,000.00	\$25,000.00
2	12" Type I Production Well, Rated at 400 GPM (including pump and motor)	EA	2	\$115,000.00	\$230,000.00
3	Well Abandonment	EA	2	\$7,500.00	\$15,000.00
4	Transmission Main, 8" Ductile Iron	LF	250	\$150.00	\$75,000.00
SITE					
1	Restoration	LS	1	\$15,000.00	\$15,000.00
ESTIMATED CONSTRUCTION COST:					\$360,000.00
10% CONTINGENCIES:					\$36,000.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$79,200.00
TOTAL OF BID					\$475,200.00

ITEM 2: INSPECTION, TESTING & MAINTENANCE OF WELLS

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Inspection & Televising	EA	7	\$4,500.00	\$31,500.00
2	Well Cleaning & Redevelop	EA	7	\$600.00	\$2,400.00
3	Well Testing & Repairs (Overhaul)	EA	7	\$2,000.00	\$ 8,000.00
ESTIMATED CONSTRUCTION COST:					\$49,700.00
TOTAL OF BID					\$49,700.00

WATER STORAGE

INITIAL PERIOD AND SHORT TERM: 1-5 YEAR IMPROVEMENTS

ITEM 1: MAINTENANCE ON EXISTING STORAGE TANKS

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Routine Tank Inspection	EA	4	\$5,000.00	\$20,000.00
ESTIMATED CONSTRUCTION COST:					\$20,000.00
10% CONTINGENCIES:					\$2,000.00
TOTAL OF BID					\$22,000.00

ITEM 2: ISABELLA GROUND TANK: MAINTENANCE

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1.	Replace Cathodic Protection System	LS	1	\$30,000.00	\$30,000.00
ESTIMATED CONSTRUCTION COST:					\$30,000.00
10% CONTINGENCIES:					\$3,000.00
TOTAL OF BID					\$33,000.00

LONG-TERM PERIOD: 6-20 YEAR IMPROVEMENTS

ITEM 1: MAINTENANCE ON EXISTING STORAGE TANKS

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	\$20,000.00	EA	4	\$5,000.00	\$20,000.00
ESTIMATED CONSTRUCTION COST:					\$20,000.00
10% CONTINGENCIES:					\$2,000.00
TOTAL OF BID					\$22,000.00

**ITEM 2: ISABELLA TREATMENT FACILITY: 500,000 GALLON GROUND
WATER STORAGE TANK**

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	500,000 Gallon Ground Water Storage Tank, 60 foot Diameter (including foundation & cathodic protection)	LS	1	\$1,500,000.00	\$1,500,000.00
2	Gate Valve and Box, 12"	EA	1	\$18,000.00	\$18,000.00
3	Site Piping	LS	1	\$100,000.00	\$100,000.00
4	SCADA / Telemetry Upgrades	LS	1	\$30,000.00	\$30,000.00
5	Restoration	LS	1	\$15,000.00	\$15,000.00
ESTIMATED CONSTRUCTION COST:					\$1,663,000.00
10% CONTINGENCIES:					\$166,000.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$366,000.00
TOTAL OF BID					\$2,195,000.00

WATER DISTRIBUTION

INITIAL PERIOD AND SHORT TERM: 1-5 YEAR IMPROVEMENTS

ITEM 1: ISABELLA TO MISSION TREATMENT FACILITIES: RAW / FINISHED WATER TRANSMISSION MAIN EXTENSION

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1.	Water Main, 12" C900	LF	6,500	\$120.00	\$780,000.00
2.	Gate Valve and Box, 12"	EA	6	\$10,500.00	\$63,000.00
3.	Connect to Existing	EA	2	\$6,500.00	\$13,000.00
4.	Patching Asphalt, Roadway and Driveways	SY	180	\$30.00	\$5,400.00
5.	Directional Drill, 12" Water Main C900	LF	230	\$250.00	\$57,500.00
6.	Site Restoration	LS	1	\$20,000.00	\$20,000.00
ESTIMATED CONSTRUCTION COST:					\$939,000.00
10% CONTINGENCIES:					\$93,900.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$207,000.00
TOTAL OF BID					\$1,239,900.00

ITEM 2: METER CALIBRATION

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Calibration of Master Meters	EA	7	\$2,600.00	\$18,200.00
ESTIMATED CONSTRUCTION COST:					\$18,200.00
10% CONTINGENCIES:					\$1,800.00
TOTAL OF BID					\$20,000.00

ITEM 3: PICKARD ROAD TRANSMISSION MAIN EXTENSION

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Mobilization	1	LS	\$25,000.00	\$25,000.00
2	Traffic Control	1	LS	\$15,000.00	\$15,000.00
3	Water Main, C900, 12"	2,000	LF	\$110.00	\$220,000.00

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
4	Water Main, C900, 8"	1,000	LF	\$95.00	\$95,000.00
5	Gate Valve and Box, 12"	2	EA	\$5,650.00	\$11,300.00
6	Gate Valve and Box, 8"	1	EA	\$4,250.00	\$4,250.00
7	Fire Hydrant Assembly	5	EA	\$6,500.00	\$32,500.00
8	Connect to Existing	2	EA	\$6,500.00	\$13,000.00
9	Live Tap and Valve, 8"	2	EA	\$8,500.00	\$17,000.00
10	Driveway Patch, Concrete	275	SY	\$100.00	\$27,500.00
11	Driveway Patch, Asphalt	45	SY	\$65.00	\$2,925.00
12	Curb & Gutter Removal & Replacement, Concrete	80	LF	\$45.00	\$3,600.00
13	Trees Remove & Replace	12	EA	\$1,500.00	\$18,000.00
14	Sidewalk Remove & Replace, Concrete	3,325	SF	\$10.00	\$33,250.00
15	Site Restoration	1	LS	\$25,000.00	\$25,000.00
ESTIMATED CONSTRUCTION COST:					\$543,300.00
10% CONTINGENCIES:					\$54,330.00
DESIGN ENGINEERING, CONSTRUCTION ADMINISTRATION:					\$119,500.00
TOTAL OF BID					\$717,130.00

ITEM 4: LEAD SERVICE LINE REPLACEMENT

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Lead Service Line Replacement	EA	150	\$5,000.00	\$750,000.00
2	Lead Hydrant Head Replacement	EA	40	\$10,500.00	\$420,000.00
ESTIMATED CONSTRUCTION COST:					\$1,170,000.00
10% CONTINGENCIES:					\$117,000.00
TOTAL OF BID					\$1,287,000.00

LONG-TERM PERIOD: 6-20 YEAR IMPROVEMENTS

ITEM 1: METER CALIBRATION

No.	Item	Unit	Est. Quantity	Unit Price	Item Cost
1	Calibration of Master Meters	EA	7	\$2,600.00	\$18,200.00
ESTIMATED CONSTRUCTION COST:					\$18,200.00
10% CONTINGENCIES:					\$1,800.00
TOTAL OF BID					\$20,000.00

NOTES REGARDING ALL OF THE TABLES ABOVE

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, land, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- This cost estimate is approximate. Actual construction bids may vary significantly from this statement of probable costs due to timing of construction, changed conditions, labor rate changes, or other factors beyond the control of Gourdie-Fraser.
- The scope of each improvement was determined within the water reliability report and may vary from the actual individual project scopes.
- These costs are estimated costs for 2022 projects.

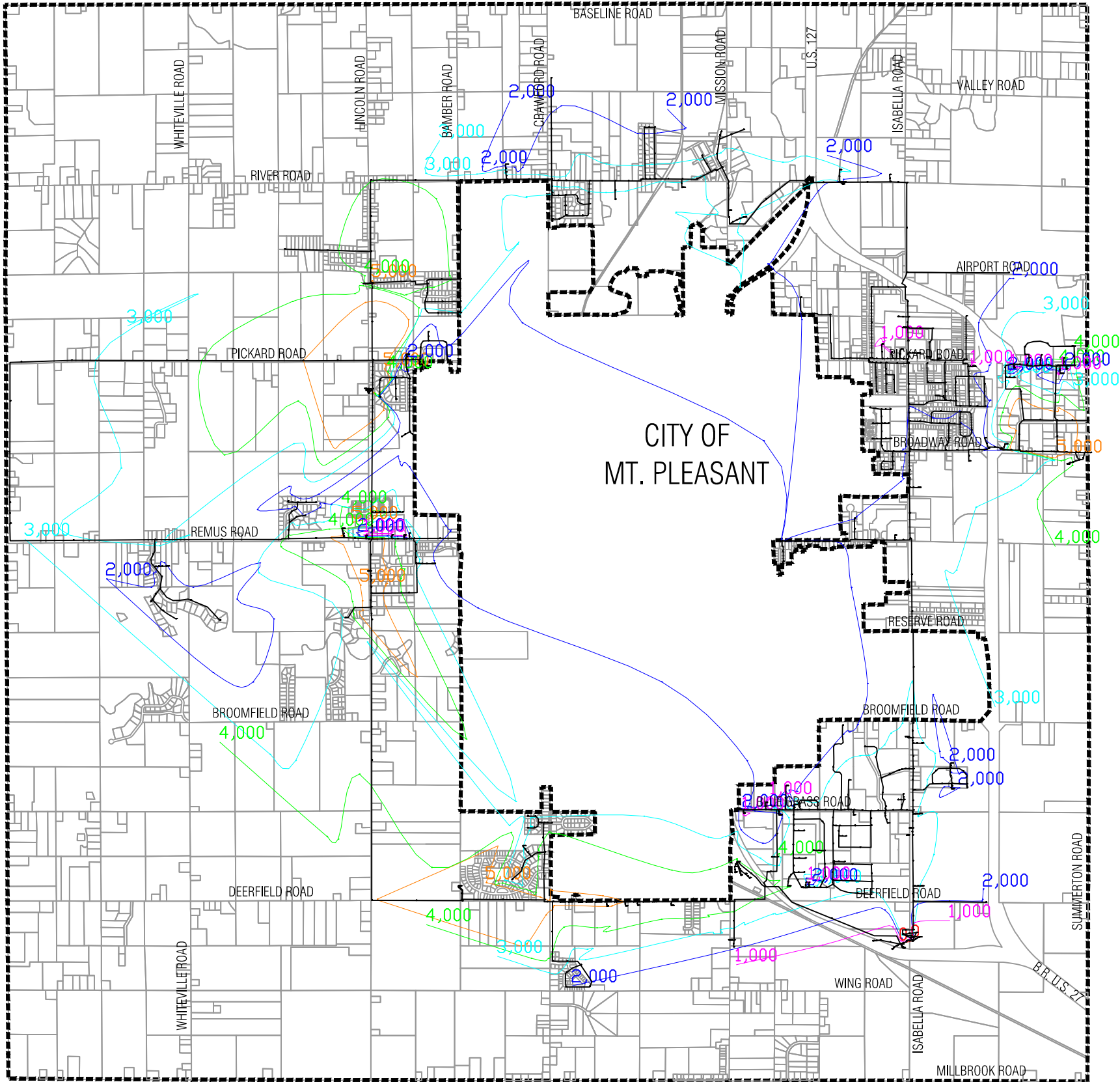
APPENDIX C

Water System Computer Model



Existing Max Day Available Fire Flow Contour Map

Charter Township Of Union, Isabella County, Michigan



NOT TO SCALE

LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

Existing Fire Flow Analysis					
Label	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Satisfies Fire Flow Constraints?	Pressure (Calculated Residual) (psi)	Service District
J-36W	1,500	15,000	TRUE	37.4	West Side Service District
J-10S	1,500	11,795	TRUE	20	East Side Service District
J-14E	1,500	8,810	TRUE	21.7	East Side Service District - Lower Pressure Zone
J-13W	1,500	8,456	TRUE	25.4	West Side Service District
J-414	1,500	8,000	TRUE	49.9	East Side Service District
J-415	1,500	8,000	TRUE	35.6	East Side Service District
J-423	1,500	8,000	TRUE	61.6	East Side Service District
J-115E	1,500	7,010	TRUE	20.4	East Side Service District - Lower Pressure Zone
J-16E	1,500	6,749	TRUE	20	East Side Service District - Lower Pressure Zone
J-48W	1,500	6,679	TRUE	22.6	West Side Service District
J-8W	1,500	6,163	TRUE	22	West Side Service District
J-116E	1,500	6,130	TRUE	23.8	East Side Service District - Lower Pressure Zone
J-73W	1,500	6,029	TRUE	20	West Side Service District
J-7W	1,500	6,004	TRUE	20	West Side Service District
J-5W	1,500	5,936	TRUE	20	West Side Service District
J-6W	1,500	5,920	TRUE	20	West Side Service District
J-17E	1,500	5,905	TRUE	20	East Side Service District - Lower Pressure Zone
J-15E	1,500	5,890	TRUE	24.3	East Side Service District - Lower Pressure Zone
Arboretum Apts.	1,500	5,875	TRUE	20	West Side Service District
J-74W	1,500	5,874	TRUE	22.2	West Side Service District
J-72W	1,500	5,858	TRUE	23	West Side Service District
J-8S	1,500	5,395	TRUE	20	East Side Service District
J-40S	1,500	5,207	TRUE	21.7	West Side Service District
Northwinds	1,500	5,190	TRUE	20.4	East Side Service District
J-87S	1,500	5,091	TRUE	20	East Side Service District
J-16W	1,500	5,039	TRUE	23.5	West Side Service District
TimberCreek	1,500	5,030	TRUE	20	East Side Service District
J-88S	1,500	4,984	TRUE	20	East Side Service District
J-7S	1,500	4,971	TRUE	20	East Side Service District
J-406	1,500	4,959	TRUE	21.7	West Side Service District
J-90S	1,500	4,949	TRUE	20	East Side Service District
J-35W	1,500	4,947	TRUE	24.1	West Side Service District
J-89S	1,500	4,942	TRUE	20	East Side Service District
Deerfield Village	1,500	4,928	TRUE	20	East Side Service District
Lexington Ridge Apts.	1,500	4,899	TRUE	20	East Side Service District
United Apts.	1,500	4,888	TRUE	20	East Side Service District
J-381	1,500	4,801	TRUE	23.5	West Side Service District
J-411	1,500	4,778	TRUE	20	<None>
J-388	1,500	4,774	TRUE	24.3	East Side Service District - Lower Pressure Zone
J-49W	1,500	4,713	TRUE	22.2	West Side Service District
J-390	1,500	4,653	TRUE	22.4	East Side Service District - Lower Pressure Zone
J-5S	1,500	4,642	TRUE	25.2	East Side Service District
J-38S	1,500	4,586	TRUE	20	East Side Service District - Lower Pressure Zone
J-19E	1,500	4,510	TRUE	20	East Side Service District - Lower Pressure Zone
J-19W	1,500	4,488	TRUE	20	West Side Service District
J-3S	1,500	4,482	TRUE	28.6	East Side Service District
J-382	1,500	4,460	TRUE	20	East Side Service District - Lower Pressure Zone
J-75S	1,500	4,389	TRUE	20	East Side Service District
J-47W	1,500	4,312	TRUE	21.5	West Side Service District
J-178E	1,500	4,185	TRUE	20	East Side Service District - Lower Pressure Zone
J-63W	1,500	4,159	TRUE	21.8	West Side Service District
Mission Treatment Facility	1,500	4,101	TRUE	20	East Side Service District
J-389	1,500	4,058	TRUE	20	East Side Service District - Lower Pressure Zone
J-95S	1,500	4,044	TRUE	25.1	East Side Service District
J-171E	1,500	4,009	TRUE	20	East Side Service District - Lower Pressure Zone
J-378	1,500	3,986	TRUE	20	West Side Service District
J-391	1,500	3,978	TRUE	23	East Side Service District - Lower Pressure Zone
J-110E	1,500	3,976	TRUE	20	East Side Service District - Lower Pressure Zone
J-108E	1,500	3,976	TRUE	20	East Side Service District - Lower Pressure Zone
Hydrant 11 - Green Acres	1,500	3,971	TRUE	20	West Side Service District
J-426	1,500	3,967	TRUE	20	East Side Service District
J-20E	1,500	3,964	TRUE	20	East Side Service District - Lower Pressure Zone
J-18E	1,500	3,963	TRUE	20	East Side Service District - Lower Pressure Zone
J-177E	1,500	3,939	TRUE	20	East Side Service District - Lower Pressure Zone
J-17W	1,500	3,935	TRUE	20	West Side Service District
J-73S	1,500	3,903	TRUE	20	East Side Service District
J-170E	1,500	3,889	TRUE	20	East Side Service District - Lower Pressure Zone
J-106E	1,500	3,881	TRUE	20	East Side Service District - Lower Pressure Zone
J-427	1,500	3,872	TRUE	20	East Side Service District
Hydrant 1 - Lincoln	1,500	3,852	TRUE	20	West Side Service District
MMCC	1,500	3,844	TRUE	20	East Side Service District - Lower Pressure Zone
J-79S	1,500	3,829	TRUE	20	East Side Service District
J-21W	1,500	3,824	TRUE	20	West Side Service District
J-9S	1,500	3,818	TRUE	20	East Side Service District
J-134E	1,500	3,737	TRUE	20	East Side Service District - Lower Pressure Zone
J-398	1,500	3,732	TRUE	21.3	West Side Service District

J-94S	1,500	3,717	TRUE	22.6	East Side Service District
J-51S	1,500	3,717	TRUE	20.5	East Side Service District
J-96S	1,500	3,715	TRUE	22.8	East Side Service District
Village Bluegrass	1,500	3,715	TRUE	22.1	East Side Service District
J-11S	1,500	3,712	TRUE	23.1	East Side Service District
J-48S	1,500	3,710	TRUE	21.4	East Side Service District
J-69S	1,500	3,709	TRUE	21	East Side Service District
J-47S	1,500	3,708	TRUE	21.3	East Side Service District
J-59S	1,500	3,708	TRUE	23.1	East Side Service District
J-57S	1,500	3,696	TRUE	22.3	East Side Service District
J-55S	1,500	3,696	TRUE	21.5	East Side Service District
J-23S	1,500	3,696	TRUE	21.6	East Side Service District
J-56S	1,500	3,694	TRUE	22.4	East Side Service District
J-52S	1,500	3,694	TRUE	22.1	East Side Service District
J-53S	1,500	3,694	TRUE	22.2	East Side Service District
J-54S	1,500	3,693	TRUE	23.2	East Side Service District
J-26S	1,500	3,693	TRUE	24.6	East Side Service District
J-25S	1,500	3,691	TRUE	28	East Side Service District
J-40S	1,500	3,690	TRUE	27.5	East Side Service District
J-37S	1,500	3,690	TRUE	27.5	East Side Service District
J-24S	1,500	3,690	TRUE	27	East Side Service District
J-31S	1,500	3,689	TRUE	24.9	East Side Service District
J-27S	1,500	3,689	TRUE	20.5	East Side Service District
J-29S	1,500	3,689	TRUE	28.2	East Side Service District
J-22S	1,500	3,688	TRUE	20.6	East Side Service District
J-379	1,500	3,688	TRUE	43.2	East Side Service District
J-19S	1,500	3,687	TRUE	27.7	East Side Service District
J-13S	1,500	3,687	TRUE	23.7	East Side Service District
J-58S	1,500	3,687	TRUE	42.6	East Side Service District
J-21S	1,500	3,684	TRUE	22.8	East Side Service District
J-403	1,500	3,681	TRUE	23	East Side Service District
J-36S	1,500	3,681	TRUE	44.4	East Side Service District
J-28S	1,500	3,672	TRUE	20	East Side Service District
J-1S	1,500	3,671	TRUE	22.6	East Side Service District
J-49S	1,500	3,670	TRUE	20	East Side Service District
J-93S	1,500	3,668	TRUE	22	East Side Service District
J-50W	1,500	3,664	TRUE	21.3	West Side Service District
J-34S	1,500	3,657	TRUE	47.7	East Side Service District
J-33S	1,500	3,657	TRUE	23.5	East Side Service District
J-83S	1,500	3,655	TRUE	22.6	East Side Service District
J-399	1,500	3,638	TRUE	21.3	West Side Service District
Previously Isolation Valve	1,500	3,618	TRUE	20	East Side Service District
J-75W	1,500	3,618	TRUE	20	West Side Service District
Walmart	1,500	3,617	TRUE	20	East Side Service District
J-25W	1,500	3,609	TRUE	20.4	West Side Service District
J-85S	1,500	3,608	TRUE	22.6	East Side Service District
Casino	1,500	3,604	TRUE	20	East Side Service District - Lower Pressure Zone
J-62S	1,500	3,598	TRUE	43	East Side Service District
J-50S	1,500	3,597	TRUE	20	East Side Service District
J-410	1,500	3,592	TRUE	23.5	East Side Service District
J-84S	1,500	3,571	TRUE	22.6	East Side Service District
J-42W	1,500	3,569	TRUE	20	West Side Service District
J-2E	1,500	3,564	TRUE	20.8	East Side Service District
J-22W	1,500	3,561	TRUE	21.3	West Side Service District
Arbors @ Eagle Crest	1,500	3,558	TRUE	21.8	East Side Service District
J-43W	1,500	3,540	TRUE	20	West Side Service District
J-32S	1,500	3,532	TRUE	20	East Side Service District
J-94W	1,500	3,529	TRUE	21	West Side Service District
J-20S	1,500	3,529	TRUE	20	East Side Service District
J-63S	1,500	3,527	TRUE	23.5	East Side Service District
J-61S	1,500	3,527	TRUE	20.8	East Side Service District
J-82S	1,500	3,526	TRUE	20.4	East Side Service District
J-52E	1,500	3,525	TRUE	20	East Side Service District
J-53E	1,500	3,519	TRUE	23.6	East Side Service District
J-3E	1,500	3,512	TRUE	22.3	East Side Service District
J-179E	1,500	3,510	TRUE	20	East Side Service District - Lower Pressure Zone
J-122E	1,500	3,501	TRUE	22.6	East Side Service District
J-120E	1,500	3,497	TRUE	24.6	East Side Service District
J-119E	1,500	3,496	TRUE	22.7	East Side Service District
J-72S	1,500	3,483	TRUE	20	East Side Service District
J-428	1,500	3,483	TRUE	20	East Side Service District
J-58W	1,500	3,465	TRUE	22.4	West Side Service District
J-123E	1,500	3,460	TRUE	25	East Side Service District
SpringBrook	1,500	3,460	TRUE	22.6	East Side Service District
J-57W	1,500	3,445	TRUE	23.6	West Side Service District
J-121E	1,500	3,445	TRUE	22.6	East Side Service District
J-142E	1,500	3,439	TRUE	20	East Side Service District
J-24W	1,500	3,433	TRUE	20	West Side Service District
J-62W	1,500	3,431	TRUE	20	West Side Service District
Jamestown I & II	1,500	3,389	TRUE	28.3	East Side Service District

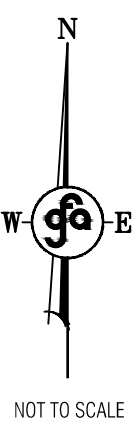
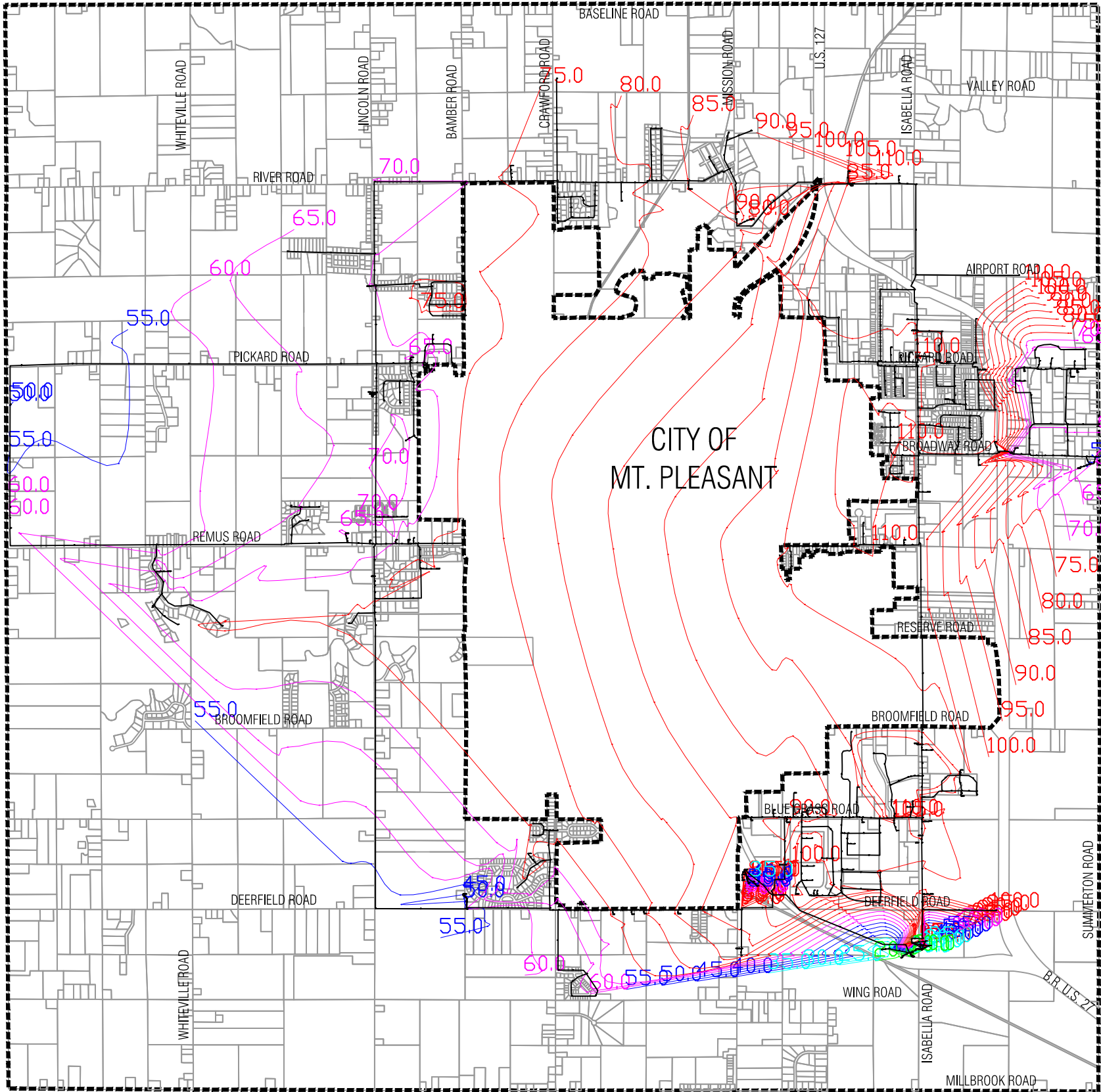
J-124E	1,500	3,389	TRUE	28.9	East Side Service District
J-28W	1,500	3,384	TRUE	20	East Side Service District
J-61W	1,500	3,368	TRUE	20.3	West Side Service District
J-30S	1,500	3,352	TRUE	21.3	East Side Service District
Hydrant 10 - Encore Blvd	1,500	3,344	TRUE	20	East Side Service District
J-129E	1,500	3,323	TRUE	21.4	East Side Service District
Union Twp WWTF	1,500	3,323	TRUE	20.9	East Side Service District
Station A	1,500	3,318	TRUE	20	East Side Service District
J-76W	1,500	3,300	TRUE	20.1	West Side Service District
J-182E	1,500	3,288	TRUE	20	East Side Service District - Lower Pressure Zone
Hydrant 4 - Summerton	1,500	3,286	TRUE	20	East Side Service District - Lower Pressure Zone
Copper Beach	1,500	3,275	TRUE	20	East Side Service District
Hydrant 12 - Aldi	1,500	3,265	TRUE	20	East Side Service District
Home Depot	1,500	3,264	TRUE	20	East Side Service District - Lower Pressure Zone
J-27W	1,500	3,254	TRUE	23.9	East Side Service District
J-396	1,500	3,247	TRUE	23.9	East Side Service District
J-4E	1,500	3,230	TRUE	20	East Side Service District
J-39S	1,500	3,224	TRUE	20	East Side Service District
J-2W	1,500	3,194	TRUE	20	West Side Service District
J-394	1,500	3,192	TRUE	22.7	East Side Service District
J-393	1,500	3,191	TRUE	24.3	East Side Service District
J-20W	1,500	3,157	TRUE	20	West Side Service District
J-9W	1,500	3,151	TRUE	20	West Side Service District
J-51W	1,500	3,145	TRUE	20.9	West Side Service District
J-46S	1,500	3,083	TRUE	20	East Side Service District
J-3W	1,500	3,050	TRUE	20	West Side Service District
J-18W	1,500	3,036	TRUE	20	West Side Service District
J-92S	1,500	3,033	TRUE	20	East Side Service District
J-71W	1,500	3,033	TRUE	20	West Side Service District
J-4W	1,500	3,028	TRUE	21.3	West Side Service District
J-60S	1,500	3,003	TRUE	20	East Side Service District
Hydrant A2 on S. Isabella	1,500	2,994	TRUE	20	East Side Service District
J-401	1,500	2,977	TRUE	21.3	West Side Service District
Hydrant 6 - River Road	1,500	2,971	TRUE	20	East Side Service District
Hydrant B2 on S. Isabella	1,500	2,929	TRUE	20	East Side Service District
Hydrant 5 - Bilbrael Drive	1,500	2,928	TRUE	20	East Side Service District
J-34W	1,500	2,922	TRUE	20.7	West Side Service District
J-52W	1,500	2,916	TRUE	20	West Side Service District
J-10W	1,500	2,855	TRUE	24.3	West Side Service District
J-71S	1,500	2,807	TRUE	20	East Side Service District
J-60E	1,500	2,792	TRUE	22.8	East Side Service District
J-12W	1,500	2,771	TRUE	20	West Side Service District
J-70S	1,500	2,769	TRUE	20	East Side Service District
J-35S	1,500	2,719	TRUE	20	East Side Service District
J-429	1,500	2,708	TRUE	20	East Side Service District
J-5E	1,500	2,612	TRUE	21.6	East Side Service District
J-62E	1,500	2,588	TRUE	22.6	East Side Service District
J-61E	1,500	2,581	TRUE	22.6	East Side Service District
J-68W	1,500	2,568	TRUE	22.4	West Side Service District
J-112E	1,500	2,565	TRUE	22.6	East Side Service District
J-11W	1,500	2,562	TRUE	20	West Side Service District
J-111E	1,500	2,559	TRUE	22.6	East Side Service District
J-79E	1,500	2,520	TRUE	20	East Side Service District
Krogers	1,500	2,489	TRUE	20	East Side Service District
J-39W	1,500	2,483	TRUE	20	West Side Service District
J-38W	1,500	2,482	TRUE	20	West Side Service District
J-80E	1,500	2,454	TRUE	20	East Side Service District
J-77W	1,500	2,398	TRUE	20	West Side Service District
J-40W	1,500	2,394	TRUE	20	West Side Service District
J-41W	1,500	2,377	TRUE	20	West Side Service District
Elmers	1,500	2,374	TRUE	20	West Side Service District
J-6E	1,500	2,323	TRUE	21.3	East Side Service District
J-86S	1,500	2,304	TRUE	20	East Side Service District
Pleasant Ridge Park	1,500	2,297	TRUE	20	East Side Service District
J-91S	1,500	2,282	TRUE	20	East Side Service District
J-80S	1,500	2,278	TRUE	20	East Side Service District
J-125E	1,500	2,272	TRUE	22.2	East Side Service District
StoneCrest	1,500	2,272	TRUE	21	East Side Service District
Mount Pleasant Country Club	1,500	2,259	TRUE	20	West Side Service District
J-26W	1,500	2,246	TRUE	20	West Side Service District
J-76S	1,500	2,226	TRUE	20	East Side Service District
J-44W	1,500	2,213	TRUE	20	West Side Service District
J-14W	1,500	2,193	TRUE	22.6	West Side Service District
Isabella Mobile Home Park	1,500	2,177	TRUE	20.8	East Side Service District
J-126E	1,500	2,177	TRUE	21.1	East Side Service District
J-2S	1,500	2,170	TRUE	20	East Side Service District
J-92W	1,500	2,166	TRUE	22.6	West Side Service District
J-74E	1,500	2,162	TRUE	24.3	East Side Service District
J-6S	1,500	2,145	TRUE	20	East Side Service District
J-383	1,500	2,085	TRUE	22.2	West Side Service District

J-9E	1,500	2,080	TRUE	21.6	East Side Service District
Baymont Inn	1,500	2,075	TRUE	20	East Side Service District - Lower Pressure Zone
J-45W	1,500	2,073	TRUE	20.9	West Side Service District
J-11E	1,500	2,071	TRUE	21.6	East Side Service District
J-37W	1,500	2,069	TRUE	20	West Side Service District
J-12E	1,500	2,065	TRUE	20.2	East Side Service District
J-384	1,500	2,064	TRUE	22.2	West Side Service District
J-65W	1,500	2,060	TRUE	22.6	West Side Service District
J-58E	1,500	2,048	TRUE	20.5	East Side Service District
J-55E	1,500	2,044	TRUE	21.7	East Side Service District
J-81S	1,500	2,042	TRUE	20	East Side Service District
J-93W	1,500	2,039	TRUE	22.6	West Side Service District
J-127E	1,500	2,029	TRUE	20	East Side Service District
Hydrant 8 - Rogers Street	1,500	2,027	TRUE	20	West Side Service District
J-21E	1,500	2,027	TRUE	21.9	East Side Service District
J-57E	1,500	2,017	TRUE	20	East Side Service District
The Crossings	1,500	2,013	TRUE	20	East Side Service District
J-56E	1,500	2,008	TRUE	20	East Side Service District
J-13E	1,500	2,000	TRUE	58	West Side Service District
J-130E	1,500	1,997	TRUE	20	East Side Service District
J-7E	1,500	1,994	TRUE	20	East Side Service District
J-73E	1,500	1,993	TRUE	20	East Side Service District
J-22E	1,500	1,990	TRUE	21.9	East Side Service District
Broadway Acres	1,500	1,982	TRUE	20	East Side Service District
J-69W	1,500	1,974	TRUE	20	West Side Service District
J-54E	1,500	1,942	TRUE	20	East Side Service District
J-36E	1,500	1,931	TRUE	21.7	East Side Service District
J-37E	1,500	1,925	TRUE	21.7	East Side Service District
J-83E	1,500	1,916	TRUE	22.6	East Side Service District
J-81E	1,500	1,903	TRUE	22.6	East Side Service District
J-50E	1,500	1,896	TRUE	21.4	East Side Service District
J-131E	1,500	1,893	TRUE	22.9	East Side Service District
Jack Loeks	1,500	1,893	TRUE	22.1	East Side Service District
J-35E	1,500	1,892	TRUE	22.6	East Side Service District
J-181E	1,500	1,889	TRUE	20	East Side Service District
J-76E	1,500	1,884	TRUE	24.6	East Side Service District
J-55W	1,500	1,882	TRUE	23.5	West Side Service District
J-82E	1,500	1,880	TRUE	22.6	East Side Service District
J-66E	1,500	1,869	TRUE	23.5	East Side Service District
J-180E	1,500	1,861	TRUE	20	East Side Service District
J-48E	1,500	1,844	TRUE	20	East Side Service District
J-132E	1,500	1,842	TRUE	20	East Side Service District
J-45E	1,500	1,838	TRUE	20	East Side Service District
Hydrant 3 - Point Royal	1,500	1,838	TRUE	20	West Side Service District
J-80W	1,500	1,834	TRUE	20.7	West Side Service District
J-38E	1,500	1,833	TRUE	20	East Side Service District
Hydrant B on E. Pickard	1,500	1,833	TRUE	20	West Side Service District
J-44E	1,500	1,827	TRUE	20	East Side Service District
J-75E	1,500	1,826	TRUE	20	East Side Service District
J-42E	1,500	1,824	TRUE	20	East Side Service District
J-408	1,500	1,824	TRUE	22.4	East Side Service District
Hydrant 9- Kay Street	1,500	1,824	TRUE	22.4	East Side Service District
J-23E	1,500	1,823	TRUE	23.1	East Side Service District
J-34E	1,500	1,816	TRUE	20	East Side Service District
J-133E	1,500	1,804	TRUE	20	East Side Service District
J-416	1,500	1,801	TRUE	20	East Side Service District
Soaring Eagle Waterpark	1,500	1,799	TRUE	20	East Side Service District
J-24E	1,500	1,798	TRUE	20	East Side Service District
Pickard St. Care Wash	1,500	1,798	TRUE	20	East Side Service District
J-27E	1,500	1,796	TRUE	20	East Side Service District
J-28E	1,500	1,796	TRUE	20	East Side Service District
J-369	1,500	1,795	TRUE	20	East Side Service District
J-59W	1,500	1,795	TRUE	20	West Side Service District
J-60W	1,500	1,795	TRUE	20	West Side Service District
Hampton Inn	1,500	1,793	TRUE	20	East Side Service District
J-56W	1,500	1,783	TRUE	20.9	West Side Service District
J-63E	1,500	1,774	TRUE	20.1	East Side Service District
J-25E	1,500	1,766	TRUE	20.2	East Side Service District
J-66W	1,500	1,764	TRUE	20	West Side Service District
J-29W	1,500	1,763	TRUE	20	West Side Service District
J-29E	1,500	1,755	TRUE	20	East Side Service District
J-64E	1,500	1,751	TRUE	23.1	East Side Service District
J-51E	1,500	1,748	TRUE	21.6	East Side Service District
J-128E	1,500	1,725	TRUE	21.6	East Side Service District
Delfield	1,500	1,725	TRUE	21.4	East Side Service District
J-1W	1,500	1,711	TRUE	20	West Side Service District
J-39E	1,500	1,707	TRUE	20	East Side Service District
J-67W	1,500	1,682	TRUE	20	West Side Service District
J-26E	1,500	1,681	TRUE	20	East Side Service District
J-49E	1,500	1,677	TRUE	20	East Side Service District

Station B	1,500	1,668	TRUE	20	East Side Service District
J-96E	1,500	1,667	TRUE	20.4	East Side Service District
J-72E	1,500	1,667	TRUE	24.4	East Side Service District
J-46W	1,500	1,663	TRUE	20	West Side Service District
J-30W	1,500	1,654	TRUE	20	West Side Service District
J-31W	1,500	1,653	TRUE	20	West Side Service District
J-12S	1,500	1,650	TRUE	20	East Side Service District
J-31E	1,500	1,649	TRUE	20	East Side Service District
J-78E	1,500	1,613	TRUE	20	East Side Service District
Hydrant 7 - River Road	1,500	1,596	TRUE	20	West Side Service District
J-70E	1,500	1,593	TRUE	20.7	East Side Service District
J-69E	1,500	1,593	TRUE	20.9	East Side Service District
J-71E	1,500	1,592	TRUE	25.2	East Side Service District
J-65E	1,500	1,587	TRUE	20	East Side Service District
Hydrant B on E. Bluegrass	1,500	1,571	TRUE	20	East Side Service District
J-54W	1,500	1,570	TRUE	20	West Side Service District
J-40E	1,500	1,552	TRUE	20	East Side Service District
J-43E	1,500	1,551	TRUE	20	East Side Service District
J-64W	1,500	1,542	TRUE	20	West Side Service District
J-70W	1,500	1,537	TRUE	20	West Side Service District
J-68E	1,500	1,526	TRUE	22.2	East Side Service District
Hydrant A on E. Bluegrass	1,500	1,521	TRUE	20	East Side Service District
Hydrant B @ Eagles	1,500	1,502	TRUE	20	East Side Service District
Hydrant A @ Eagles	1,500	1,500	TRUE	20	East Side Service District
J-77E	1,500	1,498	FALSE	20	East Side Service District
J-46E	1,500	1,496	FALSE	20	East Side Service District
J-32E	1,500	1,496	FALSE	20	East Side Service District
J-41E	1,500	1,491	FALSE	20	East Side Service District
J-53W	1,500	1,489	FALSE	20	West Side Service District
J-67E	1,500	1,478	FALSE	20	East Side Service District
University Meadows	1,500	1,458	FALSE	20	East Side Service District
J-30E	1,500	1,441	FALSE	20	East Side Service District
J-23W	1,500	1,420	FALSE	20	West Side Service District
J-91W	1,500	1,413	FALSE	22.8	West Side Service District
J-90W	1,500	1,413	FALSE	20.5	West Side Service District
J-33E	1,500	1,395	FALSE	20	East Side Service District
J-15W	1,500	1,366	FALSE	20	West Side Service District
J-32W	1,500	1,343	FALSE	20	West Side Service District
J-8E	1,500	1,307	FALSE	20	East Side Service District
Hydrant B1 on S. Isabella	1,500	1,291	FALSE	20	East Side Service District
Hydrant A1 on S. Isabella	1,500	1,283	FALSE	20	East Side Service District
Hydrant A on E. Pickard	1,500	1,241	FALSE	20	West Side Service District
J-33W	1,500	1,211	FALSE	20	West Side Service District
J-47E	1,500	1,133	FALSE	20.1	East Side Service District
Applebees	1,500	927	FALSE	20.1	East Side Service District
M&D Investments / Microtel	1,500	925	FALSE	20.1	East Side Service District
Health Park	1,500	924	FALSE	20.1	East Side Service District
Red Lobster	1,500	896	FALSE	20.1	East Side Service District
C & H Development / LoneStar	1,500	846	FALSE	20	East Side Service District - Lower Pressure Zone
Union Square	1,500	824	FALSE	20.1	East Side Service District
J-38S	1,500	791	FALSE	20.1	East Side Service District
Bill Millard	1,500	751	FALSE	20	West Side Service District
McDonalds	1,500	748	FALSE	20	West Side Service District
Bob Evans	1,500	233	FALSE	20	East Side Service District - Lower Pressure Zone
ABS Enterprises	1,500	215	FALSE	20.3	West Side Service District
Isabella Treatment Facility	1,500	0	FALSE	3.3	East Side Service District
J-380	1,500	0	FALSE	12.9	East Side Service District

Existing Max Day Pressure Contour Map

Charter Township Of Union, Isabella County, Michigan



LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

Existing Max Day Demand					
ID	Label	Pressure (psi)	Elevation (ft)	Hydraulic Grade (ft)	Service District
1070	J-379	126	728	1019.2	East Side Service District
1064	J-62S	125.6	730	1020.2	East Side Service District
1062	J-58S	125.1	730	1019.2	East Side Service District
461	J-36S	124.5	731	1018.8	East Side Service District
286	J-34S	123.1	734	1018.5	East Side Service District
358	J-35S	122.8	735	1018.8	East Side Service District
287	J-61S	122.8	738	1021.8	East Side Service District
289	J-63S	122.3	739	1021.8	East Side Service District
288	J-60S	121.5	741	1021.8	East Side Service District
336	J-76E	116.6	748	1017.6	East Side Service District
337	J-75E	116.2	749	1017.6	East Side Service District
338	J-71E	114.6	753	1018.0	East Side Service District
343	J-57E	114.6	753	1017.9	East Side Service District
344	J-56E	114.6	753	1017.9	East Side Service District
299	J-55E	114.6	753	1017.9	East Side Service District
255	J-69E	114.2	754	1018.0	East Side Service District
253	J-58E	114.2	754	1017.9	East Side Service District
254	J-72E	113.8	755	1018.0	East Side Service District
295	J-96E	113.8	755	1018.0	East Side Service District
256	J-70E	113.8	755	1018.0	East Side Service District
292	J-23E	113.7	755	1017.8	East Side Service District
294	J-408	113.7	755	1017.8	East Side Service District
296	Hydrant 9- Kay Street	113.7	755	1017.8	East Side Service District
155	J-51E	113.5	755	1017.4	East Side Service District
491	J-128E	113.5	755	1017.4	East Side Service District
492	Delfield	113.5	755	1017.4	East Side Service District
171	J-66E	112.9	757	1018.0	East Side Service District
423	J-64E	112.9	757	1018.0	East Side Service District
424	J-124E	112.5	760	1020.0	East Side Service District
267	Jamestown I & II	112.5	760	1020.0	East Side Service District
268	J-49E	112.4	758	1017.7	East Side Service District
413	J-50E	112.3	758	1017.6	East Side Service District
414	Station B	111.9	758.6	1017.3	East Side Service District
172	J-30E	111.9	759	1017.7	East Side Service District
170	J-68E	111.6	760	1018.0	East Side Service District
1029	J-131E	111.5	760	1017.7	East Side Service District
165	Jack Loeks	111.5	760	1017.7	East Side Service District
297	J-25E	111.1	761	1017.7	East Side Service District
433	J-31E	110.7	762	1017.8	East Side Service District
434	J-32E	110.7	762	1017.8	East Side Service District
160	J-33E	110.7	762	1017.8	East Side Service District
156	J-26E	110.6	762	1017.7	East Side Service District
157	J-27E	110.6	762	1017.7	East Side Service District
158	J-47E	110.6	762	1017.7	East Side Service District
161	J-369	110.6	762	1017.7	East Side Service District
162	M&D Investments / Microtel	110.6	762	1017.7	East Side Service District
183	J-74E	110.5	763	1018.5	East Side Service District
450	J-73E	110.5	763	1018.5	East Side Service District
451	J-77E	110.3	763	1018.0	East Side Service District
339	J-24E	110.2	763	1017.7	East Side Service District
340	J-83E	110.2	763	1017.7	East Side Service District
298	J-81E	110.2	763	1017.7	East Side Service District
159	J-28E	110.2	763	1017.7	East Side Service District
363	J-29E	110.2	763	1017.7	East Side Service District
364	J-416	110.2	763	1017.7	East Side Service District
163	Soaring Eagle Waterpark	110.2	763	1017.7	East Side Service District
164	J-133E	110.2	763	1017.7	East Side Service District
1012	Hampton Inn	110.2	763	1017.7	East Side Service District
1015	J-34E	110.2	763	1017.7	East Side Service District
439	J-35E	110.2	763	1017.7	East Side Service District
440	J-82E	110.2	763	1017.7	East Side Service District
166	J-65E	109.9	764	1018.0	East Side Service District
167	J-78E	109.9	764	1018.0	East Side Service District
366	J-12E	109.9	764	1018.0	East Side Service District
269	J-127E	109.9	764	1018.0	East Side Service District
293	J-130E	109.9	764	1018.0	East Side Service District
143	Broadway Acres	109.9	764	1018.0	East Side Service District
421	The Crossings	109.9	764	1018.0	East Side Service District
431	J-63E	109.5	765	1018.0	East Side Service District
432	J-67E	109.5	765	1018.0	East Side Service District
422	J-21E	109.4	765	1017.9	East Side Service District
141	J-22E	109.4	765	1017.8	East Side Service District
291	J-36E	109.4	765	1017.8	East Side Service District

153	J-37E	109.3	765	1017.7	East Side Service District
154	J-9E	109	766	1018.0	East Side Service District
169	J-11E	109	766	1018.0	East Side Service District
168	J-181E	108.9	766	1017.7	East Side Service District
140	Pickard St. Care Wash	108.9	766	1017.7	East Side Service District
142	J-180E	108.9	766	1017.7	East Side Service District
456	Applebees	108.9	766	1017.7	East Side Service District
457	J-132E	108.9	766	1017.7	East Side Service District
454	J-45E	108.9	766	1017.7	East Side Service District
455	J-46E	108.9	766	1017.7	East Side Service District
435	J-48E	108.9	766	1017.7	East Side Service District
174	Health Park	108.9	766	1017.7	East Side Service District
182	J-38E	108.5	767	1017.7	East Side Service District
173	J-39E	108.5	767	1017.7	East Side Service District
436	J-40E	108.5	767	1017.7	East Side Service District
177	J-41E	108.5	767	1017.7	East Side Service District
178	J-42E	108.5	767	1017.7	East Side Service District
179	J-43E	108.5	767	1017.7	East Side Service District
180	J-44E	108.5	767	1017.7	East Side Service District
176	J-125E	108.4	768	1018.5	East Side Service District
181	StoneCrest	108.4	768	1018.5	East Side Service District
175	J-126E	108.2	768	1018.2	East Side Service District
417	Isabella Mobile Home Park	108.2	768	1018.2	East Side Service District
418	Hydrant B1 on S. Isabella	107.6	769	1017.7	East Side Service District
419	Hydrant A1 on S. Isabella	107.6	769	1017.7	East Side Service District
420	J-6E	107.5	770	1018.5	East Side Service District
365	J-5E	107.3	771	1019.0	East Side Service District
367	J-2E	106.8	785	1031.8	East Side Service District
139	J-53E	106.4	783	1028.9	East Side Service District
138	J-7E	106.2	773	1018.5	East Side Service District
135	J-8E	106.2	773	1018.5	East Side Service District
244	J-120E	105.8	783	1027.5	East Side Service District
151	J-119E	105.8	783	1027.5	East Side Service District
152	J-52E	105.2	790	1033.2	East Side Service District
375	J-60E	105.1	778	1021.0	East Side Service District
376	J-62E	104.9	778.5	1021.0	East Side Service District
241	J-61E	104.9	778.5	1021.0	East Side Service District
258	J-111E	104.9	778.5	1021.0	East Side Service District
259	J-112E	104.9	778.5	1021.0	East Side Service District
261	J-79E	104.7	779	1021.0	East Side Service District
359	J-80E	104.7	779	1021.0	East Side Service District
361	J-4E	103.8	780	1019.8	East Side Service District
260	J-25S	103.6	778	1017.4	East Side Service District
262	J-29S	103.6	778	1017.4	East Side Service District
137	Hydrant A2 on S. Isabella	103.2	789	1027.5	East Side Service District
303	J-40S	103.2	779	1017.4	East Side Service District
304	J-38S	103.1	779	1017.4	East Side Service District
377	J-37S	103.1	779	1017.4	East Side Service District
312	J-39S	103.1	779	1017.4	East Side Service District
313	J-54E	102.9	791	1028.9	East Side Service District
310	J-24S	102.7	780	1017.4	East Side Service District
311	J-27S	102.7	780	1017.4	East Side Service District
245	Arbors @ Eagle Crest	102.3	784.5	1021.0	East Side Service District
278	Hydrant A @ Eagles	102.3	784.5	1021.0	East Side Service District
309	Hydrant B @ Eagles	102.3	784.5	1021.0	East Side Service District
257	J-123E	102.2	787	1023.1	East Side Service District
360	SpringBrook	102.2	787	1023.1	East Side Service District
362	J-28S	101.8	782	1017.4	East Side Service District
411	J-19S	101.8	782	1017.3	East Side Service District
412	Walmart	101.8	782	1017.3	East Side Service District
306	J-12S	101	784.5	1017.8	East Side Service District
279	J-26S	100.6	785	1017.5	East Side Service District
280	J-31S	100.5	785	1017.4	East Side Service District
243	J-403	100.5	785	1017.4	East Side Service District
302	J-122E	100.4	790	1022.1	East Side Service District
305	J-121E	100.4	790	1022.1	East Side Service District
486	J-3E	100.3	790	1021.9	East Side Service District
378	J-82S	100.3	790	1021.8	East Side Service District
379	J-52S	100.2	786	1017.5	East Side Service District
136	J-53S	99.7	787	1017.5	East Side Service District
335	J-20S	99.7	787	1017.4	East Side Service District
321	J-54S	99.3	788	1017.5	East Side Service District
320	J-33S	98.8	790	1018.5	East Side Service District
282	J-410	98.8	790	1018.5	East Side Service District
319	J-59S	98.7	790	1018.1	East Side Service District

290	J-94S	98.6	790	1017.9	East Side Service District
493	Copper Beach	98.6	790	1017.9	East Side Service District
322	J-96S	98.6	790	1017.9	East Side Service District
409	Village Bluegrass	98.6	790	1017.9	East Side Service District
410	J-11S	98.6	790	1017.8	East Side Service District
437	J-57S	98.4	790	1017.5	East Side Service District
438	J-55S	98.4	790	1017.5	East Side Service District
242	J-56S	98.4	790	1017.5	East Side Service District
316	J-30S	97.9	791	1017.4	East Side Service District
317	Hydrant B2 on S. Isabella	97.8	796	1022.1	East Side Service District
318	Hydrant 10 - Encore Blvd	97.5	792	1017.4	East Side Service District
307	J-51S	97.3	793	1018.0	East Side Service District
380	J-49S	97.3	793	1017.8	East Side Service District
487	J-50S	97.3	793	1017.8	East Side Service District
323	J-48S	97.3	793	1017.8	East Side Service District
325	J-3S	97.1	790	1014.4	East Side Service District
326	J-13S	97	793	1017.3	East Side Service District
324	J-142E	96.8	800	1023.7	East Side Service District
187	J-46S	96.6	794	1017.4	East Side Service District
281	J-47S	96.4	795	1017.7	East Side Service District
460	J-69S	95.5	797	1017.7	East Side Service District
308	J-23S	95.4	797	1,017.51	East Side Service District
315	Hydrant 12 - Aldi	95.4	798	1,018.46	East Side Service District
314	J-32S	94.1	800	1,017.39	East Side Service District
283	J-21S	94	800	1,017.26	East Side Service District
494	J-85S	94	800	1,017.26	East Side Service District
285	J-95S	93.2	800	1,015.46	East Side Service District
277	Krogers	93.2	800	1,015.46	East Side Service District
373	J-22S	93.2	802	1,017.36	East Side Service District
415	Mission Treatment Facility	92.7	805	1,019.35	East Side Service District
416	J-5S	92.7	793	1,007.27	East Side Service District
284	Hydrant B on E. Bluegrass	91.4	806	1,017.26	East Side Service District
190	J-93S	91.3	806	1,017.00	East Side Service District
188	University Meadows	91.3	806	1,016.91	East Side Service District
374	J-2S	91.2	806	1,016.74	East Side Service District
407	J-91S	91.2	806	1,016.74	East Side Service District
408	Red Lobster	91.2	806	1,016.74	East Side Service District
186	Previously Isolation Valve	91.2	741	951.7	<None>
403	J-92S	90.7	807	1,016.74	East Side Service District
404	Union Square	90.7	807	1,016.74	East Side Service District
1025	J-83S	90.3	808	1,016.81	East Side Service District
405	J-84S	90.3	808	1,016.81	East Side Service District
406	J-1S	90.3	808	1,016.75	East Side Service District
370	J-7S	90.2	793	1,001.40	East Side Service District
371	J-25W	89.4	745	951.64	West Side Service District
185	J-77W	89	746	951.64	West Side Service District
220	Elmers	89	746	951.64	West Side Service District
215	J-26W	89	746	951.64	West Side Service District
216	Hydrant A on E. Bluegrass	87.7	814	1,016.81	East Side Service District
427	J-86S	87.5	805	1,007.26	East Side Service District
428	J-6S	87.5	805	1,007.26	East Side Service District
372	Pleasant Ridge Park	87.5	805	1,007.26	East Side Service District
189	J-28W	85.6	754	951.86	East Side Service District
391	J-90S	85.5	800	997.71	East Side Service District
392	Lexington Ridge Apts.	85.5	800	997.71	East Side Service District
218	J-129E	85.2	755	951.91	East Side Service District
401	Union Twp WWTF	85.2	755	951.91	East Side Service District
402	J-94W	85.1	755	951.58	West Side Service District
425	Mount Pleasant Country Club	85.1	755	951.58	West Side Service District
426	Station A	83.6	758.6	951.91	East Side Service District
429	J-27W	83.4	759	951.72	East Side Service District
430	J-396	83.4	759	951.72	East Side Service District
1026	J-60W	83.3	759	951.54	West Side Service District
219	J-59W	83.3	759	951.54	West Side Service District
479	J-58W	82.9	760	951.55	West Side Service District
272	J-57W	82.9	760	951.54	West Side Service District
271	J-6W	79.5	768	951.83	West Side Service District
273	Hydrant 6 - River Road	79.5	768	951.72	East Side Service District
270	J-89S	79.1	810	992.78	East Side Service District
196	United Apts.	79.1	810	992.78	East Side Service District
480	J-72W	79.1	769	951.76	West Side Service District
399	J-24W	78.5	770	951.54	West Side Service District
400	J-429	78.1	771	951.51	East Side Service District
301	J-428	78.1	771.03	951.51	East Side Service District
221	J-393	77.7	800	979.65	East Side Service District

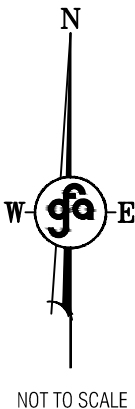
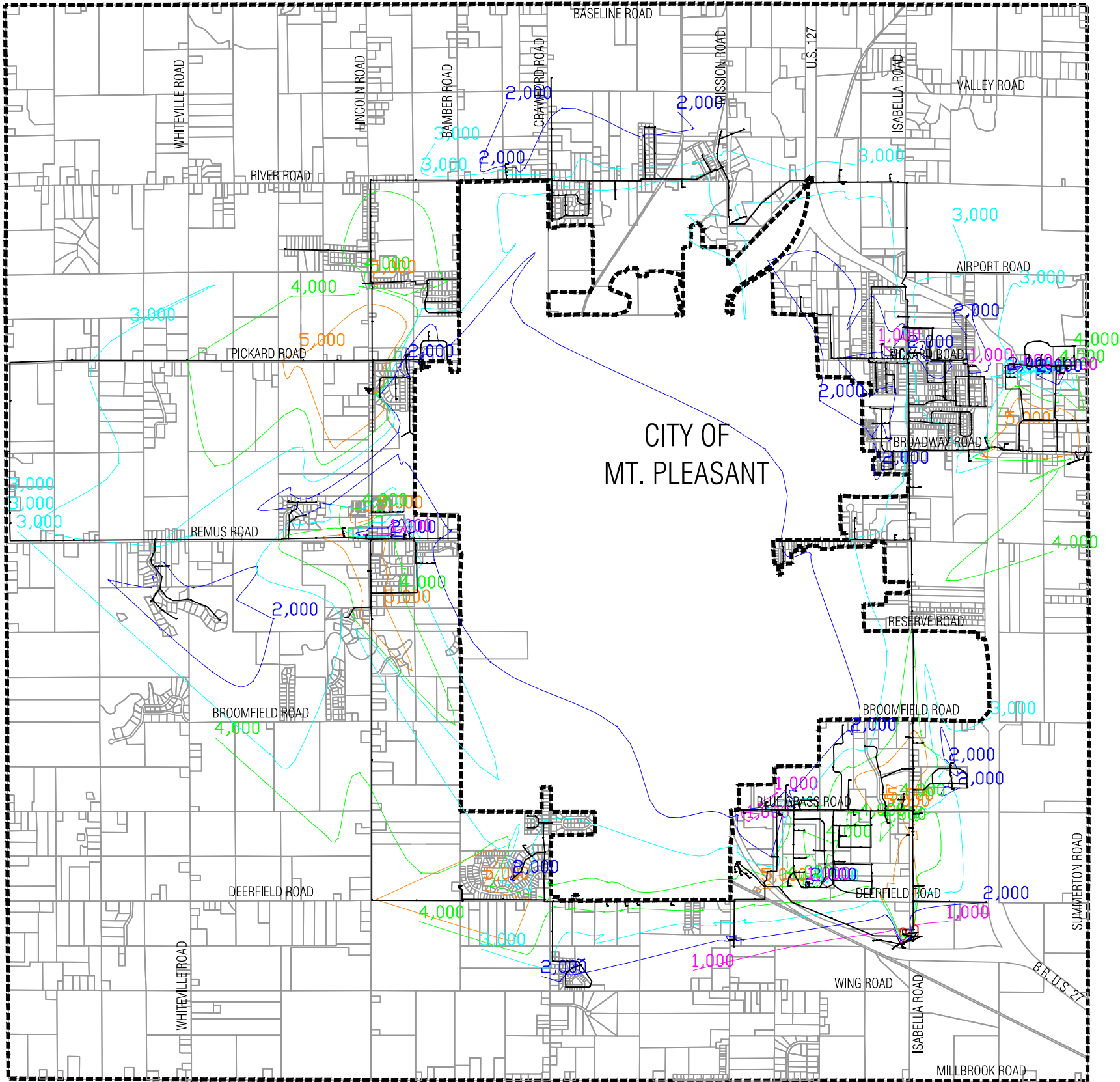
1067	J-394	77.7	800	979.65	East Side Service District
476	J-43W	77.7	772	951.48	West Side Service District
477	J-40W	77.6	772	951.46	West Side Service District
238	J-41W	77.6	772	951.46	West Side Service District
235	J-44W	77.6	772	951.46	West Side Service District
236	J-88S	77.4	812	991	East Side Service District
240	Deerfield Village	77.4	812	991	East Side Service District
397	J-42W	77.2	773	951.47	West Side Service District
398	J-45W	77.2	773	951.46	West Side Service District
237	J-22W	76.8	774	951.45	West Side Service District
239	J-9S	76.4	803	979.65	East Side Service District
214	J-4W	76.4	775	951.56	West Side Service District
192	J-401	76.4	775	951.56	West Side Service District
199	J-1W	76.4	775	951.53	West Side Service District
484	J-37W	76.3	775	951.46	West Side Service District
202	J-398	76.3	775	951.42	West Side Service District
232	J-399	76.3	775	951.42	West Side Service District
481	J-62W	76.3	775	951.32	West Side Service District
482	J-63W	76.3	775	951.32	West Side Service District
274	J-71W	76	776	951.76	West Side Service District
276	J-61W	75.9	776	951.32	West Side Service District
300	J-73S	75.6	805	979.65	East Side Service District
275	J-72S	75.6	805	979.65	East Side Service District
347	J-70S	75.6	805	979.65	East Side Service District
348	J-71S	75.6	805	979.65	East Side Service District
349	Hydrant 5 - Bilbrael Drive	75.6	805	979.65	East Side Service District
350	J-39W	75.5	777	951.46	West Side Service District
478	J-38W	75.5	777	951.46	West Side Service District
233	J-23W	75.5	777	951.45	West Side Service District
234	J-33W	75.5	777	951.4	West Side Service District
217	J-87S	75.5	814	988.4	East Side Service District
395	TimberCreek	75.5	814	988.4	East Side Service District
396	Hydrant 8 - Rogers Street	75.1	778	951.56	West Side Service District
227	Hydrant 7 - River Road	75	778	951.42	West Side Service District
485	J-31W	74.6	779	951.4	West Side Service District
483	J-30W	74.6	779	951.4	West Side Service District
228	J-32W	74.6	779	951.4	West Side Service District
229	J-17W	74.6	779	951.33	West Side Service District
230	J-5W	74.3	780	951.68	West Side Service District
211	J-7W	74.3	780	951.64	West Side Service District
198	J-3W	74.2	780	951.55	West Side Service District
197	J-2W	74.2	780	951.53	West Side Service District
200	J-18W	74.1	780	951.32	West Side Service District
201	J-75S	73.4	810	979.65	East Side Service District
212	J-76S	73.4	810	979.65	East Side Service District
345	J-73W	73.4	782	951.61	West Side Service District
346	Arboretum Apts.	73.4	782	951.61	West Side Service District
385	J-29W	73.3	782	951.4	West Side Service District
386	J-64W	73.2	782	951.27	West Side Service District
226	J-16W	72.4	784	951.32	West Side Service District
331	J-381	72.4	784	951.32	West Side Service District
208	J-76W	72	785	951.52	West Side Service District
464	ABS Enterprises	72	785	951.51	West Side Service District
393	J-91W	71.9	785	951.27	West Side Service District
394	J-48W	71.1	787	951.43	West Side Service District
341	J-66W	71.1	787	951.27	West Side Service District
248	J-67W	71.1	787	951.27	West Side Service District
333	J-49W	70.7	788	951.43	West Side Service District
334	J-65W	70.2	789	951.27	West Side Service District
250	J-93W	70.2	789	951.27	West Side Service District
332	J-75W	69.9	790	951.51	West Side Service District
383	Bill Millard	69.9	790	951.51	West Side Service District
389	J-50W	69.8	790	951.43	West Side Service District
390	J-383	69.8	790	951.4	West Side Service District
251	J-384	69.8	790	951.4	West Side Service District
466	J-21W	69.8	790	951.39	West Side Service District
467	J-378	69.8	790	951.36	West Side Service District
213	J-19W	69.8	790	951.33	West Side Service District
462	J-20W	69.8	790	951.33	West Side Service District
209	J-51W	69.4	791	951.43	West Side Service District
210	J-55W	69.3	791	951.27	West Side Service District
252	J-56W	69.3	791	951.27	West Side Service District
263	Hydrant 1 - Lincoln	68.9	792	951.32	West Side Service District
264	J-53W	68.9	792	951.27	West Side Service District
465	J-52W	68.5	793	951.43	West Side Service District

266	J-54W	68.5	793	951.27	West Side Service District
249	J-8W	67.7	795	951.49	West Side Service District
265	J-74W	67.7	795	951.49	West Side Service District
195	McDonalds	67.7	795	951.49	West Side Service District
387	Hydrant 3 - Point Royal	67.7	795	951.4	West Side Service District
388	Hydrant A on E. Pickard	67.6	795	951.27	West Side Service District
468	J-70W	67.3	796	951.46	West Side Service District
384	J-13W	67.2	796	951.29	West Side Service District
328	J-14W	67.2	796	951.27	West Side Service District
205	J-92W	67.2	796	951.27	West Side Service District
206	J-69W	66.8	797	951.46	West Side Service District
381	J-40S	66.4	798	951.48	West Side Service District
330	J-406	66.4	798	951.48	West Side Service District
488	J-68W	66.4	798	951.46	West Side Service District
489	J-90W	66.3	798	951.27	West Side Service District
329	J-36W	65.9	799	951.28	West Side Service District
342	J-15W	65.9	799	951.27	West Side Service District
231	J-423	65.9	799	951.26	<None>
207	J-47W	65.5	800	951.46	West Side Service District
1043	J-35W	65.5	800	951.3	West Side Service District
246	Hydrant 11 - Green Acres	64.7	802	951.48	West Side Service District
222	J-80W	64.7	802	951.46	West Side Service District
490	Hydrant B on E. Pickard	64.6	802	951.27	West Side Service District
327	J-46W	64	803.5	951.46	West Side Service District
382	J-20E	63.6	753	899.97	East Side Service District - Lower Pressure Zone
247	J-426	63.6	753	899.97	East Side Service District
184	Northwinds	63.2	835	981.01	East Side Service District
351	J-108E	63.2	754	899.97	East Side Service District - Lower Pressure Zone
356	J-79S	62.7	836	981.01	East Side Service District
352	J-80S	62.7	836	981.01	East Side Service District
353	J-81S	62.7	836	981.01	East Side Service District
354	J-106E	62.7	755	899.97	East Side Service District - Lower Pressure Zone
357	J-8S	62.6	835	979.65	East Side Service District
191	J-110E	62.3	756	899.97	East Side Service District - Lower Pressure Zone
355	J-134E	61.9	757	899.97	East Side Service District - Lower Pressure Zone
441	Casino	61.9	757	899.97	East Side Service District - Lower Pressure Zone
442	J-182E	61.4	758	899.98	East Side Service District - Lower Pressure Zone
458	Home Depot	61.4	758	899.98	East Side Service District - Lower Pressure Zone
459	J-179E	61.4	758	899.97	East Side Service District - Lower Pressure Zone
452	J-18E	61.4	758	899.97	East Side Service District - Lower Pressure Zone
149	Bob Evans	61.4	758	899.97	East Side Service District - Lower Pressure Zone
453	J-10W	61.2	810	951.37	West Side Service District
193	J-19E	61	759	899.97	East Side Service District - Lower Pressure Zone
150	J-178E	61	759	899.97	East Side Service District - Lower Pressure Zone
446	C & H Development / LoneStar	61	759	899.97	East Side Service District - Lower Pressure Zone
444	J-171E	61	759	899.97	East Side Service District - Lower Pressure Zone
445	MMCC	61	759	899.97	East Side Service District - Lower Pressure Zone
447	J-177E	61	759	899.97	East Side Service District - Lower Pressure Zone
448	Baymont Inn	61	759	899.97	East Side Service District - Lower Pressure Zone
449	J-170E	61	759	899.97	East Side Service District - Lower Pressure Zone
443	J-427	61	759	899.97	East Side Service District
148	J-16E	60.6	760	899.99	East Side Service District - Lower Pressure Zone
147	J-17E	60.6	760	899.98	East Side Service District - Lower Pressure Zone
469	J-382	60.6	760	899.98	East Side Service District - Lower Pressure Zone
224	J-10S	59.6	831	968.82	East Side Service District
223	J-34W	59	815	951.37	West Side Service District
144	J-13E	58.8	764	900	West Side Service District
369	J-116E	58.4	765	899.99	East Side Service District - Lower Pressure Zone
146	J-15E	58.4	765	899.98	East Side Service District - Lower Pressure Zone
470	J-388	58.4	765	899.98	East Side Service District - Lower Pressure Zone
471	J-385	58.4	765	899.98	East Side Service District - Lower Pressure Zone
473	J-390	58.4	765	899.98	East Side Service District - Lower Pressure Zone
474	J-391	58.4	765	899.98	East Side Service District - Lower Pressure Zone
194	J-9W	57.7	818	951.41	West Side Service District
145	J-14E	55.8	771	899.99	East Side Service District - Lower Pressure Zone
368	J-115E	55.8	771	899.99	East Side Service District - Lower Pressure Zone
475	Hydrant 4 - Summerton	55.4	772	899.98	East Side Service District - Lower Pressure Zone
472	J-389	54.1	775	899.98	East Side Service District - Lower Pressure Zone
1002	J-414	53	831	953.57	East Side Service District
204	J-12W	51.6	832	951.33	West Side Service District
988	J-411	51.1	835	953.14	East Side Service District
999	J-414	51	849	966.83	East Side Service District
203	J-11W	49.9	836	951.35	West Side Service District
463	J-380	13	778.5	808.46	East Side Service District
134	Isabella Treatment Facility	3.3	802	809.59	East Side Service District

225	Meridian Treatment Facility	(N/A)	829	(N/A)	West Side Service District
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5 Year Max Day Available Fire Flow Contour Map

Charter Township Of Union, Isabella County, Michigan



LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

5 Year Fire Flow Analysis

Label	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Satisfies Fire Flow Constraints?	Pressure (Calculated Residual) (psi)	Service District
J-13E	1,500	8,000	TRUE	49.4	West Side Service District
J-14E	1,500	8,000	TRUE	27.4	East Side Service District - Lower Pressure Zone
J-13W	1,500	8,000	TRUE	29.2	West Side Service District
J-10S	1,500	8,000	TRUE	34.1	East Side Service District
J-36W	1,500	8,000	TRUE	57.3	West Side Service District
J-414	1,500	8,000	TRUE	49.3	East Side Service District
J-415	1,500	8,000	TRUE	35.6	East Side Service District
J-423	1,500	8,000	TRUE	62.3	East Side Service District
J-115E	1,500	7,073	TRUE	20	East Side Service District - Lower Pressure Zone
J-48W	1,500	6,907	TRUE	20	West Side Service District
J-16E	1,500	6,765	TRUE	20	East Side Service District - Lower Pressure Zone
J-116E	1,500	6,512	TRUE	20	East Side Service District - Lower Pressure Zone
J-62S	1,500	6,445	TRUE	23.9	East Side Service District
J-8W	1,500	6,343	TRUE	20	West Side Service District
J-15E	1,500	6,311	TRUE	20	East Side Service District - Lower Pressure Zone
J-379	1,500	6,073	TRUE	25.9	East Side Service District
J-74W	1,500	6,062	TRUE	20	West Side Service District
J-73W	1,500	6,053	TRUE	20	West Side Service District
J-72W	1,500	6,051	TRUE	20	West Side Service District
J-58S	1,500	6,049	TRUE	25.5	East Side Service District
J-7W	1,500	6,027	TRUE	20	West Side Service District
J-52E	1,500	6,023	TRUE	20	East Side Service District
J-2E	1,500	6,023	TRUE	20	East Side Service District
J-5W	1,500	5,959	TRUE	20	West Side Service District
J-6W	1,500	5,939	TRUE	20	West Side Service District
J-17E	1,500	5,925	TRUE	20	East Side Service District - Lower Pressure Zone
J-36S	1,500	5,920	TRUE	28.5	East Side Service District
Arboretum Apts.	1,500	5,898	TRUE	20	West Side Service District
J-53E	1,500	5,885	TRUE	20	East Side Service District
J-120E	1,500	5,807	TRUE	20	East Side Service District
J-34S	1,500	5,757	TRUE	32.6	East Side Service District
J-119E	1,500	5,547	TRUE	20	East Side Service District
J-123E	1,500	5,543	TRUE	20	East Side Service District
J-122E	1,500	5,438	TRUE	20	East Side Service District
J-3E	1,500	5,432	TRUE	20	East Side Service District
J-124E	1,500	5,417	TRUE	20	East Side Service District
Arbors @ Eagle Crest	1,500	5,405	TRUE	20	East Side Service District
Jamestown I & II	1,500	5,346	TRUE	20	East Side Service District
J-40S	1,500	5,342	TRUE	20	West Side Service District
SpringBrook	1,500	5,217	TRUE	20	East Side Service District
J-142E	1,500	5,212	TRUE	20	East Side Service District
J-35W	1,500	5,206	TRUE	20	West Side Service District
J-121E	1,500	5,178	TRUE	20	East Side Service District
J-82S	1,500	5,163	TRUE	20	East Side Service District
J-16W	1,500	5,155	TRUE	20	West Side Service District
J-3S	1,500	5,130	TRUE	20	East Side Service District
J-388	1,500	5,113	TRUE	20	East Side Service District - Lower Pressure Zone
J-406	1,500	5,087	TRUE	20	West Side Service District
J-33S	1,500	5,008	TRUE	20	East Side Service District
J-59S	1,500	4,949	TRUE	20	East Side Service District
J-381	1,500	4,912	TRUE	20	West Side Service District
J-25S	1,500	4,861	TRUE	20	East Side Service District
J-29S	1,500	4,856	TRUE	20	East Side Service District
J-19S	1,500	4,852	TRUE	20	East Side Service District
J-49W	1,500	4,847	TRUE	20	West Side Service District
J-94S	1,500	4,841	TRUE	20	East Side Service District
J-11S	1,500	4,833	TRUE	20	East Side Service District
J-390	1,500	4,833	TRUE	20	East Side Service District - Lower Pressure Zone
J-96S	1,500	4,832	TRUE	20	East Side Service District
J-40S	1,500	4,822	TRUE	20	East Side Service District
J-37S	1,500	4,819	TRUE	20	East Side Service District
J-24S	1,500	4,790	TRUE	20	East Side Service District
J-411	1,500	4,788	TRUE	20	East Side Service District
J-410	1,500	4,768	TRUE	20	East Side Service District
Village Bluegrass	1,500	4,758	TRUE	20	East Side Service District
J-48S	1,500	4,669	TRUE	20	East Side Service District
J-4E	1,500	4,668	TRUE	20	East Side Service District
J-51S	1,500	4,668	TRUE	20	East Side Service District
J-47S	1,500	4,665	TRUE	20	East Side Service District
J-26S	1,500	4,659	TRUE	20	East Side Service District
J-69S	1,500	4,658	TRUE	20	East Side Service District
J-31S	1,500	4,654	TRUE	20	East Side Service District
J-5S	1,500	4,631	TRUE	20	East Side Service District
J-13S	1,500	4,606	TRUE	20	East Side Service District
J-63S	1,500	4,598	TRUE	20	East Side Service District
J-38S	1,500	4,597	TRUE	20	East Side Service District - Lower Pressure Zone
J-7S	1,500	4,596	TRUE	20	East Side Service District
J-54S	1,500	4,574	TRUE	20	East Side Service District
J-23S	1,500	4,551	TRUE	20	East Side Service District
J-21S	1,500	4,536	TRUE	20	East Side Service District
J-57S	1,500	4,530	TRUE	20	East Side Service District
J-19E	1,500	4,528	TRUE	20	East Side Service District - Lower Pressure Zone
J-56S	1,500	4,523	TRUE	20	East Side Service District
J-382	1,500	4,472	TRUE	20	East Side Service District - Lower Pressure Zone
J-53S	1,500	4,469	TRUE	20	East Side Service District
J-403	1,500	4,459	TRUE	20	East Side Service District
J-55S	1,500	4,457	TRUE	20	East Side Service District
J-95S	1,500	4,456	TRUE	20	East Side Service District

J-52S	1,500	4,449	TRUE	20	East Side Service District
J-61S	1,500	4,435	TRUE	20	East Side Service District
J-22S	1,500	4,422	TRUE	20	East Side Service District
J-49S	1,500	4,420	TRUE	20	East Side Service District
J-90S	1,500	4,416	TRUE	20	East Side Service District
J-47W	1,500	4,413	TRUE	20	West Side Service District
J-19W	1,500	4,412	TRUE	20	West Side Service District
J-8S	1,500	4,385	TRUE	20	East Side Service District
Lexington Ridge Apts.	1,500	4,346	TRUE	20	East Side Service District
J-87S	1,500	4,324	TRUE	20	East Side Service District
J-93S	1,500	4,312	TRUE	20	East Side Service District
J-85S	1,500	4,288	TRUE	20	East Side Service District
TimberCreek	1,500	4,254	TRUE	20	East Side Service District
J-88S	1,500	4,248	TRUE	20	East Side Service District
J-89S	1,500	4,238	TRUE	20	East Side Service District
J-27S	1,500	4,237	TRUE	20	East Side Service District
J-83S	1,500	4,224	TRUE	20	East Side Service District
J-50S	1,500	4,218	TRUE	20	East Side Service District
J-1S	1,500	4,216	TRUE	20	East Side Service District
Northwinds	1,500	4,203	TRUE	20	East Side Service District
J-178E	1,500	4,202	TRUE	20	East Side Service District - Lower Pressure Zone
J-28S	1,500	4,182	TRUE	20	East Side Service District
Deerfield Village	1,500	4,181	TRUE	20	East Side Service District
J-63W	1,500	4,178	TRUE	20	West Side Service District
J-391	1,500	4,172	TRUE	20	East Side Service District - Lower Pressure Zone
United Apts.	1,500	4,172	TRUE	20	East Side Service District
J-389	1,500	4,068	TRUE	20	East Side Service District - Lower Pressure Zone
Walmart	1,500	4,035	TRUE	20	East Side Service District
J-171E	1,500	4,026	TRUE	20	East Side Service District - Lower Pressure Zone
J-84S	1,500	3,992	TRUE	20	East Side Service District
J-110E	1,500	3,991	TRUE	20	East Side Service District - Lower Pressure Zone
J-108E	1,500	3,991	TRUE	20	East Side Service District - Lower Pressure Zone
Hydrant 11 - Green Acres	1,500	3,988	TRUE	20	West Side Service District
J-426	1,500	3,983	TRUE	20	East Side Service District
J-20E	1,500	3,980	TRUE	20	East Side Service District - Lower Pressure Zone
J-18E	1,500	3,979	TRUE	20	East Side Service District - Lower Pressure Zone
J-177E	1,500	3,955	TRUE	20	East Side Service District - Lower Pressure Zone
J-32S	1,500	3,945	TRUE	20	East Side Service District
J-170E	1,500	3,905	TRUE	20	East Side Service District - Lower Pressure Zone
J-378	1,500	3,903	TRUE	20	West Side Service District
J-106E	1,500	3,895	TRUE	20	East Side Service District - Lower Pressure Zone
J-427	1,500	3,888	TRUE	20	East Side Service District
J-17W	1,500	3,881	TRUE	20	West Side Service District
J-20S	1,500	3,876	TRUE	20	East Side Service District
MMCC	1,500	3,860	TRUE	20	East Side Service District - Lower Pressure Zone
J-5E	1,500	3,857	TRUE	20	East Side Service District
Hydrant 1 - Lincoln	1,500	3,797	TRUE	20	West Side Service District
J-134E	1,500	3,751	TRUE	20	East Side Service District - Lower Pressure Zone
J-50W	1,500	3,731	TRUE	20	West Side Service District
J-21W	1,500	3,723	TRUE	20	West Side Service District
J-75S	1,500	3,679	TRUE	20	East Side Service District
J-398	1,500	3,677	TRUE	20	West Side Service District
Hydrant A2 on S. Isabella	1,500	3,666	TRUE	20	East Side Service District
Hydrant 12 - Aldi	1,500	3,646	TRUE	20	East Side Service District
J-75W	1,500	3,632	TRUE	20	West Side Service District
Casino	1,500	3,617	TRUE	20	East Side Service District - Lower Pressure Zone
J-30S	1,500	3,589	TRUE	20	East Side Service District
J-399	1,500	3,585	TRUE	20	West Side Service District
J-179E	1,500	3,524	TRUE	20	East Side Service District - Lower Pressure Zone
Mission Treatment Facility	1,500	3,523	TRUE	20	East Side Service District
Hydrant 10 - Encore Blvd	1,500	3,514	TRUE	20	East Side Service District
Copper Beach	1,500	3,499	TRUE	20	East Side Service District
J-6E	1,500	3,498	TRUE	20	East Side Service District
J-22W	1,500	3,498	TRUE	20	West Side Service District
J-25W	1,500	3,485	TRUE	20	West Side Service District
Previously Isolation Valve	1,500	3,473	TRUE	20	East Side Service District
J-42W	1,500	3,458	TRUE	20	West Side Service District
J-57W	1,500	3,441	TRUE	20	West Side Service District
J-94W	1,500	3,432	TRUE	20	West Side Service District
J-43W	1,500	3,426	TRUE	20	West Side Service District
J-58W	1,500	3,420	TRUE	20	West Side Service District
Hydrant B2 on S. Isabella	1,500	3,395	TRUE	20	East Side Service District
J-62W	1,500	3,389	TRUE	20	West Side Service District
J-428	1,500	3,365	TRUE	20	East Side Service District
J-126E	1,500	3,347	TRUE	20	East Side Service District
J-61W	1,500	3,337	TRUE	20	West Side Service District
J-125E	1,500	3,331	TRUE	20	East Side Service District
Isabella Mobile Home Park	1,500	3,326	TRUE	20	East Side Service District
J-76E	1,500	3,324	TRUE	20	East Side Service District
J-76W	1,500	3,315	TRUE	20	West Side Service District
J-60S	1,500	3,314	TRUE	20	East Side Service District
J-24W	1,500	3,311	TRUE	20	West Side Service District
J-182E	1,500	3,297	TRUE	20	East Side Service District - Lower Pressure Zone
J-73S	1,500	3,297	TRUE	20	East Side Service District
Hydrant 4 - Summerton	1,500	3,293	TRUE	20	East Side Service District - Lower Pressure Zone
J-39S	1,500	3,287	TRUE	20	East Side Service District
J-9E	1,500	3,274	TRUE	20	East Side Service District
Home Depot	1,500	3,273	TRUE	20	East Side Service District - Lower Pressure Zone
J-11E	1,500	3,266	TRUE	20	East Side Service District
StoneCrest	1,500	3,252	TRUE	20	East Side Service District
J-21E	1,500	3,238	TRUE	20	East Side Service District

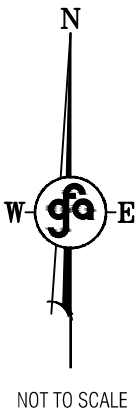
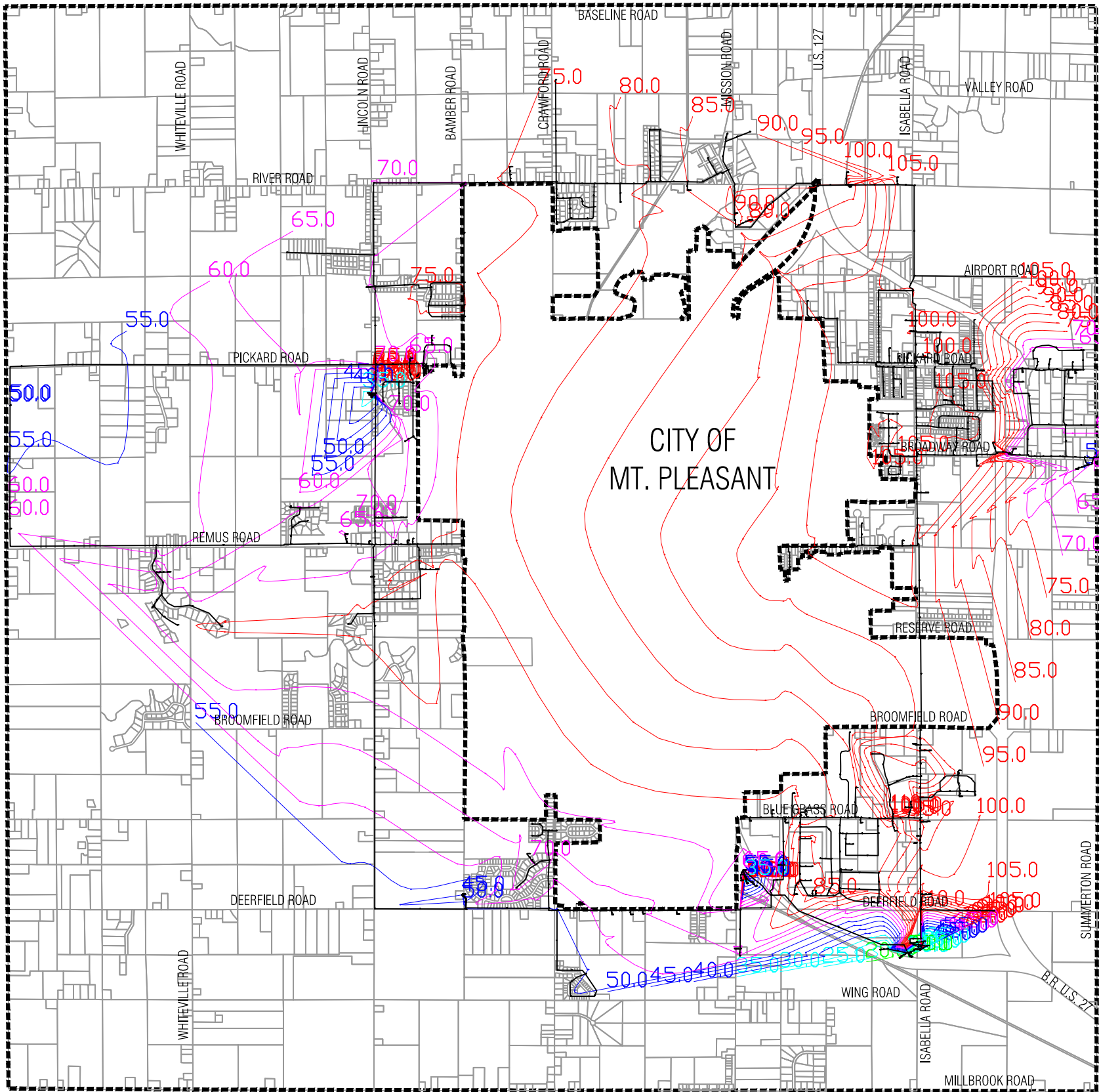
J-9S	1,500	3,235	TRUE	20	East Side Service District
J-27W	1,500	3,225	TRUE	20	East Side Service District
J-39E	1,500	3,218	TRUE	20	East Side Service District
J-28W	1,500	3,214	TRUE	20	East Side Service District
J-2W	1,500	3,206	TRUE	20	West Side Service District
J-22E	1,500	3,204	TRUE	20	East Side Service District
J-50E	1,500	3,202	TRUE	20	East Side Service District
J-51E	1,500	3,197	TRUE	20	East Side Service District
J-128E	1,500	3,196	TRUE	20	East Side Service District
J-129E	1,500	3,188	TRUE	20	East Side Service District
J-51W	1,500	3,187	TRUE	20	West Side Service District
Delfield	1,500	3,180	TRUE	20	East Side Service District
J-131E	1,500	3,173	TRUE	20	East Side Service District
Union Twp WWTF	1,500	3,172	TRUE	20	East Side Service District
J-60E	1,500	3,169	TRUE	20	East Side Service District
J-9W	1,500	3,165	TRUE	20	West Side Service District
Station B	1,500	3,155	TRUE	20	East Side Service District
J-83E	1,500	3,151	TRUE	20	East Side Service District
Station A	1,500	3,141	TRUE	20	East Side Service District
J-35E	1,500	3,138	TRUE	20	East Side Service District
J-36E	1,500	3,137	TRUE	20	East Side Service District
J-37E	1,500	3,132	TRUE	20	East Side Service District
J-12E	1,500	3,112	TRUE	20	East Side Service District
J-20W	1,500	3,111	TRUE	20	West Side Service District
Jack Loeks	1,500	3,108	TRUE	20	East Side Service District
J-81E	1,500	3,091	TRUE	20	East Side Service District
J-82E	1,500	3,079	TRUE	20	East Side Service District
J-4W	1,500	3,078	TRUE	20	West Side Service District
J-3W	1,500	3,061	TRUE	20	West Side Service District
J-46S	1,500	3,045	TRUE	20	East Side Service District
J-71W	1,500	3,041	TRUE	20	West Side Service District
J-10W	1,500	3,040	TRUE	20	West Side Service District
J-74E	1,500	3,032	TRUE	20	East Side Service District
J-401	1,500	3,026	TRUE	20	West Side Service District
J-55E	1,500	3,021	TRUE	20	East Side Service District
J-18W	1,500	2,999	TRUE	20	West Side Service District
J-58E	1,500	2,972	TRUE	20	East Side Service District
J-79S	1,500	2,969	TRUE	20	East Side Service District
J-127E	1,500	2,965	TRUE	20	East Side Service District
J-34W	1,500	2,961	TRUE	20	West Side Service District
J-72S	1,500	2,939	TRUE	20	East Side Service District
J-52W	1,500	2,926	TRUE	20	West Side Service District
The Crossings	1,500	2,909	TRUE	20	East Side Service District
J-181E	1,500	2,882	TRUE	20	East Side Service District
J-130E	1,500	2,856	TRUE	20	East Side Service District
Hydrant 6 - River Road	1,500	2,844	TRUE	20	East Side Service District
J-57E	1,500	2,836	TRUE	20	East Side Service District
J-393	1,500	2,834	TRUE	20	East Side Service District
J-56E	1,500	2,809	TRUE	20	East Side Service District
Broadway Acres	1,500	2,807	TRUE	20	East Side Service District
J-62E	1,500	2,791	TRUE	20	East Side Service District
J-92S	1,500	2,785	TRUE	20	East Side Service District
J-394	1,500	2,784	TRUE	20	East Side Service District
J-180E	1,500	2,783	TRUE	20	East Side Service District
J-61E	1,500	2,780	TRUE	20	East Side Service District
J-12W	1,500	2,775	TRUE	20	West Side Service District
J-75E	1,500	2,770	TRUE	20	East Side Service District
J-112E	1,500	2,753	TRUE	20	East Side Service District
J-111E	1,500	2,742	TRUE	20	East Side Service District
J-48E	1,500	2,730	TRUE	20	East Side Service District
J-35S	1,500	2,726	TRUE	20	East Side Service District
J-132E	1,500	2,720	TRUE	20	East Side Service District
J-45E	1,500	2,708	TRUE	20	East Side Service District
J-38E	1,500	2,693	TRUE	20	East Side Service District
J-44E	1,500	2,680	TRUE	20	East Side Service District
J-42E	1,500	2,668	TRUE	20	East Side Service District
J-68W	1,500	2,655	TRUE	20	West Side Service District
J-429	1,500	2,631	TRUE	20	East Side Service District
J-23E	1,500	2,610	TRUE	20	East Side Service District
J-79E	1,500	2,602	TRUE	20	East Side Service District
J-34E	1,500	2,589	TRUE	20	East Side Service District
J-408	1,500	2,582	TRUE	20	East Side Service District
Hydrant 9- Kay Street	1,500	2,580	TRUE	20	East Side Service District
J-11W	1,500	2,570	TRUE	20	West Side Service District
J-66E	1,500	2,567	TRUE	20	East Side Service District
Pickard St. Care Wash	1,500	2,566	TRUE	20	East Side Service District
J-133E	1,500	2,547	TRUE	20	East Side Service District
J-416	1,500	2,536	TRUE	20	East Side Service District
Soaring Eagle Waterpark	1,500	2,530	TRUE	20	East Side Service District
J-28E	1,500	2,516	TRUE	20	East Side Service District
Hampton Inn	1,500	2,513	TRUE	20	East Side Service District
J-80E	1,500	2,506	TRUE	20	East Side Service District
J-369	1,500	2,490	TRUE	20	East Side Service District
J-24E	1,500	2,483	TRUE	20	East Side Service District
J-27E	1,500	2,480	TRUE	20	East Side Service District
J-7E	1,500	2,476	TRUE	20	East Side Service District
Hydrant 5 - Bilbrael Drive	1,500	2,462	TRUE	20	East Side Service District
J-73E	1,500	2,424	TRUE	20	East Side Service District
J-39W	1,500	2,420	TRUE	20	West Side Service District
J-38W	1,500	2,418	TRUE	20	West Side Service District
J-29E	1,500	2,401	TRUE	20	East Side Service District

J-25E	1,500	2,394	TRUE	20	East Side Service District
J-71S	1,500	2,362	TRUE	20	East Side Service District
J-40W	1,500	2,336	TRUE	20	West Side Service District
J-70S	1,500	2,331	TRUE	20	East Side Service District
J-77W	1,500	2,329	TRUE	20	West Side Service District
J-41W	1,500	2,321	TRUE	20	West Side Service District
J-39E	1,500	2,319	TRUE	20	East Side Service District
Elmers	1,500	2,307	TRUE	20	West Side Service District
J-64E	1,500	2,269	TRUE	20	East Side Service District
J-14W	1,500	2,264	TRUE	20	West Side Service District
J-63E	1,500	2,261	TRUE	20	East Side Service District
J-92W	1,500	2,237	TRUE	20	West Side Service District
J-49E	1,500	2,213	TRUE	20	East Side Service District
Mount Pleasant Country Club	1,500	2,197	TRUE	20	West Side Service District
J-26E	1,500	2,186	TRUE	20	East Side Service District
J-26W	1,500	2,183	TRUE	20	West Side Service District
J-44W	1,500	2,162	TRUE	20	West Side Service District
J-383	1,500	2,146	TRUE	20	West Side Service District
J-72E	1,500	2,127	TRUE	20	East Side Service District
J-384	1,500	2,124	TRUE	20	West Side Service District
J-65W	1,500	2,124	TRUE	20	West Side Service District
J-31E	1,500	2,106	TRUE	20	East Side Service District
J-93W	1,500	2,103	TRUE	20	West Side Service District
Baymont Inn	1,500	2,080	TRUE	20	East Side Service District - Lower Pressure Zone
J-45W	1,500	2,043	TRUE	20	West Side Service District
Hydrant 8 - Rogers Street	1,500	2,032	TRUE	20	West Side Service District
J-54E	1,500	2,025	TRUE	20	East Side Service District
J-37W	1,500	2,022	TRUE	20	West Side Service District
J-96E	1,500	2,019	TRUE	20	East Side Service District
J-71E	1,500	2,000	TRUE	20	East Side Service District
Krogers	1,500	1,982	TRUE	20	East Side Service District
J-69W	1,500	1,980	TRUE	20	West Side Service District
J-40E	1,500	1,967	TRUE	20	East Side Service District
J-43E	1,500	1,965	TRUE	20	East Side Service District
J-55W	1,500	1,963	TRUE	20	West Side Service District
J-78E	1,500	1,941	TRUE	20	East Side Service District
J-91S	1,500	1,902	TRUE	20	East Side Service District
J-69E	1,500	1,897	TRUE	20	East Side Service District
J-70E	1,500	1,896	TRUE	20	East Side Service District
J-65E	1,500	1,892	TRUE	20	East Side Service District
J-76S	1,500	1,876	TRUE	20	East Side Service District
J-46E	1,500	1,857	TRUE	20	East Side Service District
J-80W	1,500	1,856	TRUE	20	West Side Service District
J-41E	1,500	1,847	TRUE	20	East Side Service District
Hydrant 3 - Point Royal	1,500	1,845	TRUE	20	West Side Service District
Hydrant B on E. Pickard	1,500	1,836	TRUE	20	West Side Service District
J-68E	1,500	1,832	TRUE	20	East Side Service District
J-32E	1,500	1,810	TRUE	20	East Side Service District
J-56W	1,500	1,804	TRUE	20	West Side Service District
J-2S	1,500	1,796	TRUE	20	East Side Service District
J-80S	1,500	1,789	TRUE	20	East Side Service District
J-29W	1,500	1,769	TRUE	20	West Side Service District
J-66W	1,500	1,767	TRUE	20	West Side Service District
J-59W	1,500	1,753	TRUE	20	West Side Service District
J-60W	1,500	1,753	TRUE	20	West Side Service District
J-77E	1,500	1,746	TRUE	20	East Side Service District
J-86S	1,500	1,740	TRUE	20	East Side Service District
Pleasant Ridge Park	1,500	1,735	TRUE	20	East Side Service District
J-30E	1,500	1,723	TRUE	20	East Side Service District
J-67E	1,500	1,719	TRUE	20	East Side Service District
J-1W	1,500	1,715	TRUE	20	West Side Service District
J-67W	1,500	1,686	TRUE	20	West Side Service District
J-46W	1,500	1,669	TRUE	20	West Side Service District
J-30W	1,500	1,660	TRUE	20	West Side Service District
J-31W	1,500	1,658	TRUE	20	West Side Service District
J-33E	1,500	1,641	TRUE	20	East Side Service District
J-6S	1,500	1,626	TRUE	20	East Side Service District
J-81S	1,500	1,619	TRUE	20	East Side Service District
J-54W	1,500	1,574	TRUE	20	West Side Service District
Hydrant 7 - River Road	1,500	1,569	TRUE	20	West Side Service District
J-64W	1,500	1,546	TRUE	20	West Side Service District
J-70W	1,500	1,541	TRUE	20	West Side Service District
Hydrant B1 on S. Isabella	1,500	1,497	FALSE	20	East Side Service District
Hydrant A1 on S. Isabella	1,500	1,495	FALSE	20	East Side Service District
J-53W	1,500	1,493	FALSE	20	West Side Service District
J-91W	1,500	1,462	FALSE	20	West Side Service District
J-12S	1,500	1,448	FALSE	20	East Side Service District
Hydrant B @ Eagles	1,500	1,434	FALSE	20	East Side Service District
Hydrant A @ Eagles	1,500	1,432	FALSE	20	East Side Service District
J-90W	1,500	1,425	FALSE	20	West Side Service District
J-23W	1,500	1,393	FALSE	20	West Side Service District
J-8E	1,500	1,389	FALSE	20	East Side Service District
J-15W	1,500	1,370	FALSE	20	West Side Service District
J-32W	1,500	1,348	FALSE	20	West Side Service District
Hydrant B on E. Bluegrass	1,500	1,330	FALSE	20	East Side Service District
J-47E	1,500	1,257	FALSE	20	East Side Service District
Hydrant A on E. Bluegrass	1,500	1,254	FALSE	20	East Side Service District
Hydrant A on E. Pickard	1,500	1,244	FALSE	20	West Side Service District
University Meadows	1,500	1,221	FALSE	20	East Side Service District
J-33W	1,500	1,214	FALSE	20	West Side Service District
Applebees	1,500	980	FALSE	20	East Side Service District

Health Park	1,500	977	FALSE	20	East Side Service District
M&D Investments / Microtel	1,500	972	FALSE	20	East Side Service District
C & H Development / LoneStar	1,500	847	FALSE	20	East Side Service District - Lower Pressure Zone
Red Lobster	1,500	766	FALSE	20	East Side Service District
Bill Millard	1,500	753	FALSE	20	West Side Service District
McDonalds	1,500	749	FALSE	20	West Side Service District
J-385	1,500	710	FALSE	20	East Side Service District
Union Square	1,500	703	FALSE	20	East Side Service District
Bob Evans	1,500	233	FALSE	20	East Side Service District - Lower Pressure Zone
ABS Enterprises	1,500	216	FALSE	20.3	West Side Service District
Isabella Treatment Facility	1,500	0	FALSE	6.3	East Side Service District
J-380	1,500	0	FALSE	12	East Side Service District

5 Year Max Day Pressure Contour Map

Charter Township Of Union, Isabella County, Michigan



LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

5 Year Max Day Demand

ID	Label	Pressure (psi)	Elevation (ft)	Hydraulic Grade (ft)	Service District
286	J-62S	117.8	730	1,002.17	East Side Service District
336	J-61S	116.9	738	1,008.27	East Side Service District
337	J-63S	116.5	739	1,008.27	East Side Service District
338	J-60S	115.6	741	1,008.27	East Side Service District
241	J-52E	115.6	790	1,057.09	East Side Service District
461	J-379	115.3	728	994.46	East Side Service District
135	J-2E	115	785	1,050.89	East Side Service District
358	J-58S	114.2	730	994.03	East Side Service District
287	J-36S	112.8	731	991.68	East Side Service District
288	J-35S	111.1	735	991.68	East Side Service District
244	J-53E	110.7	783	1,038.92	East Side Service District
289	J-34S	110.2	734	988.73	East Side Service District
343	J-76E	108.9	748	999.74	East Side Service District
344	J-75E	108.5	749	999.74	East Side Service District
375	J-120E	108	783	1,032.65	East Side Service District
376	J-119E	108	783	1,032.65	East Side Service District
245	J-54E	107.3	791	1,038.92	East Side Service District
299	J-71E	106.9	753	1,000.03	East Side Service District
255	J-57E	106.9	753	999.98	East Side Service District
253	J-56E	106.9	753	999.98	East Side Service District
254	J-55E	106.9	753	999.98	East Side Service District
295	J-69E	106.4	754	1,000.03	East Side Service District
256	J-58E	106.4	754	999.99	East Side Service District
292	J-72E	106	755	1,000.03	East Side Service District
294	J-96E	106	755	1,000.03	East Side Service District
296	J-70E	106	755	1,000.03	East Side Service District
155	J-23E	105.9	755	999.83	East Side Service District
491	J-408	105.9	755	999.83	East Side Service District
492	Hydrant 9- Kay Street	105.9	755	999.83	East Side Service District
171	J-51E	105.9	755	999.66	East Side Service District
423	J-128E	105.8	755	999.64	East Side Service District
424	Delfield	105.8	755	999.64	East Side Service District
377	Hydrant A2 on S. Isabella	105.4	789	1,032.65	East Side Service District
267	J-66E	105.2	757	1,000.04	East Side Service District
268	J-64E	105.2	757	1,000.04	East Side Service District
413	J-124E	104.7	760	1,001.96	East Side Service District
414	Jamestown I & II	104.7	760	1,001.96	East Side Service District
172	J-49E	104.6	758	999.79	East Side Service District
170	J-50E	104.6	758	999.76	East Side Service District
1029	Station B	104.3	758.6	999.6	East Side Service District
165	J-30E	104.2	759	999.8	East Side Service District
297	J-68E	103.8	760	1,000.03	East Side Service District
433	J-131E	103.7	760	999.79	East Side Service District
434	Jack Loeks	103.7	760	999.79	East Side Service District
160	J-25E	103.3	761	999.82	East Side Service District
156	J-31E	102.9	762	999.83	East Side Service District
157	J-32E	102.9	762	999.83	East Side Service District
158	J-33E	102.9	762	999.83	East Side Service District
161	J-26E	102.9	762	999.81	East Side Service District
162	J-27E	102.9	762	999.81	East Side Service District
183	J-47E	102.9	762	999.81	East Side Service District
450	J-369	102.9	762	999.8	East Side Service District
451	M&D Investments / Microtel	102.9	762	999.8	East Side Service District
339	J-74E	102.8	763	1,000.54	East Side Service District
340	J-73E	102.8	763	1,000.54	East Side Service District
298	J-77E	102.6	763	1,000.03	East Side Service District
159	J-24E	102.5	763	999.82	East Side Service District
363	J-83E	102.5	763	999.82	East Side Service District
364	J-81E	102.5	763	999.82	East Side Service District
163	J-28E	102.5	763	999.8	East Side Service District
164	J-29E	102.5	763	999.8	East Side Service District
1012	J-416	102.5	763	999.8	East Side Service District
1015	Soaring Eagle Waterpark	102.5	763	999.8	East Side Service District
439	J-133E	102.5	763	999.8	East Side Service District
440	Hampton Inn	102.5	763	999.8	East Side Service District
166	J-34E	102.5	763	999.8	East Side Service District
167	J-35E	102.5	763	999.8	East Side Service District
366	J-82E	102.5	763	999.8	East Side Service District
269	J-65E	102.1	764	1,000.04	East Side Service District
293	J-78E	102.1	764	1,000.03	East Side Service District
143	J-12E	102.1	764	1,000.02	East Side Service District
421	J-127E	102.1	764	1,000.02	East Side Service District
431	J-130E	102.1	764	1,000.02	East Side Service District
432	Broadway Acres	102.1	764	1,000.02	East Side Service District
422	The Crossings	102.1	764	1,000.02	East Side Service District
141	J-63E	101.7	765	1,000.03	East Side Service District
291	J-67E	101.7	765	1,000.03	East Side Service District
153	J-21E	101.7	765	999.97	East Side Service District

154	J-22E	101.6	765	999.91	East Side Service District
169	J-36E	101.6	765	999.83	East Side Service District
168	J-37E	101.6	765	999.83	East Side Service District
140	J-9E	101.3	766	1,000.05	East Side Service District
142	J-11E	101.3	766	1,000.03	East Side Service District
456	J-181E	101.2	766	999.82	East Side Service District
457	Pickard St. Care Wash	101.2	766	999.82	East Side Service District
454	J-180E	101.2	766	999.82	East Side Service District
455	Applebees	101.2	766	999.81	East Side Service District
435	J-132E	101.2	766	999.81	East Side Service District
174	J-45E	101.2	766	999.81	East Side Service District
173	J-48E	101.2	766	999.81	East Side Service District
182	J-46E	101.2	766	999.81	East Side Service District
436	Health Park	101.2	766	999.8	East Side Service District
177	J-38E	100.7	767	999.82	East Side Service District
178	J-39E	100.7	767	999.82	East Side Service District
180	J-40E	100.7	767	999.82	East Side Service District
179	J-41E	100.7	767	999.82	East Side Service District
176	J-42E	100.7	767	999.81	East Side Service District
181	J-43E	100.7	767	999.81	East Side Service District
175	J-44E	100.7	767	999.81	East Side Service District
417	J-125E	100.6	768	1,000.54	East Side Service District
418	StoneCrest	100.6	768	1,000.54	East Side Service District
419	J-126E	100.5	768	1,000.24	East Side Service District
420	Isabella Mobile Home Park	100.5	768	1,000.24	East Side Service District
365	Hydrant B1 on S. Isabella	99.9	769	999.82	East Side Service District
367	Hydrant A1 on S. Isabella	99.9	769	999.8	East Side Service District
139	J-6E	99.7	770	1,000.54	East Side Service District
138	J-5E	99.5	771	1,001.05	East Side Service District
151	J-7E	98.4	773	1,000.54	East Side Service District
152	J-8E	98.4	773	1,000.54	East Side Service District
258	J-60E	98.4	778	1,005.46	East Side Service District
411	J-123E	98.3	787	1,014.25	East Side Service District
412	SpringBrook	98.3	787	1,014.25	East Side Service District
259	J-62E	98.2	778.5	1,005.46	East Side Service District
261	J-61E	98.2	778.5	1,005.46	East Side Service District
359	J-111E	98.2	778.5	1,005.46	East Side Service District
361	J-112E	98.2	778.5	1,005.46	East Side Service District
260	J-79E	98	779	1,005.46	East Side Service District
262	J-80E	98	779	1,005.46	East Side Service District
137	J-4E	96	780	1,001.82	East Side Service District
257	Arbors @ Eagle Crest	95.6	784.5	1,005.46	East Side Service District
360	Hydrant A @ Eagles	95.6	784.5	1,005.46	East Side Service District
362	Hydrant B @ Eagles	95.6	784.5	1,005.46	East Side Service District
378	J-122E	95.1	790	1,009.91	East Side Service District
379	J-121E	95.1	790	1,009.91	East Side Service District
136	J-3E	94.6	790	1,008.68	East Side Service District
335	J-82S	94.4	790	1,008.27	East Side Service District
460	J-142E	93.7	800	1,016.50	East Side Service District
380	Hydrant B2 on S. Isabella	92.5	796	1,009.91	East Side Service District
1025	Previously Isolation Valve	91.1	741	951.51	East Side Service District
215	J-25W	89.3	745	951.49	West Side Service District
427	J-77W	88.9	746	951.49	West Side Service District
216	J-26W	88.9	746	951.49	West Side Service District
428	Elmers	88.9	746	951.49	West Side Service District
303	J-25S	87.9	778	981.16	East Side Service District
304	J-29S	87.7	778	980.65	East Side Service District
312	J-40S	87.4	779	981.05	East Side Service District
313	J-38S	87.4	779	981.05	East Side Service District
310	J-37S	87.4	779	981.02	East Side Service District
311	J-39S	87.4	779	981.02	East Side Service District
278	J-24S	87	780	980.97	East Side Service District
309	J-27S	86.8	780	980.65	East Side Service District
243	J-12S	86.4	784.5	984.24	East Side Service District
306	J-28S	86	782	980.86	East Side Service District
290	J-33S	86	790	988.73	East Side Service District
493	J-410	86	790	988.73	East Side Service District
279	J-19S	85.8	782	980.29	East Side Service District
280	Walmart	85.8	782	980.29	East Side Service District
218	J-28W	85.5	754	951.59	East Side Service District
425	J-129E	85.1	755	951.61	East Side Service District
426	Union Twp WWTF	85.1	755	951.61	East Side Service District
302	J-26S	85	785	981.49	East Side Service District
429	J-94W	85	755	951.47	West Side Service District
430	Mount Pleasant Country Club	85	755	951.47	West Side Service District
322	J-59S	84.8	790	985.94	East Side Service District
305	J-31S	84.7	785	980.86	East Side Service District
486	J-403	84.7	785	980.86	East Side Service District
321	J-52S	84.6	786	981.6	East Side Service District
409	J-94S	84.3	790	984.95	East Side Service District

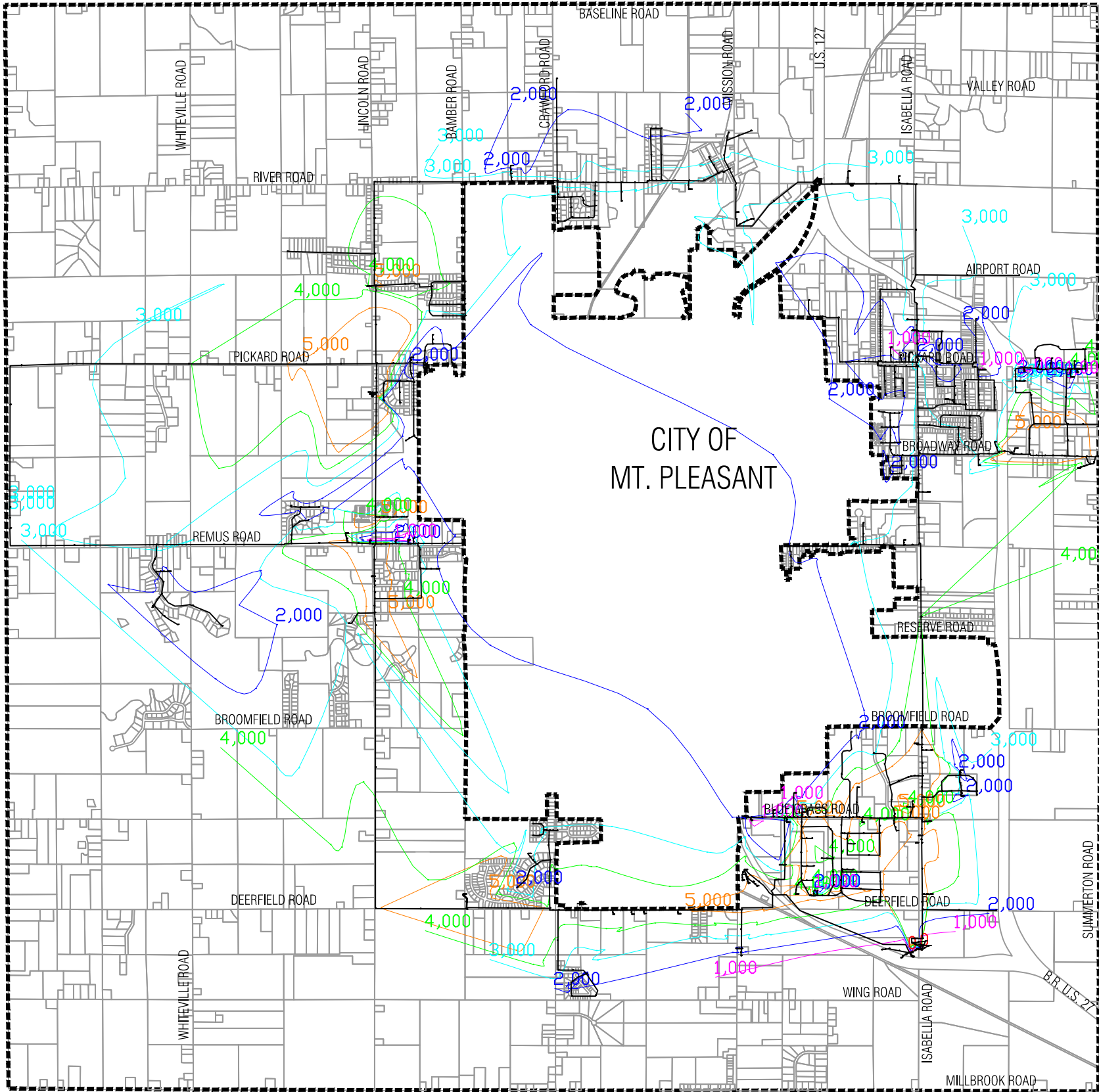
410	Copper Beach	84.3	790	984.95	East Side Service District
437	J-96S	84.2	790	984.63	East Side Service District
438	Village Bluegrass	84.2	790	984.63	East Side Service District
320	J-53S	84.2	787	981.57	East Side Service District
242	J-11S	84	790	984.24	East Side Service District
282	J-20S	83.9	787	980.94	East Side Service District
319	J-54S	83.7	788	981.57	East Side Service District
1026	Station A	83.5	758.6	951.61	East Side Service District
219	J-27W	83.3	759	951.52	East Side Service District
479	J-396	83.3	759	951.52	East Side Service District
272	J-60W	83.3	759	951.46	West Side Service District
271	J-59W	83.3	759	951.45	West Side Service District
323	J-51S	83.1	793	985.14	East Side Service District
316	J-57S	83	790	981.95	East Side Service District
317	J-55S	83	790	981.95	East Side Service District
318	J-56S	82.9	790	981.66	East Side Service District
273	J-58W	82.8	760	951.46	West Side Service District
270	J-57W	82.8	760	951.46	West Side Service District
325	J-49S	82.6	793	983.9	East Side Service District
326	J-50S	82.6	793	983.9	East Side Service District
324	J-48S	82.6	793	983.87	East Side Service District
494	Hydrant 12 - Aldi	82.5	798	988.73	East Side Service District
307	J-30S	82.1	791	980.7	East Side Service District
487	Hydrant 10 - Encore Blvd	81.7	792	980.86	East Side Service District
315	J-47S	81.6	795	983.49	East Side Service District
281	J-13S	81	793	980.17	East Side Service District
308	J-46S	80.8	794	980.7	East Side Service District
314	J-69S	80.7	797	983.49	East Side Service District
283	J-23S	79.9	797	981.72	East Side Service District
196	J-6W	79.6	768	951.89	West Side Service District
480	Hydrant 6 - River Road	79.4	768	951.52	East Side Service District
301	J-72W	79.1	769	951.83	West Side Service District
221	J-24W	78.5	770	951.45	West Side Service District
285	J-32S	78.2	800	980.75	East Side Service District
1070	J-429	78.1	771	951.45	East Side Service District
1067	J-428	78.1	771.03	951.45	East Side Service District
277	J-21S	77.8	800	979.75	East Side Service District
373	J-85S	77.8	800	979.75	East Side Service District
238	J-43W	77.6	772	951.44	West Side Service District
235	J-40W	77.6	772	951.43	West Side Service District
236	J-41W	77.6	772	951.43	West Side Service District
240	J-44W	77.6	772	951.43	West Side Service District
284	J-22S	77.2	802	980.54	East Side Service District
237	J-42W	77.2	773	951.44	West Side Service District
239	J-45W	77.2	773	951.43	West Side Service District
214	J-22W	76.8	774	951.43	West Side Service District
199	J-4W	76.4	775	951.63	West Side Service District
484	J-401	76.4	775	951.63	West Side Service District
202	J-1W	76.4	775	951.6	West Side Service District
481	J-398	76.3	775	951.43	West Side Service District
482	J-399	76.3	775	951.43	West Side Service District
232	J-37W	76.3	775	951.43	West Side Service District
276	J-63W	76.3	775	951.43	West Side Service District
274	J-62W	76.3	775	951.43	West Side Service District
300	J-71W	76.1	776	951.83	West Side Service District
275	J-61W	75.9	776	951.43	West Side Service District
227	J-33W	75.5	777	951.48	West Side Service District
217	J-23W	75.5	777	951.43	West Side Service District
233	J-39W	75.5	777	951.43	West Side Service District
234	J-38W	75.5	777	951.43	West Side Service District
374	Hydrant B on E. Bluegrass	75.2	806	979.75	East Side Service District
485	Hydrant 8 - Rogers Street	75.1	778	951.63	West Side Service District
483	Hydrant 7 - River Road	75	778	951.43	West Side Service District
228	J-31W	74.6	779	951.48	West Side Service District
229	J-30W	74.6	779	951.48	West Side Service District
230	J-32W	74.6	779	951.48	West Side Service District
211	J-17W	74.6	779	951.43	West Side Service District
198	J-5W	74.3	780	951.76	West Side Service District
197	J-7W	74.3	780	951.71	West Side Service District
200	J-3W	74.3	780	951.62	West Side Service District
201	J-2W	74.2	780	951.6	West Side Service District
407	J-93S	74.2	806	977.57	East Side Service District
408	University Meadows	74.2	806	977.51	East Side Service District
212	J-18W	74.2	780	951.43	West Side Service District
385	J-73W	73.4	782	951.68	West Side Service District
386	Arboretum Apts.	73.4	782	951.68	West Side Service District
226	J-29W	73.3	782	951.48	West Side Service District
331	J-64W	73.3	782	951.39	West Side Service District
403	J-91S	73.2	806	975.24	East Side Service District
186	J-2S	73.2	806	975.24	East Side Service District

404	Red Lobster	73.2	806	975.24	East Side Service District
405	J-92S	72.8	807	975.24	East Side Service District
406	Union Square	72.8	807	975.24	East Side Service District
370	J-83S	72.6	808	975.88	East Side Service District
371	J-84S	72.6	808	975.88	East Side Service District
208	J-16W	72.4	784	951.43	West Side Service District
464	J-381	72.4	784	951.43	West Side Service District
185	J-1S	72.4	808	975.24	East Side Service District
393	J-76W	72.1	785	951.6	West Side Service District
394	ABS Enterprises	72.1	785	951.57	West Side Service District
341	J-91W	72	785	951.39	West Side Service District
248	J-48W	71.2	787	951.54	West Side Service District
333	J-66W	71.1	787	951.39	West Side Service District
334	J-67W	71.1	787	951.39	West Side Service District
250	J-49W	70.8	788	951.54	West Side Service District
415	J-95S	70.7	800	963.34	East Side Service District
416	Krogers	70.7	800	963.34	East Side Service District
187	J-3S	70.6	790	953.07	East Side Service District
220	J-7S	70.5	793	955.95	East Side Service District
332	J-65W	70.3	789	951.39	West Side Service District
383	J-93W	70.3	789	951.39	West Side Service District
476	J-393	70.1	800	962.09	East Side Service District
477	J-394	70.1	800	962.09	East Side Service District
372	Hydrant A on E. Bluegrass	70	814	975.88	East Side Service District
389	J-75W	69.9	790	951.59	West Side Service District
390	Bill Millard	69.9	790	951.59	West Side Service District
188	J-5S	69.9	793	954.59	East Side Service District
251	J-50W	69.9	790	951.54	West Side Service District
466	J-383	69.9	790	951.49	West Side Service District
467	J-384	69.9	790	951.49	West Side Service District
213	J-21W	69.8	790	951.43	West Side Service District
462	J-378	69.8	790	951.43	West Side Service District
209	J-19W	69.8	790	951.43	West Side Service District
210	J-20W	69.8	790	951.43	West Side Service District
252	J-51W	69.5	791	951.54	West Side Service District
263	J-55W	69.4	791	951.39	West Side Service District
264	J-56W	69.4	791	951.39	West Side Service District
465	Hydrant 1 - Lincoln	69	792	951.43	West Side Service District
266	J-53W	69	792	951.39	West Side Service District
192	J-9S	68.8	803	962.09	East Side Service District
249	J-52W	68.6	793	951.54	West Side Service District
265	J-54W	68.5	793	951.39	West Side Service District
347	J-73S	68	805	962.09	East Side Service District
349	J-72S	68	805	962.09	East Side Service District
348	J-70S	68	805	962.09	East Side Service District
350	J-71S	68	805	962.09	East Side Service District
478	Hydrant 5 - Bilbrael Drive	68	805	962.09	East Side Service District
401	J-90S	67.8	800	956.81	East Side Service District
402	Lexington Ridge Apts.	67.8	800	956.81	East Side Service District
190	Mission Treatment Facility	67.8	805	961.77	East Side Service District
195	J-8W	67.7	795	951.58	West Side Service District
387	J-74W	67.7	795	951.58	West Side Service District
388	McDonalds	67.7	795	951.57	West Side Service District
468	Hydrant 3 - Point Royal	67.7	795	951.49	West Side Service District
384	Hydrant A on E. Pickard	67.7	795	951.39	West Side Service District
328	J-70W	67.3	796	951.54	West Side Service District
205	J-13W	67.2	796	951.43	West Side Service District
206	J-14W	67.2	796	951.39	West Side Service District
381	J-92W	67.2	796	951.39	West Side Service District
330	J-69W	66.9	797	951.54	West Side Service District
488	J-40S	66.4	798	951.57	West Side Service District
489	J-406	66.4	798	951.57	West Side Service District
329	J-68W	66.4	798	951.54	West Side Service District
342	J-90W	66.4	798	951.39	West Side Service District
231	J-36W	66	799	951.43	West Side Service District
1043	J-423	65.9	799	951.43	East Side Service District
207	J-15W	65.9	799	951.39	West Side Service District
345	J-75S	65.8	810	962.09	East Side Service District
346	J-76S	65.8	810	962.09	East Side Service District
246	J-47W	65.6	800	951.54	West Side Service District
222	J-35W	65.5	800	951.43	West Side Service District
391	J-86S	64.7	805	954.58	East Side Service District
189	J-6S	64.7	805	954.58	East Side Service District
392	Pleasant Ridge Park	64.7	805	954.58	East Side Service District
490	Hydrant 11 - Green Acres	64.7	802	951.57	West Side Service District
327	J-80W	64.7	802	951.54	West Side Service District
382	Hydrant B on E. Pickard	64.6	802	951.39	West Side Service District
399	J-89S	64.1	810	958.08	East Side Service District
400	United Apts.	64.1	810	958.08	East Side Service District
247	J-46W	64	803.5	951.54	West Side Service District

184	J-20E	63.6	753	899.96	East Side Service District - Lower Pressure Zone
1062	J-426	63.6	753	899.96	East Side Service District
397	J-88S	63.4	812	958.54	East Side Service District
398	Deerfield Village	63.4	812	958.54	East Side Service District
356	J-108E	63.1	754	899.96	East Side Service District - Lower Pressure Zone
395	J-87S	62.9	814	959.31	East Side Service District
396	TimberCreek	62.9	814	959.31	East Side Service District
357	J-106E	62.7	755	899.96	East Side Service District - Lower Pressure Zone
355	J-110E	62.3	756	899.96	East Side Service District - Lower Pressure Zone
441	J-134E	61.9	757	899.96	East Side Service District - Lower Pressure Zone
442	Casino	61.9	757	899.96	East Side Service District - Lower Pressure Zone
458	J-182E	61.4	758	899.96	East Side Service District - Lower Pressure Zone
459	Home Depot	61.4	758	899.96	East Side Service District - Lower Pressure Zone
452	J-179E	61.4	758	899.96	East Side Service District - Lower Pressure Zone
149	J-18E	61.4	758	899.96	East Side Service District - Lower Pressure Zone
453	Bob Evans	61.4	758	899.95	East Side Service District - Lower Pressure Zone
193	J-10W	61.2	810	951.47	West Side Service District
150	J-19E	61	759	899.96	East Side Service District - Lower Pressure Zone
446	J-178E	61	759	899.96	East Side Service District - Lower Pressure Zone
444	J-171E	61	759	899.96	East Side Service District - Lower Pressure Zone
445	MMCC	61	759	899.96	East Side Service District - Lower Pressure Zone
447	C & H Development / LoneStar	61	759	899.96	East Side Service District - Lower Pressure Zone
448	J-177E	61	759	899.96	East Side Service District - Lower Pressure Zone
449	Baymont Inn	61	759	899.96	East Side Service District - Lower Pressure Zone
443	J-170E	61	759	899.96	East Side Service District - Lower Pressure Zone
1064	J-427	61	759	899.96	East Side Service District
148	J-16E	60.6	760	899.98	East Side Service District - Lower Pressure Zone
147	J-17E	60.6	760	899.97	East Side Service District - Lower Pressure Zone
469	J-382	60.6	760	899.97	East Side Service District - Lower Pressure Zone
223	J-34W	59	815	951.47	West Side Service District
144	J-13E	58.8	764	900	West Side Service District
369	J-116E	58.4	765	899.98	East Side Service District - Lower Pressure Zone
146	J-15E	58.4	765	899.98	East Side Service District - Lower Pressure Zone
471	J-388	58.4	765	899.98	East Side Service District - Lower Pressure Zone
473	J-390	58.4	765	899.98	East Side Service District - Lower Pressure Zone
470	J-385	58.4	765	899.98	East Side Service District - Lower Pressure Zone
474	J-391	58.4	765	899.98	East Side Service District - Lower Pressure Zone
224	J-10S	58.4	831	965.97	East Side Service District
194	J-9W	57.8	818	951.5	West Side Service District
145	J-14E	55.8	771	899.99	East Side Service District - Lower Pressure Zone
368	J-115E	55.8	771	899.98	East Side Service District - Lower Pressure Zone
475	Hydrant 4 - Summerton	55.4	772	899.98	East Side Service District - Lower Pressure Zone
191	J-8S	55	835	962.09	East Side Service District
351	Northwinds	54.8	835	961.64	East Side Service District
352	J-79S	54.4	836	961.64	East Side Service District
353	J-80S	54.4	836	961.64	East Side Service District
354	J-81S	54.4	836	961.64	East Side Service District
472	J-389	54.1	775	899.98	East Side Service District - Lower Pressure Zone
1002	J-415	53	831	953.57	East Side Service District
204	J-12W	51.7	832	951.45	West Side Service District
988	J-411	51.1	835	953.16	East Side Service District
999	J-414	50.9	849	966.69	East Side Service District
203	J-11W	50	836	951.46	West Side Service District
463	J-380	12.2	778.5	806.73	East Side Service District
134	Isabella Treatment Facility	6.4	802	816.81	East Side Service District
225	Meridian Treatment Facility	(N/A)	829	(N/A)	West Side Service District

20 Year Max Day Available Fire Flow Contour Map

Charter Township Of Union, Isabella County, Michigan



NOT TO SCALE

LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

20 Year Fire Flow Analysis					
Label	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Satisfies Fire Flow Constraints?	Pressure (Calculated Residual) (psi)	Service District
J-13E	1,500	8,000	TRUE	49.8	West Side Service District
J-14E	1,500	8,000	TRUE	25.4	East Side Service District - Lower Pressure Zone
J-13W	1,500	8,000	TRUE	21.6	West Side Service District
J-10S	1,500	8,000	TRUE	31.3	East Side Service District
J-36W	1,500	8,000	TRUE	41	West Side Service District
J-414	1,500	8,000	TRUE	51	East Side Service District
J-415	1,500	8,000	TRUE	36.4	East Side Service District
J-423	1,500	8,000	TRUE	50.3	East Side Service District
J-115E	1,500	7,038	TRUE	19.6	East Side Service District - Lower Pressure Zone
J-48W	1,500	6,836	TRUE	17.4	West Side Service District
J-16E	1,500	6,737	TRUE	26.7	East Side Service District - Lower Pressure Zone
J-116E	1,500	6,478	TRUE	16.3	East Side Service District - Lower Pressure Zone
J-15E	1,500	6,277	TRUE	15.7	East Side Service District - Lower Pressure Zone
J-8W	1,500	6,269	TRUE	18	West Side Service District
J-62S	1,500	6,152	TRUE	3	East Side Service District
J-72W	1,500	6,002	TRUE	17	West Side Service District
J-73W	1,500	5,995	TRUE	20	West Side Service District
J-74W	1,500	5,992	TRUE	17.8	West Side Service District
J-7W	1,500	5,971	TRUE	22.5	West Side Service District
J-5W	1,500	5,905	TRUE	23.8	West Side Service District
J-6W	1,500	5,894	TRUE	21.5	West Side Service District
J-17E	1,500	5,892	TRUE	20	East Side Service District - Lower Pressure Zone
Arboretum Apts.	1,500	5,842	TRUE	22.4	West Side Service District
J-52E	1,500	5,822	TRUE	17.8	East Side Service District
J-2E	1,500	5,818	TRUE	16.4	East Side Service District
J-379	1,500	5,786	TRUE	3	East Side Service District
J-58S	1,500	5,764	TRUE	3	East Side Service District
J-53E	1,500	5,667	TRUE	15.2	East Side Service District
J-36S	1,500	5,644	TRUE	3	East Side Service District
J-120E	1,500	5,580	TRUE	14.7	East Side Service District
J-34S	1,500	5,493	TRUE	3	East Side Service District
J-119E	1,500	5,333	TRUE	17.3	East Side Service District
J-123E	1,500	5,282	TRUE	14.4	East Side Service District
J-40S	1,500	5,279	TRUE	18.3	West Side Service District
J-122E	1,500	5,165	TRUE	14.9	East Side Service District
J-3E	1,500	5,156	TRUE	14.8	East Side Service District
J-124E	1,500	5,150	TRUE	11.5	East Side Service District
Jamestown I & II	1,500	5,085	TRUE	12.8	East Side Service District
J-35W	1,500	5,125	TRUE	16.8	West Side Service District
Arbors @ Eagle Crest	1,500	5,123	TRUE	15	East Side Service District
J-388	1,500	5,088	TRUE	15.7	East Side Service District - Lower Pressure Zone
J-406	1,500	5,030	TRUE	18.3	West Side Service District
J-16W	1,500	4,988	TRUE	16.5	West Side Service District
SpringBrook	1,500	4,978	TRUE	17.6	East Side Service District
J-35	1,500	4,959	TRUE	20.1	East Side Service District
J-142E	1,500	4,949	TRUE	18.3	East Side Service District
J-121E	1,500	4,925	TRUE	17.4	East Side Service District
J-82S	1,500	4,906	TRUE	17.2	East Side Service District
J-390	1,500	4,809	TRUE	17.7	East Side Service District - Lower Pressure Zone
J-49W	1,500	4,806	TRUE	17.8	West Side Service District
J-411	1,500	4,771	TRUE	48.7	East Side Service District
J-381	1,500	4,756	TRUE	16.5	West Side Service District
J-33S	1,500	4,751	TRUE	12.4	East Side Service District
J-59S	1,500	4,698	TRUE	12	East Side Service District
J-25S	1,500	4,643	TRUE	11.2	East Side Service District
J-29S	1,500	4,640	TRUE	11	East Side Service District
J-19S	1,500	4,628	TRUE	11	East Side Service District
J-40S	1,500	4,605	TRUE	11.6	East Side Service District
J-37S	1,500	4,603	TRUE	11.6	East Side Service District
J-94S	1,500	4,598	TRUE	12.9	East Side Service District
J-11S	1,500	4,591	TRUE	12.8	East Side Service District
J-96S	1,500	4,590	TRUE	12.9	East Side Service District
J-38S	1,500	4,576	TRUE	20.9	East Side Service District - Lower Pressure Zone
J-24S	1,500	4,573	TRUE	12	East Side Service District
J-410	1,500	4,532	TRUE	15.1	East Side Service District
Village Bluegrass	1,500	4,523	TRUE	13.8	East Side Service District
J-55	1,500	4,506	TRUE	14.8	East Side Service District
J-19E	1,500	4,500	TRUE	20.2	East Side Service District - Lower Pressure Zone
J-75	1,500	4,487	TRUE	18.4	East Side Service District
J-63S	1,500	4,453	TRUE	19.1	East Side Service District
J-382	1,500	4,451	TRUE	35.9	East Side Service District - Lower Pressure Zone
J-26S	1,500	4,442	TRUE	13.8	East Side Service District
J-31S	1,500	4,437	TRUE	13.7	East Side Service District
J-48S	1,500	4,433	TRUE	14.6	East Side Service District
J-51S	1,500	4,432	TRUE	15.1	East Side Service District
J-47S	1,500	4,424	TRUE	14.6	East Side Service District

J-69S	1,500	4,413	TRUE	14.7	East Side Service District
J-4E	1,500	4,407	TRUE	24.1	East Side Service District
J-13S	1,500	4,376	TRUE	14.1	East Side Service District
J-47W	1,500	4,361	TRUE	18.5	West Side Service District
J-54S	1,500	4,356	TRUE	15	East Side Service District
J-23S	1,500	4,315	TRUE	15.4	East Side Service District
J-57S	1,500	4,311	TRUE	15.6	East Side Service District
J-90S	1,500	4,311	TRUE	20	East Side Service District
J-56S	1,500	4,304	TRUE	15.6	East Side Service District
J-61S	1,500	4,298	TRUE	23.2	East Side Service District
J-21S	1,500	4,295	TRUE	14.8	East Side Service District
J-8S	1,500	4,278	TRUE	19.7	East Side Service District
J-95S	1,500	4,262	TRUE	20	East Side Service District
J-53S	1,500	4,261	TRUE	16.1	East Side Service District
J-19W	1,500	4,260	TRUE	20	West Side Service District
J-403	1,500	4,257	TRUE	15.9	East Side Service District
J-52S	1,500	4,246	TRUE	16.3	East Side Service District
J-55S	1,500	4,244	TRUE	16.4	East Side Service District
Lexington Ridge Apts.	1,500	4,243	TRUE	20.9	East Side Service District
J-87S	1,500	4,223	TRUE	20	East Side Service District
J-49S	1,500	4,205	TRUE	17.5	East Side Service District
J-22S	1,500	4,184	TRUE	16.6	East Side Service District
J-178E	1,500	4,176	TRUE	20	East Side Service District - Lower Pressure Zone
TimberCreek	1,500	4,156	TRUE	20.9	East Side Service District
J-391	1,500	4,154	TRUE	17	East Side Service District - Lower Pressure Zone
J-88S	1,500	4,146	TRUE	20	East Side Service District
J-89S	1,500	4,135	TRUE	20	East Side Service District
Northwinds	1,500	4,096	TRUE	19.6	East Side Service District
Deerfield Village	1,500	4,081	TRUE	20.8	East Side Service District
J-93S	1,500	4,077	TRUE	16.9	East Side Service District
United Apts.	1,500	4,071	TRUE	20.8	East Side Service District
J-85S	1,500	4,068	TRUE	17.4	East Side Service District
J-27S	1,500	4,061	TRUE	18.2	East Side Service District
J-63W	1,500	4,059	TRUE	18.1	West Side Service District
J-389	1,500	4,048	TRUE	21.3	East Side Service District - Lower Pressure Zone
J-50S	1,500	4,018	TRUE	19.7	East Side Service District
J-28S	1,500	4,006	TRUE	19	East Side Service District
J-171E	1,500	4,000	TRUE	20	East Side Service District - Lower Pressure Zone
J-83S	1,500	3,993	TRUE	17.4	East Side Service District
J-1S	1,500	3,988	TRUE	17.9	East Side Service District
J-108E	1,500	3,967	TRUE	21.3	East Side Service District - Lower Pressure Zone
J-110E	1,500	3,967	TRUE	20.5	East Side Service District - Lower Pressure Zone
J-20E	1,500	3,957	TRUE	21	East Side Service District - Lower Pressure Zone
J-426	1,500	3,960	TRUE	19.9	East Side Service District
J-18E	1,500	3,954	TRUE	21.4	East Side Service District - Lower Pressure Zone
Hydrant 11 - Green Acres	1,500	3,949	TRUE	34.7	West Side Service District
J-177E	1,500	3,931	TRUE	20	East Side Service District - Lower Pressure Zone
J-170E	1,500	3,881	TRUE	22	East Side Service District - Lower Pressure Zone
J-106E	1,500	3,872	TRUE	23.7	East Side Service District - Lower Pressure Zone
Walmart	1,500	3,871	TRUE	20.4	East Side Service District
J-427	1,500	3,864	TRUE	24.1	East Side Service District
MMCC	1,500	3,836	TRUE	23	East Side Service District - Lower Pressure Zone
J-84S	1,500	3,784	TRUE	17.4	East Side Service District
J-17W	1,500	3,770	TRUE	22.3	West Side Service District
J-32S	1,500	3,754	TRUE	21.9	East Side Service District
J-378	1,500	3,754	TRUE	25.7	West Side Service District
J-134E	1,500	3,729	TRUE	20	East Side Service District - Lower Pressure Zone
J-20S	1,500	3,714	TRUE	20.7	East Side Service District
J-50W	1,500	3,704	TRUE	18.7	West Side Service District
Hydrant 1 - Lincoln	1,500	3,683	TRUE	38.3	West Side Service District
J-5E	1,500	3,620	TRUE	19.7	East Side Service District
J-75S	1,500	3,612	TRUE	20	East Side Service District
J-75W	1,500	3,601	TRUE	20	West Side Service District
Casino	1,500	3,597	TRUE	22.6	East Side Service District - Lower Pressure Zone
J-21W	1,500	3,557	TRUE	26.2	West Side Service District
Hydrant A2 on S. Isabella	1,500	3,538	TRUE	34.8	East Side Service District
J-398	1,500	3,512	TRUE	18.7	West Side Service District
J-179E	1,500	3,505	TRUE	20	East Side Service District - Lower Pressure Zone
Hydrant 12 - Aldi	1,500	3,481	TRUE	27.1	East Side Service District
J-30S	1,500	3,442	TRUE	18.7	East Side Service District
Mission Treatment Facility	1,500	3,435	TRUE	33.4	East Side Service District
J-399	1,500	3,427	TRUE	18.7	West Side Service District
Hydrant 10 - Encore Blvd	1,500	3,370	TRUE	26.4	East Side Service District
Copper Beach	1,500	3,359	TRUE	27.5	East Side Service District
J-22W	1,500	3,332	TRUE	18.7	West Side Service District
J-25W	1,500	3,318	TRUE	19.6	West Side Service District
J-62W	1,500	3,301	TRUE	22.9	West Side Service District
Previously Isolation Valve	1,500	3,304	TRUE	9	East Side Service District
J-42W	1,500	3,293	TRUE	20.1	West Side Service District
J-76W	1,500	3,287	TRUE	19.9	West Side Service District

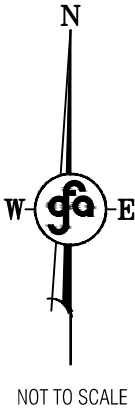
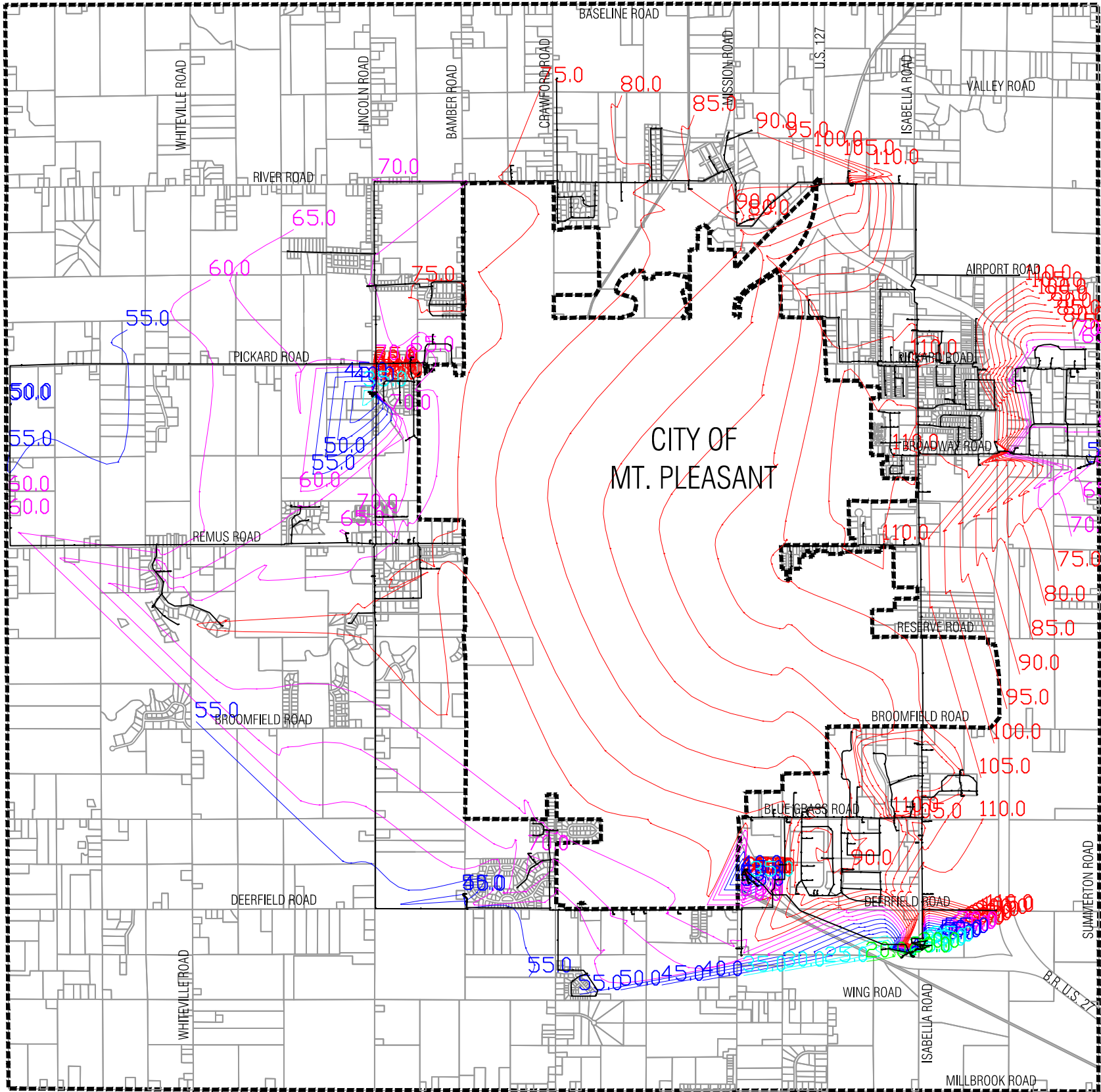
J-182E	1,500	3,282	TRUE	20	East Side Service District - Lower Pressure Zone
Hydrant 4 - Summerton	1,500	3,280	TRUE	30.8	East Side Service District - Lower Pressure Zone
J-57W	1,500	3,275	TRUE	16.4	West Side Service District
J-94W	1,500	3,265	TRUE	19.1	West Side Service District
J-6E	1,500	3,265	TRUE	18.7	East Side Service District
J-43W	1,500	3,259	TRUE	21.1	West Side Service District
Home Depot	1,500	3,258	TRUE	20.6	East Side Service District - Lower Pressure Zone
Hydrant B2 on S. Isabella	1,500	3,256	TRUE	34.3	East Side Service District
J-58W	1,500	3,254	TRUE	17.6	West Side Service District
J-61W	1,500	3,250	TRUE	19.6	West Side Service District
J-73S	1,500	3,240	TRUE	20	East Side Service District
J-60S	1,500	3,226	TRUE	34.3	East Side Service District
J-428	1,500	3,198	TRUE	20	East Side Service District
J-2W	1,500	3,180	TRUE	22.2	West Side Service District
J-9S	1,500	3,180	TRUE	21.2	East Side Service District
J-39S	1,500	3,175	TRUE	28.6	East Side Service District
J-51W	1,500	3,166	TRUE	19.1	West Side Service District
J-24W	1,500	3,143	TRUE	24.5	West Side Service District
J-9W	1,500	3,123	TRUE	26.5	West Side Service District
J-125E	1,500	3,119	TRUE	17.8	East Side Service District
Isabella Mobile Home Park	1,500	3,095	TRUE	20.5	East Side Service District
J-76E	1,500	3,114	TRUE	14.7	East Side Service District
J-126E	1,500	3,114	TRUE	20	East Side Service District
J-4W	1,500	3,055	TRUE	18.7	West Side Service District
J-60E	1,500	3,052	TRUE	17.2	East Side Service District
J-27W	1,500	3,051	TRUE	16.1	East Side Service District
StoneCrest	1,500	3,047	TRUE	19.8	East Side Service District
J-396	1,500	3,045	TRUE	16.1	East Side Service District
J-9E	1,500	3,041	TRUE	20	East Side Service District
J-3W	1,500	3,037	TRUE	26.3	West Side Service District
J-28W	1,500	3,033	TRUE	19.8	East Side Service District
J-11E	1,500	3,033	TRUE	20.2	East Side Service District
J-71W	1,500	3,025	TRUE	43.9	West Side Service District
J-20W	1,500	3,021	TRUE	41.7	West Side Service District
Union Twp WWTF	1,500	2,988	TRUE	19	East Side Service District
J-21E	1,500	3,006	TRUE	19.5	East Side Service District
J-10W	1,500	3,004	TRUE	16.4	West Side Service District
J-128E	1,500	3,004	TRUE	20	East Side Service District
J-401	1,500	3,003	TRUE	18.7	West Side Service District
J-129E	1,500	3,003	TRUE	18.5	East Side Service District
J-51E	1,500	3,003	TRUE	21.3	East Side Service District
Delfield	1,500	2,990	TRUE	20.5	East Side Service District
J-50E	1,500	2,985	TRUE	17.5	East Side Service District
J-22E	1,500	2,974	TRUE	19.2	East Side Service District
Station B	1,500	2,968	TRUE	20	East Side Service District
J-131E	1,500	2,952	TRUE	16.8	East Side Service District
Station A	1,500	2,955	TRUE	20.9	East Side Service District
J-46S	1,500	2,931	TRUE	29.8	East Side Service District
J-83E	1,500	2,927	TRUE	17.4	East Side Service District
J-34W	1,500	2,924	TRUE	19.2	West Side Service District
J-18W	1,500	2,924	TRUE	31.4	West Side Service District
J-35E	1,500	2,915	TRUE	17.4	East Side Service District
J-36E	1,500	2,912	TRUE	18.7	East Side Service District
J-52W	1,500	2,907	TRUE	27.1	West Side Service District
J-37E	1,500	2,907	TRUE	18.5	East Side Service District
J-12E	1,500	2,897	TRUE	20	East Side Service District
Jack Loeks	1,500	2,895	TRUE	18.6	East Side Service District
J-79S	1,500	2,893	TRUE	20	East Side Service District
J-72S	1,500	2,887	TRUE	20	East Side Service District
J-81E	1,500	2,874	TRUE	17.4	East Side Service District
J-82E	1,500	2,863	TRUE	17.4	East Side Service District
J-74E	1,500	2,855	TRUE	15.7	East Side Service District
J-55E	1,500	2,833	TRUE	21.2	East Side Service District
J-393	1,500	2,788	TRUE	15.7	East Side Service District
J-58E	1,500	2,787	TRUE	21.1	East Side Service District
The Crossings	1,500	2,714	TRUE	21.6	East Side Service District
J-127E	1,500	2,765	TRUE	20	East Side Service District
J-394	1,500	2,740	TRUE	16.9	East Side Service District
J-12W	1,500	2,734	TRUE	22.7	West Side Service District
J-62E	1,500	2,691	TRUE	17.4	East Side Service District
Hydrant 6 - River Road	1,500	2,691	TRUE	31.1	East Side Service District
J-181E	1,500	2,683	TRUE	20	East Side Service District
J-61E	1,500	2,681	TRUE	17.4	East Side Service District
J-92S	1,500	2,677	TRUE	20	East Side Service District
J-130E	1,500	2,667	TRUE	20	East Side Service District
J-35S	1,500	2,667	TRUE	36	East Side Service District
J-57E	1,500	2,665	TRUE	20.8	East Side Service District
J-112E	1,500	2,655	TRUE	17.4	East Side Service District
J-111E	1,500	2,644	TRUE	17.4	East Side Service District
J-56E	1,500	2,641	TRUE	21.9	East Side Service District

J-68W	1,500	2,630	TRUE	17.6	West Side Service District
Broadway Acres	1,500	2,623	TRUE	21.5	East Side Service District
J-75E	1,500	2,612	TRUE	29	East Side Service District
J-180E	1,500	2,593	TRUE	20	East Side Service District
Soaring Eagle Waterpark	1,500	2,349	TRUE	20.2	East Side Service District
J-48E	1,500	2,545	TRUE	20.7	East Side Service District
J-132E	1,500	2,537	TRUE	20	East Side Service District
J-11W	1,500	2,532	TRUE	28.5	West Side Service District
J-45E	1,500	2,527	TRUE	20	East Side Service District
J-429	1,500	2,516	TRUE	38.3	East Side Service District
J-38E	1,500	2,512	TRUE	20	East Side Service District
J-79E	1,500	2,509	TRUE	20	East Side Service District
J-44E	1,500	2,500	TRUE	21.8	East Side Service District
J-42E	1,500	2,489	TRUE	20	East Side Service District
J-23E	1,500	2,441	TRUE	17	East Side Service District
Hydrant 5 - Bilbrael Drive	1,500	2,426	TRUE	24.8	East Side Service District
J-80E	1,500	2,417	TRUE	23.2	East Side Service District
J-408	1,500	2,416	TRUE	18	East Side Service District
Pickard St. Care Wash	1,500	2,400	TRUE	29.1	East Side Service District
Hydrant 9- Kay Street	1,500	2,414	TRUE	18.1	East Side Service District
J-66E	1,500	2,413	TRUE	16.5	East Side Service District
J-34E	1,500	2,405	TRUE	20.4	East Side Service District
J-133E	1,500	2,366	TRUE	20	East Side Service District
J-416	1,500	2,354	TRUE	20	East Side Service District
J-28E	1,500	2,338	TRUE	20	East Side Service District
Hampton Inn	1,500	2,335	TRUE	21.2	East Side Service District
J-7E	1,500	2,334	TRUE	20	East Side Service District
J-71S	1,500	2,330	TRUE	32.5	East Side Service District
J-369	1,500	2,318	TRUE	20	East Side Service District
J-39W	1,500	2,318	TRUE	20	West Side Service District
J-38W	1,500	2,316	TRUE	20.1	West Side Service District
J-24E	1,500	2,315	TRUE	21.7	East Side Service District
J-27E	1,500	2,312	TRUE	21.4	East Side Service District
J-70S	1,500	2,299	TRUE	33.1	East Side Service District
J-73E	1,500	2,297	TRUE	32.7	East Side Service District
J-40W	1,500	2,243	TRUE	27.7	West Side Service District
J-25E	1,500	2,236	TRUE	20	East Side Service District
J-77W	1,500	2,236	TRUE	20	West Side Service District
J-29E	1,500	2,236	TRUE	21.7	East Side Service District
J-41W	1,500	2,228	TRUE	25.7	West Side Service District
J-14W	1,500	2,223	TRUE	17.4	West Side Service District
Elmers	1,500	2,215	TRUE	21.1	West Side Service District
J-92W	1,500	2,197	TRUE	17.4	West Side Service District
J-39E	1,500	2,175	TRUE	20	East Side Service District
J-64E	1,500	2,141	TRUE	17	East Side Service District
J-63E	1,500	2,125	TRUE	20	East Side Service District
J-383	1,500	2,124	TRUE	17.8	West Side Service District
Mount Pleasant Country Club	1,500	2,112	TRUE	48	West Side Service District
J-384	1,500	2,102	TRUE	17.8	West Side Service District
J-26W	1,500	2,099	TRUE	26.9	West Side Service District
J-49E	1,500	2,090	TRUE	39.4	East Side Service District
J-65W	1,500	2,089	TRUE	17.4	West Side Service District
J-44W	1,500	2,078	TRUE	24.4	West Side Service District
Baymont Inn	1,500	2,071	TRUE	47.9	East Side Service District - Lower Pressure Zone
J-93W	1,500	2,068	TRUE	17.4	West Side Service District
J-26E	1,500	2,049	TRUE	28.8	East Side Service District
Hydrant 8 - Rogers Street	1,500	2,021	TRUE	46.3	West Side Service District
J-72E	1,500	2,009	TRUE	15.7	East Side Service District
J-31E	1,500	1,978	TRUE	20	East Side Service District
J-54E	1,500	1,976	TRUE	47.6	East Side Service District
J-69W	1,500	1,966	TRUE	36.5	West Side Service District
J-45W	1,500	1,965	TRUE	19.1	West Side Service District
J-37W	1,500	1,944	TRUE	21	West Side Service District
Krogers	1,500	1,933	TRUE	44	East Side Service District
J-55W	1,500	1,931	TRUE	16.5	West Side Service District
J-96E	1,500	1,911	TRUE	20.7	East Side Service District
J-71E	1,500	1,893	TRUE	14.8	East Side Service District
J-40E	1,500	1,855	TRUE	33.2	East Side Service District
J-43E	1,500	1,854	TRUE	41.4	East Side Service District
J-76S	1,500	1,853	TRUE	39.8	East Side Service District
J-80W	1,500	1,842	TRUE	19.4	West Side Service District
J-91S	1,500	1,841	TRUE	20	East Side Service District
J-78E	1,500	1,832	TRUE	24.6	East Side Service District
Hydrant 3 - Point Royal	1,500	1,828	TRUE	31.1	West Side Service District
Hydrant B on E. Pickard	1,500	1,806	TRUE	33.1	West Side Service District
J-69E	1,500	1,798	TRUE	20.1	East Side Service District
J-70E	1,500	1,797	TRUE	20.2	East Side Service District
J-65E	1,500	1,790	TRUE	35.9	East Side Service District
J-56W	1,500	1,775	TRUE	19.1	West Side Service District
J-80S	1,500	1,759	TRUE	20	East Side Service District

J-46E	1,500	1,754	TRUE	21.8	East Side Service District
J-29W	1,500	1,753	TRUE	21.3	West Side Service District
J-41E	1,500	1,745	TRUE	37.4	East Side Service District
J-66W	1,500	1,741	TRUE	20	West Side Service District
J-2S	1,500	1,739	TRUE	23.4	East Side Service District
J-68E	1,500	1,733	TRUE	17.9	East Side Service District
J-32E	1,500	1,709	TRUE	32.8	East Side Service District
J-1W	1,500	1,706	TRUE	47.1	West Side Service District
J-86S	1,500	1,702	TRUE	20	East Side Service District
Pleasant Ridge Park	1,500	1,697	TRUE	20.2	East Side Service District
J-59W	1,500	1,692	TRUE	27.4	West Side Service District
J-60W	1,500	1,692	TRUE	27.4	West Side Service District
J-67W	1,500	1,662	TRUE	24.1	West Side Service District
J-46W	1,500	1,656	TRUE	27.8	West Side Service District
J-77E	1,500	1,653	TRUE	22.5	East Side Service District
J-30W	1,500	1,645	TRUE	20	West Side Service District
J-31W	1,500	1,644	TRUE	20.1	West Side Service District
J-30E	1,500	1,628	TRUE	43.4	East Side Service District
J-67E	1,500	1,627	TRUE	24.9	East Side Service District
J-81S	1,500	1,594	TRUE	24.6	East Side Service District
J-6S	1,500	1,592	TRUE	23.8	East Side Service District
J-33E	1,500	1,554	TRUE	39.6	East Side Service District
J-54W	1,500	1,551	TRUE	30.1	West Side Service District
J-70W	1,500	1,531	TRUE	32	West Side Service District
J-64W	1,500	1,526	TRUE	30.7	West Side Service District
Hydrant 7 - River Road	1,500	1,522	TRUE	48.5	West Side Service District
J-53W	1,500	1,473	FALSE	33	West Side Service District
J-91W	1,500	1,442	FALSE	17.3	West Side Service District
Hydrant B1 on S. Isabella	1,500	1,426	FALSE	50.7	East Side Service District
Hydrant A1 on S. Isabella	1,500	1,424	FALSE	50.8	East Side Service District
J-12S	1,500	1,410	FALSE	46.3	East Side Service District
J-90W	1,500	1,404	FALSE	19.6	West Side Service District
Hydrant B @ Eagles	1,500	1,391	FALSE	49.6	East Side Service District
Hydrant A @ Eagles	1,500	1,389	FALSE	49.6	East Side Service District
J-15W	1,500	1,350	FALSE	23.1	West Side Service District
J-23W	1,500	1,350	FALSE	48.7	West Side Service District
J-32W	1,500	1,337	FALSE	36.9	West Side Service District
J-8E	1,500	1,327	FALSE	50.7	East Side Service District
Hydrant B on E. Bluegrass	1,500	1,293	FALSE	46.9	East Side Service District
Hydrant A on E. Pickard	1,500	1,230	FALSE	47.7	West Side Service District
Hydrant A on E. Bluegrass	1,500	1,217	FALSE	49.4	East Side Service District
J-33W	1,500	1,206	FALSE	45.3	West Side Service District
J-47E	1,500	1,201	FALSE	47.8	East Side Service District
University Meadows	1,500	1,187	FALSE	47.7	East Side Service District
Applebees	1,500	940	FALSE	50.9	East Side Service District
Health Park	1,500	937	FALSE	50.9	East Side Service District
M&D Investments / Microtel	1,500	930	FALSE	50.9	East Side Service District
C & H Development / LoneStar	1,500	844	FALSE	53	East Side Service District - Lower Pressure Zone
Bill Millard	1,500	750	FALSE	49.1	West Side Service District
Red Lobster	1,500	747	FALSE	50.6	East Side Service District
McDonalds	1,500	747	FALSE	49	West Side Service District
J-38S	1,500	696	FALSE	50.8	East Side Service District
Union Square	1,500	687	FALSE	50.7	East Side Service District
Bob Evans	1,500	232	FALSE	53.9	East Side Service District - Lower Pressure Zone
ABS Enterprises	1,500	214	FALSE	49.7	West Side Service District
Isabella Treatment Facility	1,500	0	FALSE	50.9	East Side Service District
J-380	1,500	0	FALSE	50.9	East Side Service District

20 Year Max Day Pressure Contour Map

Charter Township Of Union, Isabella County, Michigan



LEGEND

- UNION TOWNSHIP LIMITS
- EXISTING WATERMAIN
- CONTOURS

20 Year Max Day Demand					
ID	Label	Pressure (psi)	Elevation (ft)	Hydraulic Grade (ft)	Service District
286	J-62S	115.7	730	997.39	East Side Service District
336	J-61S	115	738	1,003.77	East Side Service District
337	J-63S	114.6	739	1,003.77	East Side Service District
241	J-52E	114.3	790	1,054.16	East Side Service District
338	J-60S	113.7	741	1,003.77	East Side Service District
135	J-2E	113.7	785	1,047.75	East Side Service District
461	J-379	113.3	728	989.97	East Side Service District
358	J-58S	112.3	730	989.55	East Side Service District
287	J-36S	110.9	731	987.29	East Side Service District
244	J-53E	109.2	783	1,035.39	East Side Service District
288	J-35S	109.2	735	987.29	East Side Service District
289	J-34S	108.4	734	984.46	East Side Service District
343	J-76E	106.5	748	994.24	East Side Service District
375	J-120E	106.4	783	1,028.91	East Side Service District
376	J-119E	106.4	783	1,028.91	East Side Service District
344	J-75E	106.1	749	994.24	East Side Service District
245	J-54E	105.7	791	1,035.39	East Side Service District
299	J-71E	104.5	753	994.58	East Side Service District
255	J-57E	104.5	753	994.52	East Side Service District
253	J-56E	104.5	753	994.52	East Side Service District
254	J-55E	104.5	753	994.52	East Side Service District
295	J-69E	104.1	754	994.58	East Side Service District
256	J-58E	104.1	754	994.53	East Side Service District
377	Hydrant A2 on S. Isabella	103.8	789	1,028.91	East Side Service District
292	J-72E	103.7	755	994.58	East Side Service District
294	J-96E	103.7	755	994.58	East Side Service District
296	J-70E	103.7	755	994.58	East Side Service District
155	J-23E	103.6	755	994.35	East Side Service District
491	J-408	103.6	755	994.35	East Side Service District
492	Hydrant 9- Kay Street	103.6	755	994.35	East Side Service District
171	J-51E	103.5	755	994.15	East Side Service District
423	J-128E	103.5	755	994.13	East Side Service District
424	Delfield	103.5	755	994.13	East Side Service District
267	J-66E	102.8	757	994.59	East Side Service District
268	J-64E	102.8	757	994.59	East Side Service District
413	J-124E	102.6	760	997.11	East Side Service District
414	Jamestown I & II	102.6	760	997.11	East Side Service District
172	J-49E	102.2	758	994.29	East Side Service District
170	J-50E	102.2	758	994.26	East Side Service District
1029	Station B	101.9	758.6	994.09	East Side Service District
165	J-30E	101.8	759	994.3	East Side Service District
297	J-68E	101.5	760	994.58	East Side Service District
433	J-131E	101.4	760	994.29	East Side Service District
434	Jack Loeks	101.4	760	994.29	East Side Service District
160	J-25E	100.9	761	994.32	East Side Service District
156	J-31E	100.5	762	994.35	East Side Service District
157	J-32E	100.5	762	994.34	East Side Service District
158	J-33E	100.5	762	994.34	East Side Service District
161	J-26E	100.5	762	994.32	East Side Service District
162	J-27E	100.5	762	994.32	East Side Service District
183	J-47E	100.5	762	994.31	East Side Service District
450	J-369	100.5	762	994.31	East Side Service District
451	M&D Investments / Microtel	100.5	762	994.31	East Side Service District
339	J-74E	100.5	763	995.23	East Side Service District
340	J-73E	100.5	763	995.23	East Side Service District
298	J-77E	100.2	763	994.58	East Side Service District
159	J-24E	100.1	763	994.33	East Side Service District
363	J-83E	100.1	763	994.33	East Side Service District
364	J-81E	100.1	763	994.33	East Side Service District
163	J-28E	100.1	763	994.3	East Side Service District
164	J-29E	100.1	763	994.3	East Side Service District
1012	J-41E	100.1	763	994.3	East Side Service District
1015	Soaring Eagle Waterpark	100.1	763	994.3	East Side Service District
439	J-133E	100.1	763	994.3	East Side Service District
440	Hampton Inn	100.1	763	994.3	East Side Service District
166	J-34E	100.1	763	994.3	East Side Service District
167	J-35E	100.1	763	994.3	East Side Service District
366	J-82E	100.1	763	994.3	East Side Service District
269	J-65E	99.8	764	994.59	East Side Service District
293	J-78E	99.8	764	994.58	East Side Service District
143	J-12E	99.8	764	994.57	East Side Service District
421	J-127E	99.8	764	994.56	East Side Service District
431	J-130E	99.8	764	994.56	East Side Service District
432	Broadway Acres	99.8	764	994.56	East Side Service District
422	The Crossings	99.8	764	994.56	East Side Service District
141	J-63E	99.3	765	994.59	East Side Service District
291	J-67E	99.3	765	994.58	East Side Service District
153	J-21E	99.3	765	994.5	East Side Service District
154	J-22E	99.3	765	994.44	East Side Service District
169	J-36E	99.2	765	994.34	East Side Service District
168	J-37E	99.2	765	994.33	East Side Service District
140	J-9E	98.9	766	994.6	East Side Service District
142	J-11E	98.9	766	994.59	East Side Service District
456	J-181E	98.8	766	994.33	East Side Service District
457	Pickard St. Care Wash	98.8	766	994.32	East Side Service District
454	J-180E	98.8	766	994.32	East Side Service District
455	Applebees	98.8	766	994.32	East Side Service District
435	J-132E	98.8	766	994.32	East Side Service District
174	J-45E	98.8	766	994.32	East Side Service District

173	J-48E	98.8	766	994.31	East Side Service District
182	J-46E	98.8	766	994.31	East Side Service District
436	Health Park	98.8	766	994.3	East Side Service District
177	J-38E	98.4	767	994.32	East Side Service District
178	J-39E	98.4	767	994.32	East Side Service District
180	J-40E	98.4	767	994.32	East Side Service District
179	J-41E	98.4	767	994.32	East Side Service District
176	J-42E	98.3	767	994.32	East Side Service District
181	J-43E	98.3	767	994.32	East Side Service District
175	J-44E	98.3	767	994.32	East Side Service District
417	J-125E	98.3	768	995.24	East Side Service District
418	StoneCrest	98.3	768	995.23	East Side Service District
419	J-126E	98.1	768	994.85	East Side Service District
420	Isabella Mobile Home Park	98.1	768	994.85	East Side Service District
365	Hydrant B1 on S. Isabella	97.5	769	994.33	East Side Service District
367	Hydrant A1 on S. Isabella	97.5	769	994.3	East Side Service District
139	J-6E	97.4	770	995.24	East Side Service District
138	J-5E	97.3	771	995.9	East Side Service District
411	J-123E	96.4	787	1,009.90	East Side Service District
412	SpringBrook	96.4	787	1,009.90	East Side Service District
258	J-60E	96.4	778	1,000.81	East Side Service District
259	J-62E	96.2	778.5	1,000.81	East Side Service District
261	J-61E	96.2	778.5	1,000.81	East Side Service District
359	J-111E	96.2	778.5	1,000.81	East Side Service District
361	J-112E	96.2	778.5	1,000.81	East Side Service District
151	J-7E	96.2	773	995.23	East Side Service District
152	J-8E	96.2	773	995.23	East Side Service District
260	J-79E	96	779	1,000.81	East Side Service District
262	J-80E	96	779	1,000.81	East Side Service District
137	J-4E	93.9	780	996.92	East Side Service District
257	Arbors @ Eagle Crest	93.6	784.5	1,000.82	East Side Service District
360	Hydrant A @ Eagles	93.6	784.5	1,000.81	East Side Service District
362	Hydrant B @ Eagles	93.6	784.5	1,000.81	East Side Service District
378	J-122E	93.2	790	1,005.44	East Side Service District
379	J-121E	93.2	790	1,005.44	East Side Service District
136	J-3E	92.7	790	1,004.18	East Side Service District
335	J-82S	92.5	790	1,003.77	East Side Service District
460	J-142E	91.8	800	1,012.23	East Side Service District
1025	Previously Isolation Valve	91.1	741	951.5	East Side Service District
380	Hydrant B2 on S. Isabella	90.6	796	1,005.44	East Side Service District
215	J-25W	89.3	745	951.48	West Side Service District
427	J-77W	88.9	746	951.47	West Side Service District
216	J-26W	88.9	746	951.47	West Side Service District
428	Elmers	88.9	746	951.47	West Side Service District
303	J-25S	86.2	778	977.17	East Side Service District
304	J-29S	86	778	976.69	East Side Service District
312	J-40S	85.7	779	977.07	East Side Service District
313	J-38S	85.7	779	977.06	East Side Service District
310	J-37S	85.7	779	977.03	East Side Service District
311	J-39S	85.7	779	977.03	East Side Service District
218	J-28W	85.5	754	951.58	East Side Service District
278	J-24S	85.2	780	976.99	East Side Service District
309	J-27S	85.1	780	976.69	East Side Service District
425	J-129E	85.1	755	951.6	East Side Service District
426	Union Twp WWTF	85.1	755	951.6	East Side Service District
429	J-94W	85	755	951.46	West Side Service District
430	Mount Pleasant Country Club	85	755	951.46	West Side Service District
243	J-12S	84.6	784.5	980.1	East Side Service District
306	J-28S	84.3	782	976.88	East Side Service District
290	J-33S	84.1	790	984.46	East Side Service District
493	J-410	84.1	790	984.46	East Side Service District
279	J-19S	84.1	782	976.35	East Side Service District
280	Walmart	84.1	782	976.35	East Side Service District
1026	Station A	83.5	758.6	951.6	East Side Service District
219	J-27W	83.3	759	951.51	East Side Service District
479	J-396	83.3	759	951.51	East Side Service District
302	J-26S	83.3	785	977.48	East Side Service District
272	J-60W	83.3	759	951.44	West Side Service District
271	J-59W	83.3	759	951.44	West Side Service District
305	J-31S	83	785	976.88	East Side Service District
486	J-403	83	785	976.88	East Side Service District
322	J-59S	83	790	981.76	East Side Service District
321	J-52S	82.9	786	977.59	East Side Service District
273	J-58W	82.8	760	951.44	West Side Service District
270	J-57W	82.8	760	951.44	West Side Service District
409	J-94S	82.5	790	980.79	East Side Service District
410	Copper Beach	82.5	790	980.78	East Side Service District
320	J-53S	82.4	787	977.57	East Side Service District
437	J-96S	82.4	790	980.48	East Side Service District
438	Village Bluegrass	82.4	790	980.48	East Side Service District
242	J-11S	82.2	790	980.1	East Side Service District
282	J-20S	82.2	787	976.96	East Side Service District
319	J-54S	82	788	977.56	East Side Service District
323	J-51S	81.3	793	980.99	East Side Service District
316	J-57S	81.3	790	977.92	East Side Service District
317	J-55S	81.3	790	977.92	East Side Service District
318	J-56S	81.2	790	977.65	East Side Service District
325	J-49S	80.8	793	979.79	East Side Service District
326	J-50S	80.8	793	979.79	East Side Service District
324	J-48S	80.8	793	979.76	East Side Service District
494	Hydrant 12 - Aldi	80.7	798	984.46	East Side Service District

307	J-30S	80.4	791	976.73	East Side Service District
487	Hydrant 10 - Encore Blvd	80	792	976.88	East Side Service District
315	J-47S	79.8	795	979.4	East Side Service District
196	J-6W	79.6	768	951.87	West Side Service District
480	Hydrant 6 - River Road	79.4	768	951.51	East Side Service District
281	J-13S	79.3	793	976.23	East Side Service District
301	J-72W	79.1	769	951.81	West Side Service District
308	J-46S	79.1	794	976.73	East Side Service District
314	J-69S	78.9	797	979.4	East Side Service District
221	J-24W	78.5	770	951.44	West Side Service District
283	J-23S	78.2	797	977.71	East Side Service District
1070	J-429	78.1	771	951.43	East Side Service District
1067	J-428	78.1	771.03	951.43	East Side Service District
238	J-43W	77.6	772	951.43	West Side Service District
235	J-40W	77.6	772	951.42	West Side Service District
236	J-41W	77.6	772	951.42	West Side Service District
240	J-44W	77.6	772	951.42	West Side Service District
237	J-42W	77.2	773	951.42	West Side Service District
239	J-45W	77.2	773	951.42	West Side Service District
214	J-22W	76.8	774	951.42	West Side Service District
285	J-32S	76.5	800	976.79	East Side Service District
199	J-4W	76.4	775	951.61	West Side Service District
484	J-401	76.4	775	951.61	West Side Service District
202	J-1W	76.4	775	951.59	West Side Service District
481	J-398	76.3	775	951.42	West Side Service District
482	J-399	76.3	775	951.42	West Side Service District
232	J-37W	76.3	775	951.42	West Side Service District
276	J-63W	76.3	775	951.42	West Side Service District
274	J-62W	76.3	775	951.42	West Side Service District
277	J-21S	76.1	800	975.84	East Side Service District
373	J-85S	76.1	800	975.84	East Side Service District
300	J-71W	76.1	776	951.81	West Side Service District
275	J-61W	75.9	776	951.42	West Side Service District
284	J-22S	75.5	802	976.59	East Side Service District
227	J-33W	75.5	777	951.46	West Side Service District
217	J-23W	75.5	777	951.42	West Side Service District
233	J-39W	75.5	777	951.42	West Side Service District
234	J-38W	75.5	777	951.42	West Side Service District
485	Hydrant 8 - Rogers Street	75.1	778	951.61	West Side Service District
483	Hydrant 7 - River Road	75	778	951.42	West Side Service District
228	J-31W	74.6	779	951.46	West Side Service District
229	J-30W	74.6	779	951.46	West Side Service District
230	J-32W	74.6	779	951.46	West Side Service District
211	J-17W	74.6	779	951.42	West Side Service District
198	J-5W	74.3	780	951.74	West Side Service District
197	J-7W	74.3	780	951.7	West Side Service District
200	J-3W	74.2	780	951.6	West Side Service District
201	J-2W	74.2	780	951.59	West Side Service District
212	J-18W	74.2	780	951.42	West Side Service District
374	Hydrant 8 on E. Bluegrass	73.5	806	975.84	East Side Service District
385	J-73W	73.4	782	951.67	West Side Service District
386	Arboretum Apts.	73.4	782	951.67	West Side Service District
226	J-29W	73.3	782	951.46	West Side Service District
331	J-64W	73.3	782	951.37	West Side Service District
407	J-93S	72.6	806	973.78	East Side Service District
408	University Meadows	72.5	806	973.65	East Side Service District
208	J-16W	72.4	784	951.42	West Side Service District
464	J-381	72.4	784	951.42	West Side Service District
393	J-76W	72.1	785	951.58	West Side Service District
394	ABS Enterprises	72.1	785	951.55	West Side Service District
341	J-91W	72	785	951.37	West Side Service District
403	J-91S	71.7	806	971.61	East Side Service District
186	J-2S	71.7	806	971.61	East Side Service District
404	Red Lobster	71.7	806	971.61	East Side Service District
405	J-92S	71.2	807	971.62	East Side Service District
406	Union Square	71.2	807	971.61	East Side Service District
248	J-48W	71.2	787	951.52	West Side Service District
333	J-66W	71.1	787	951.37	West Side Service District
334	J-67W	71.1	787	951.37	West Side Service District
370	J-83S	71	808	972.21	East Side Service District
371	J-84S	71	808	972.21	East Side Service District
185	J-1S	70.8	808	971.62	East Side Service District
250	J-49W	70.7	788	951.52	West Side Service District
332	J-65W	70.3	789	951.38	West Side Service District
383	J-93W	70.3	789	951.38	West Side Service District
389	J-75W	69.9	790	951.57	West Side Service District
390	Bill Millard	69.9	790	951.57	West Side Service District
251	J-50W	69.9	790	951.52	West Side Service District
466	J-383	69.9	790	951.47	West Side Service District
467	J-384	69.9	790	951.47	West Side Service District
213	J-21W	69.8	790	951.42	West Side Service District
462	J-378	69.8	790	951.42	West Side Service District
209	J-19W	69.8	790	951.42	West Side Service District
210	J-20W	69.8	790	951.42	West Side Service District
476	J-393	69.8	800	961.22	East Side Service District
477	J-394	69.8	800	961.22	East Side Service District
220	J-7S	69.7	793	954.15	East Side Service District
187	J-3S	69.7	790	951.03	East Side Service District
415	J-95S	69.5	800	960.56	East Side Service District
416	Krogers	69.5	800	960.56	East Side Service District
252	J-51W	69.5	791	951.52	West Side Service District

263	J-55W	69.4	791	951.37	West Side Service District
264	J-56W	69.4	791	951.37	West Side Service District
188	J-5S	69.1	793	952.66	East Side Service District
465	Hydrant 1 - Lincoln	69	792	951.42	West Side Service District
266	J-53W	69	792	951.37	West Side Service District
249	J-52W	68.6	793	951.52	West Side Service District
265	J-54W	68.5	793	951.37	West Side Service District
192	J-9S	68.5	803	961.22	East Side Service District
372	Hydrant A on E. Bluegrass	68.4	814	972.21	East Side Service District
195	J-8W	67.7	795	951.56	West Side Service District
387	J-74W	67.7	795	951.56	West Side Service District
388	McDonalds	67.7	795	951.56	West Side Service District
468	Hydrant 3 - Point Royal	67.7	795	951.47	West Side Service District
384	Hydrant A on E. Pickard	67.7	795	951.38	West Side Service District
347	J-73S	67.6	805	961.22	East Side Service District
349	J-72S	67.6	805	961.22	East Side Service District
348	J-70S	67.6	805	961.22	East Side Service District
350	J-71S	67.6	805	961.22	East Side Service District
478	Hydrant 5 - Bilbrael Drive	67.6	805	961.22	East Side Service District
328	J-70W	67.3	796	951.52	West Side Service District
205	J-13W	67.2	796	951.42	West Side Service District
206	J-14W	67.2	796	951.38	West Side Service District
381	J-92W	67.2	796	951.38	West Side Service District
401	J-90S	67.1	800	955.09	East Side Service District
402	Lexington Ridge Apts.	67.1	800	955.09	East Side Service District
190	Mission Treatment Facility	67	805	959.84	East Side Service District
330	J-69W	66.9	797	951.52	West Side Service District
488	J-40S	66.4	798	951.55	West Side Service District
489	J-40E	66.4	798	951.55	West Side Service District
329	J-68W	66.4	798	951.52	West Side Service District
342	J-90W	66.4	798	951.37	West Side Service District
231	J-36W	65.9	799	951.43	West Side Service District
1043	J-423	65.9	799	951.42	East Side Service District
207	J-15W	65.9	799	951.37	West Side Service District
246	J-47W	65.6	800	951.52	West Side Service District
222	J-35W	65.5	800	951.42	West Side Service District
345	J-75S	65.4	810	961.22	East Side Service District
346	J-76S	65.4	810	961.22	East Side Service District
490	Hydrant 11 - Green Acres	64.7	802	951.55	West Side Service District
327	J-80W	64.7	802	951.52	West Side Service District
382	Hydrant B on E. Pickard	64.6	802	951.38	West Side Service District
247	J-46W	64	803.5	951.52	West Side Service District
391	J-86S	63.9	805	952.63	East Side Service District
189	J-6S	63.9	805	952.63	East Side Service District
392	Pleasant Ridge Park	63.9	805	952.63	East Side Service District
1062	J-426	63.6	753	899.94	East Side Service District
184	J-20E	63.6	753	899.94	East Side Service District - Lower Pressure Zone
399	J-89S	63.4	810	956.52	East Side Service District
400	United Apts.	63.4	810	956.52	East Side Service District
356	J-108E	63.1	754	899.94	East Side Service District - Lower Pressure Zone
397	J-88S	62.8	812	957.04	East Side Service District
398	Deerfield Village	62.8	812	957.04	East Side Service District
357	J-106E	62.7	755	899.94	East Side Service District - Lower Pressure Zone
355	J-110E	62.3	756	899.94	East Side Service District - Lower Pressure Zone
395	J-87S	62.3	814	957.93	East Side Service District
396	TimberCreek	62.3	814	957.93	East Side Service District
441	J-134E	61.8	757	899.94	East Side Service District - Lower Pressure Zone
442	Casino	61.8	757	899.94	East Side Service District - Lower Pressure Zone
458	J-182E	61.4	758	899.95	East Side Service District - Lower Pressure Zone
459	Home Depot	61.4	758	899.95	East Side Service District - Lower Pressure Zone
452	J-179E	61.4	758	899.95	East Side Service District - Lower Pressure Zone
149	J-18E	61.4	758	899.94	East Side Service District - Lower Pressure Zone
453	Bob Evans	61.4	758	899.93	East Side Service District - Lower Pressure Zone
193	J-10W	61.2	810	951.46	West Side Service District
150	J-19E	61	759	899.95	East Side Service District - Lower Pressure Zone
446	J-178E	61	759	899.95	East Side Service District - Lower Pressure Zone
444	J-171E	61	759	899.95	East Side Service District - Lower Pressure Zone
445	MMCC	61	759	899.95	East Side Service District - Lower Pressure Zone
447	C & H Development / LoneStar	61	759	899.95	East Side Service District - Lower Pressure Zone
448	J-177E	61	759	899.94	East Side Service District - Lower Pressure Zone
449	Baymont Inn	61	759	899.94	East Side Service District - Lower Pressure Zone
443	J-170E	61	759	899.94	East Side Service District - Lower Pressure Zone
1064	J-427	61	759	899.94	East Side Service District
148	J-16E	60.6	760	899.97	East Side Service District - Lower Pressure Zone
147	J-17E	60.6	760	899.96	East Side Service District - Lower Pressure Zone
469	J-382	60.6	760	899.96	East Side Service District - Lower Pressure Zone
223	J-34W	59	815	951.46	West Side Service District
144	J-13E	58.8	764	899.99	West Side Service District
369	J-116E	58.4	765	899.97	East Side Service District - Lower Pressure Zone
146	J-15E	58.4	765	899.97	East Side Service District - Lower Pressure Zone
471	J-388	58.4	765	899.97	East Side Service District - Lower Pressure Zone
470	J-385	58.4	765	899.97	East Side Service District - Lower Pressure Zone
473	J-390	58.4	765	899.97	East Side Service District - Lower Pressure Zone
474	J-391	58.4	765	899.97	East Side Service District - Lower Pressure Zone
224	J-10S	58.3	831	965.82	East Side Service District
194	J-9W	57.7	818	951.48	West Side Service District
145	J-14E	55.8	771	899.98	East Side Service District - Lower Pressure Zone
368	J-115E	55.8	771	899.98	East Side Service District - Lower Pressure Zone
475	Hydrant 4 - Summerton	55.4	772	899.97	East Side Service District - Lower Pressure Zone
191	J-8S	54.6	835	961.22	East Side Service District
351	Northwinds	54.4	835	960.68	East Side Service District

472	J-389	54.1	775	899.97	East Side Service District - Lower Pressure Zone
352	J-79S	53.9	836	960.68	East Side Service District
353	J-80S	53.9	836	960.68	East Side Service District
354	J-81S	53.9	836	960.68	East Side Service District
1002	J-41S	53	831	953.57	East Side Service District
204	J-12W	51.7	832	951.44	West Side Service District
988	J-411	51.1	835	953.16	East Side Service District
999	J-414	50.9	849	966.68	East Side Service District
203	J-11W	49.9	836	951.45	West Side Service District
463	J-380	12.2	778.5	806.66	East Side Service District
134	Isabella Treatment Facility	6.7	802	817.54	East Side Service District
225	Meridian Treatment Facility	(N/A)	829	(N/A)	West Side Service District

APPENDIX D

Supplemental Data & Calculations



TREATED METERED FLOWS
AVERAGE DAY DEMAND, MGD
EAST SIDE SERVICE DISTRICT

Month	<u>WELLS NO. 10, 11, 7, 8 & 9</u>				
	2017	2018	2019	2020	2021
January	0.94	0.87	0.91	0.89	0.85
February	0.96	0.93	0.99	0.85	0.92
March	0.92	0.86	0.90	0.81	0.91
April	0.92	0.88	0.90	0.73	0.93
May	1.01	0.97	0.88	0.83	1.10
June	1.13	1.13	1.03	1.34	1.28
July	1.15	1.35	1.27	1.63	1.27
August	1.16	1.32	1.35	1.55	1.33
September	1.30	1.25	1.17	1.24	1.15
October	1.09	1.07	1.00	1.08	1.03
November	0.85	0.90	0.84	0.84	0.88
December	0.80	0.83	0.82	0.77	0.87
YEAR ADD	1.02	1.03	1.00	1.05	1.04

METERED FLOWS
AVERAGE DAY DEMAND, MGD
LOWER PRESSURE ZONE #2 (WEST SIDE)

Month	<u>WELL #3 & #4</u>				
	2017	2018	2019	2020	2021
January	0.13	0.08	0.11	0.14	0.13
February	0.13	0.10	0.12	0.14	0.15
March	0.15	0.08	0.10	0.14	0.14
April	0.14	0.08	0.11	0.13	0.16
May	0.22	0.17	0.14	0.25	0.28
June	0.33	0.28	0.23	0.40	0.38
July	0.36	0.42	0.42	0.58	0.36
August	0.38	0.35	0.42	0.47	0.40
September	0.41	0.30	0.24	0.20	0.29
October	0.20	0.18	0.16	0.20	0.22
November	0.10	0.11	0.14	0.14	0.15
December	0.08	0.11	0.13	0.14	0.14
YEAR ADD	0.22	0.19	0.19	0.24	0.23

DISTRIBUTION METERED FLOWS *
AVERAGE DAY DEMAND, MGD
EAST SIDE SERVICE DISTRICT

Month	<u>WELL #10, #11 & #7</u>				
	2017	2018	2019	2020	2021
January	0.84	0.80	0.80	0.75	0.72
February	0.83	0.84	0.87	0.74	0.77
March	0.77	0.78	0.79	0.67	0.78
April	0.79	0.80	0.79	0.59	0.77
May	0.80	0.80	0.74	0.72	0.81
June	0.80	0.85	0.80	0.94	0.90
July	1.03	0.93	0.85	1.06	0.90
August	0.88	0.97	0.93	1.08	0.94
September	0.90	0.95	0.94	0.94	0.87
October	0.91	0.89	0.84	0.87	0.81
November	0.81	0.81	0.77	0.70	0.73
December	0.61	0.75	0.70	0.64	0.73
YEAR ADD	0.83	0.85	0.82	0.81	0.81

METERED FLOWS
AVERAGE DAILY DEMAND, MGD

Month	<u>WELL #8 & #9</u>				
	2017	2018	2019	2020	2021
January	0.27	0.25	0.28	0.26	0.23
February	0.28	0.28	0.30	0.27	0.24
March	0.27	0.26	0.27	0.23	0.24
April	0.27	0.26	0.27	0.21	0.25
May	0.28	0.27	0.26	0.25	0.26
June	0.28	0.28	0.29	0.32	0.30
July	0.27	0.30	0.31	0.36	0.30
August	0.29	0.31	0.34	0.32	0.31
September	0.31	0.33	0.33	0.27	0.29
October	0.30	0.30	0.26	0.25	0.28
November	0.32	0.27	0.27	0.21	0.26
December	0.13	0.27	0.25	0.20	0.26
YEAR ADD	0.27	0.28	0.29	0.26	0.27

METERED FLOWS
AVERAGE DAY DEMAND, MGD (Wells)

Month	<u>WELL #10, #11 & #7</u>				
	2017	2018	2019	2020	2021
January	0.56	0.55	0.52	0.48	0.49
February	0.55	0.56	0.57	0.47	0.53
March	0.50	0.52	0.52	0.44	0.53
April	0.51	0.54	0.52	0.38	0.53
May	0.52	0.53	0.48	0.47	0.55
June	0.52	0.57	0.51	0.63	0.61
July	0.76	0.63	0.53	0.70	0.61
August	0.59	0.66	0.59	0.76	0.63
September	0.58	0.62	0.61	0.67	0.58
October	0.60	0.59	0.58	0.62	0.53
November	0.49	0.53	0.50	0.49	0.47
December	0.48	0.48	0.45	0.44	0.47
YEAR ADD	0.56	0.57	0.53	0.54	0.54

TREATED METERED FLOWS
AVERAGE DA DEMAND, MGD
TOTAL OF ALL SERVICE DISTRICT (WELLS)

Month	<u>WELL NO 3 THROUGH 11</u>				
	2017	2018	2019	2020	2021
January	0.96	0.89	0.91	0.89	0.85
February	0.96	0.94	0.99	0.88	0.92
March	0.92	0.86	0.90	0.81	0.92
April	0.92	0.88	0.90	0.73	0.93
May	1.01	0.97	0.88	0.97	1.10
June	1.13	1.13	1.03	1.34	1.28
July	1.39	1.35	1.27	1.63	1.27
August	1.26	1.32	1.35	1.55	1.33
September	1.31	1.25	1.19	1.14	1.15
October	1.11	1.07	1.01	1.08	1.03
November	0.91	0.92	0.91	0.84	0.88
December	0.69	0.86	0.83	0.77	0.87
YEAR ADD	1.05	1.04	1.01	1.05	1.04

METERED FLOWS
AVERAGE DAY DEMAND, MGD (Distribution)

Month	<u>Isabella Pumps</u>				
	2017	2018	2019	2020	2021
January	0.54	0.55	0.52	0.48	0.49
February	0.55	0.56	0.58	0.50	0.53
March	0.50	0.52	0.52	0.44	0.53
April	0.52	0.54	0.52	0.38	0.53
May	0.52	0.54	0.48	0.47	0.55
June	0.52	0.57	0.51	0.63	0.61
July	0.77	0.63	0.54	0.69	0.60
August	0.58	0.66	0.59	0.76	0.63
September	0.59	0.62	0.61	0.67	0.58
October	0.60	0.59	0.58	0.62	0.53
November	0.49	0.54	0.50	0.50	0.47
December	0.48	0.48	0.45	0.44	0.47
YEAR ADD	0.56	0.57	0.53	0.55	0.54

DISTRIBUTION METERED FLOWS *
AVERAGE DAY DEMAND, MGD
TOTAL OF ALL SERVICE DISTRICT (PUMPED)

Month	2017	2018	2019	2020	2021
January	0.94	0.89	0.91	0.89	0.86
February	0.96	0.94	0.99	0.91	0.92
March	0.92	0.86	0.89	0.81	0.92
April	0.93	0.88	0.90	0.73	0.93
May	1.01	0.97	0.88	0.97	1.10
June	1.13	1.13	1.03	1.34	1.28
July	1.40	1.35	1.27	1.63	1.26
August	1.25	1.32	1.35	1.55	1.33
September	1.32	1.25	1.19	1.14	1.15
October	1.11	1.07	1.01	1.08	1.03
November	0.91	0.92	0.91	0.84	0.88
December	0.69	0.86	0.83	0.78	0.87
YEAR ADD	1.05	1.04	1.01	1.06	1.04

TREATED METERED FLOWS**MAX DAY DEMAND, MGD**

EAST SIDE SERVICE DISTRICT

Month	<u>WELLS NO. 10, 11, 7, 8 & 9</u>				
	2017	2018	2019	2020	2021
January	1.13	1.13	1.10	1.11	0.97
February	1.06	1.08	1.10	1.00	1.08
March	1.06	1.03	1.05	1.02	1.46
April	1.12	1.05	1.08	0.82	1.21
May	1.46	1.31	1.04	1.53	1.39
June	1.33	1.35	1.49	1.69	1.58
July	1.37	1.63	1.52	1.87	1.44
August	1.39	1.58	1.67	2.13	1.62
September	1.70	1.25	1.56	1.49	1.44
October	1.44	1.65	1.34	1.44	1.44
November	1.00	1.20	1.06	1.02	1.02
December	0.97	1.09	0.99	0.89	1.04
YEAR MAX	1.70	1.65	1.67	2.13	1.62

METERED FLOWS**MAX DAY DEMAND, MGD**

LOWER PRESSURE ZONE #2 (WEST SIDE)

Month	<u>WELL #3 & #4</u>				
	2017	2018	2019	2020	2021
January	0.18	0.12	0.21	0.21	0.20
February	0.23	0.23	0.19	0.21	0.20
March	0.20	0.12	0.16	0.28	0.21
April	0.23	0.19	0.18	0.21	0.26
May	0.44	0.29	0.21	0.53	0.42
June	0.49	0.43	0.36	0.63	0.54
July	0.51	0.66	0.61	0.74	0.48
August	0.56	0.49	0.63	0.69	0.00
September	0.72	0.46	0.45	0.48	0.41
October	0.46	0.92	0.39	0.48	0.45
November	0.16	0.27	0.16	0.20	0.20
December	0.13	0.18	0.20	0.20	0.20
YEAR MAX	0.72	0.92	0.63	0.74	0.54
	721,737	920,000	630,971	744,005	540,256

DISTRIBUTION METERED FLOWS ***MAX DAILY DEMAND, MGD**

EAST SIDE SERVICE DISTRICT

Month	2017	2018	2019	2020	2021
January	1.07	1.07	1.00	0.92	0.95
February	0.97	0.97	1.01	0.92	0.89
March	0.95	1.00	0.93	0.87	0.88
April	0.96	0.94	0.92	0.70	1.00
May	1.12	1.05	0.79	1.00	0.98
June	0.94	1.01	1.20	1.20	1.03
July	1.20	1.08	1.01	1.24	1.02
August	1.44	1.14	1.14	1.63	1.13
September	1.26	1.12	1.24	1.12	1.07
October	1.18	1.04	1.18	1.15	0.99
November	0.82	1.08	0.92	0.87	0.88
December	0.68	0.97	0.84	0.72	0.87
YEAR MAX	1.44	1.14	1.24	1.63	1.13
	1,438,876	1,136,902	1,241,306	1,632,426	1,132,995

METERED FLOWS**MAX DAY DEMAND, MGD**

Month	<u>WELL #8 & #9</u>				
	2017	2018	2019	2020	2021
January	0.33	0.37	0.35	0.35	0.40
February	0.34	0.31	0.36	0.32	0.28
March	0.34	0.34	0.34	0.31	0.30
April	0.34	0.32	0.34	0.25	0.31
May	0.35	0.36	0.31	0.36	0.31
June	0.33	0.33	0.58	0.40	0.35
July	0.31	0.39	0.38	0.42	0.36
August	0.43	0.36	0.42	0.42	0.38
September	0.41	0.37	0.43	0.31	0.37
October	0.36	0.36	0.39	0.32	0.37
November	0.27	0.35	0.35	0.27	0.32
December	0.08	0.35	0.30	0.23	0.33
YEAR MAX	0.43	0.39	0.58	0.42	0.40

METERED FLOWS**MAX DAY DEMAND, MGD (Wells)**

Month	<u>WELL #10, #11 & #7</u>				
	2017	2018	2019	2020	2021
January	0.74	0.71	0.66	0.57	0.55
February	0.64	0.66	0.65	0.61	0.61
March	0.62	0.67	0.59	0.56	0.58
April	0.62	0.62	0.58	0.44	0.69
May	0.77	0.69	0.48	0.64	0.66
June	0.61	0.68	0.63	0.80	0.68
July	0.90	0.69	0.63	0.82	0.66
August	1.00	0.77	0.72	1.21	0.75
September	0.85	0.75	0.81	0.81	0.70
October	0.82	0.68	0.80	0.83	0.62
November	0.55	0.73	0.58	0.60	0.56
December	0.61	0.62	0.55	0.49	0.54
YEAR MAX	1.00	0.77	0.81	1.21	0.75

TREATED METERED FLOWS**MAX DAY DEMAND, MGD**

TOTAL OF ALL SERVICE DISTRICT (WELLS)

Month	<u>WELL NO 3 THROUGH 11</u>				
	2017	2018	2019	2020	2021
January	1.25	1.19	1.21	1.13	1.15
February	1.20	1.20	1.20	1.14	1.09
March	1.15	1.12	1.09	1.15	1.09
April	1.18	1.14	1.10	0.91	1.26
May	1.56	1.33	1.01	1.53	1.40
June	1.43	1.43	1.56	1.83	1.58
July	1.72	1.73	1.62	1.99	1.49
August	2.00	1.63	1.78	2.32	1.13
September	1.98	1.59	1.69	1.60	1.48
October	1.64	1.96	1.58	1.63	1.44
November	0.98	1.35	1.08	1.07	1.08
December	0.81	1.14	1.04	0.92	1.07
YEAR MAX	2.00	1.96	1.78	2.32	1.58

METERED FLOWS**MAX DAY DEMAND, MGD (Distribution)**

Month	<u>Isabella Pumps</u>				
	2017	2018	2019	2020	2021
January	0.69	0.67	0.67	0.59	0.55
February	0.65	0.67	0.65	0.61	0.63
March	0.63	0.67	0.62	0.62	0.61
April	0.68	0.63	0.65	0.45	0.68
May	0.70	0.73	0.65	0.66	0.70
June	0.64	0.67	0.60	0.83	0.68
July	0.95	0.73	0.65	0.85	0.69
August	0.99	0.83	0.74	1.22	0.78
September	0.96	0.77	0.77	0.78	0.71
October	0.88	0.69	0.82	0.80	0.61
November	0.59	0.71	0.61	0.61	0.55
December	0.59	0.58	0.55	0.52	0.57
YEAR MAX	0.99	0.83	0.82	1.22	0.78

DISTRIBUTION METERED FLOWS ***MAX DAY DEMAND, MGD**

TOTAL OF ALL SERVICE DISTRICT (PUMPED)

Month	2017	2018	2019	2020	2021
January	1.02	1.03	1.01	0.94	0.95
February	0.99	0.99	1.01	0.93	0.91
March	0.97	1.01	0.96	0.93	0.91
April	1.01	0.96	0.99	0.71	0.99
May	1.05	1.09	0.96	1.01	1.01
June	0.98	1.00	1.18	1.22	1.03
July	1.26	1.12	1.03	1.27	1.05
August	1.42	1.19	1.16	1.64	1.16
September	1.37	1.14	1.21	1.09	1.08
October	1.24	1.05	1.20	1.12	0.98
November	0.86	1.06	0.96	0.88	0.86
December	0.66	0.93	0.85	0.76	0.89
YEAR MAX	1.42	1.19	1.21	1.64	1.16

TREATED METERED FLOWS
TOTAL DAILY DEMAND, MGD
EAST SIDE SERVICE DISTRICT

Month	<u>WELLS NO. 10, 11, 7, 8 & 9</u>				
	2017	2018	2019	2020	2021
January	29.00	27.04	28.18	27.49	26.45
February	26.90	26.08	27.66	24.58	25.68
March	28.48	26.65	27.76	25.15	28.32
April	27.60	26.41	26.88	21.80	28.05
May	31.45	29.92	27.39	25.80	34.03
June	33.93	33.82	30.81	40.14	38.39
July	35.61	41.83	39.22	50.62	39.22
August	35.86	40.95	41.88	48.00	41.38
September	38.92	37.48	35.25	37.29	34.61
October	33.80	33.22	30.95	33.33	31.86
November	25.40	26.94	25.29	25.16	26.40
December	24.86	25.86	25.50	23.96	27.02
YEAR TOTAL	371.80	376.22	366.77	383.32	381.42

METERED FLOWS
TOTAL DAILY DEMAND, MGD
LOWER PRESSURE ZONE #2 (WEST SIDE)

Month	<u>WELL #3 & #4</u>				
	2017	2018	2019	2020	2021
January	3.91	2.40	3.41	4.25	0.20
February	3.55	2.67	3.25	2.22	4.06
March	4.64	2.45	3.12	4.38	4.42
April	4.03	2.39	3.22	3.98	4.88
May	6.71	5.13	4.48	3.43	8.80
June	9.94	8.37	6.91	11.86	11.25
July	11.10	12.94	13.01	17.86	11.26
August	10.64	0.49	12.91	14.58	12.25
September	11.98	9.05	7.28	6.25	8.57
October	6.30	0.92	5.10	6.25	6.80
November	2.72	3.25	2.21	4.09	4.48
December	2.34	3.36	3.88	4.25	4.41
YEAR TOTAL	77.87	53.42	68.78	83.40	81.36

METERED FLOWS
TOTAL DAILY DEMAND, MGD

Month	<u>WELL #8 & #9</u>				
	2017	2018	2019	2020	2021
January	8.46	7.62	8.55	8.21	0.40
February	7.83	7.74	8.33	7.90	6.69
March	8.31	8.05	8.43	7.20	7.59
April	8.16	7.84	8.10	6.33	7.38
May	8.54	8.24	7.92	7.90	8.11
June	8.38	8.36	8.57	9.46	8.91
July	1.09	9.44	9.68	11.19	9.19
August	6.93	9.73	10.64	10.01	9.49
September	9.40	9.80	9.64	8.11	8.67
October	8.79	9.44	7.82	7.88	8.68
November	0.27	7.70	8.10	6.30	7.68
December	0.08	7.70	7.75	6.12	7.93
YEAR TOTAL	76.23	101.63	103.52	96.61	90.71

DISTRIBUTION METERED FLOWS *
TOTAL DAILY DEMAND, MGD
EAST SIDE SERVICE DISTRICT

Month	2017	2018	2019	2020	2021
January	25.92	24.64	24.78	23.24	15.51
February	23.35	23.42	24.41	22.36	21.62
March	23.84	24.20	24.64	21.66	24.05
April	23.57	24.02	23.66	17.83	23.17
May	24.73	24.80	22.90	22.36	25.24
June	23.99	25.46	23.90	28.28	27.13
July	24.51	28.89	26.21	32.76	27.97
August	25.21	30.20	28.97	33.42	29.14
September	26.94	28.43	27.97	28.16	26.04
October	27.50	27.66	25.85	27.08	25.06
November	14.91	23.69	23.09	21.07	21.93
December	14.95	22.52	21.78	19.71	22.61
YEAR TOTAL	279.43	307.92	298.15	297.92	289.46

METERED FLOWS
TOTAL DAILY DEMAND, MGD (Wells)

Month	<u>WELL #10, #11 & #7</u>				
	2017	2018	2019	2020	2021
January	17.46	17.02	16.23	15.03	15.12
February	15.53	15.68	16.08	14.46	14.93
March	15.52	16.15	16.20	14.46	16.45
April	15.41	16.18	15.56	11.49	15.80
May	16.19	16.56	14.98	14.47	17.13
June	15.62	17.10	15.33	18.82	18.22
July	23.42	19.45	16.54	21.58	18.77
August	18.29	20.46	18.33	23.41	19.65
September	17.53	18.63	18.32	20.04	17.37
October	18.71	18.23	18.04	19.20	16.39
November	14.64	15.99	14.99	14.77	14.25
December	14.87	14.83	14.03	13.59	14.68
YEAR TOTAL	203.20	206.29	194.64	201.31	198.75

TREATED METERED FLOWS
TOTAL DAILY DEMAND, MGD
TOTAL OF ALL SERVICE DISTRICT (WELLS)

Month	<u>WELL NO 3 THROUGH 11</u>				
	2017	2018	2019	2020	2021
January	29.83	27.04	28.18	27.49	15.71
February	26.90	26.08	27.66	24.58	25.68
March	28.48	26.65	27.76	26.04	28.47
April	27.60	26.41	26.88	21.80	28.05
May	31.45	29.92	27.39	25.80	34.03
June	33.93	33.82	30.81	40.14	38.39
July	35.61	41.83	39.22	50.62	39.22
August	35.86	30.69	41.88	48.00	41.38
September	38.92	37.48	35.25	34.40	34.61
October	33.80	28.58	30.95	33.33	31.86
November	17.63	26.94	25.30	25.16	26.40
December	17.29	25.89	25.66	23.96	27.02
YEAR TOTAL	357.30	361.34	366.93	381.32	370.83

METERED FLOWS
TOTAL DAILY DEMAND, MGD (Distribution)

Month	<u>Isabella Pumps</u>				
	2017	2018	2019	2020	2021
January	16.64	0.67	16.25	15.00	15.21
February	15.53	15.72	16.12	14.42	14.91
March	15.57	0.67	16.17	13.63	16.51
April	15.47	16.18	15.55	11.46	15.76
May	16.21	16.65	14.96	14.45	17.08
June	15.70	17.11	15.34	18.88	18.20
July	23.78	19.47	16.66	21.51	18.69
August	18.12	20.45	18.34	23.45	19.60
September	17.67	18.73	18.32	20.14	17.37
October	18.74	18.24	18.13	19.37	16.35
November	14.67	16.07	14.97	14.86	14.18
December	14.89	14.82	14.06	13.75	14.63
YEAR TOTAL	203.00	174.78	194.86	200.92	198.50

DISTRIBUTION METERED FLOWS *
TOTAL DAILY DEMAND, MGD
TOTAL OF ALL SERVICE DISTRICT (PUMPED)

Month	2017	2018	2019	2020	2021
January	46.47	27.71	44.44	42.49	30.92
February	42.42	41.80	43.77	39.00	40.60
March	44.05	27.32	43.93	39.67	44.98
April	43.08	42.60	42.43	33.27	43.81
May	47.65	46.58	42.35	40.24	51.11
June	49.63	50.94	46.15	59.02	56.59
July	59.39	61.30	55.88	72.13	57.91
August	53.98	51.14	60.21	71.45	60.98
September	56.59	56.22	53.56	54.54	51.98
October	52.54	46.82	49.08	52.70	48.21
November	32.31	43.00	40.27	40.03	40.58
December	32.19	40.71	39.72	37.70	41.65
YEAR TOTAL	560.30	536.12	561.79	582.24	569.33

APPENDIX E

Well Inspection Reports





Charter Township of Union
Shawn McBride – Water Superintendent
2010 S. Lincoln Rd.
Mt. Pleasant, Michigan 48858

Re: 2019 Annual Well and Pump Servicing & Testing

Dear Shawn,

Please find enclosed updated service inspection reports with data from the recently completed performance testing and inspection of your wells and pumping equipment. The oil was changed in each vertical turbine pump motor, the packing checked/changed, and greased where applicable. The documents are for insertion into your master record book to ensure that it is up-to-date.

Pump #3 West The pump in this well is producing 418 GPM @ 65 pounds of pressure at the surface and 60' pumping level. Volts and amps are both running slightly over full load condition with the VFD at 60 Hz.

Well #3 West The well's specific capacity (SC) was calculated to 11.0 GPM/ft. of drawdown. This number will serve as a baseline for future tests. No further work is recommended.

Pump #4 East The pump in this well is producing 428 GPM @ 65 pounds of pressure at the surface and 54' pumping level when tested at 53 Hz. Amps are running under full load condition and the pump appears to be in good condition. The 6" gate valve is leaking and needs to be replaced.

Well #4 East The well's specific capacity (SC) was calculated to 15.3 GPM/ft. of drawdown. This number will serve as a baseline for future tests. No further work is recommended.

Pump #7 The pump in this well is producing 798 GPM @ 10 pounds of pressure at the surface and 44' pumping level. Volts and amps are both running under full load condition with the VFD at 52 Hz.

Well #7 The well's specific capacity is up at this time, recording a 26.6 GPM/ft drawdown when tested at the system operating pressure of 10 pounds of pressure. This well remains in satisfactory condition as static and pumping levels have remained stable. No further work is recommended.

Pump #8 The pump in this well is producing 433 GPM @ 84 pounds of pressure at the surface and 49.9' pumping level. Amps are running under full load condition with the VFD at 57 Hz.

Well #8 The well's specific capacity is up at this time, recording a 12.9 GPM/ft drawdown when tested at the system operating pressure of 84 pounds of pressure. This number will serve as a baseline for future tests. No further work is recommended.

Pump #9 The pump in this well is producing 427 GPM @ 84 pounds of pressure at the surface and 58' pumping level. Amps are running under full load condition with the VFD at 56 Hz.

Well #9 The well's specific capacity is up at this time, recording a 10.2 GPM/ft drawdown when tested at the system operating pressure of 84 pounds of pressure. This number will serve as a baseline for future tests. No further work is recommended.

Pump #10 The pump in this well is producing 409 GPM @ 10 pounds of pressure at the surface and 36' pumping level. Amps are running under full load condition.

Well #10 The well's specific capacity is up at this time, recording a 17.8 GPM/ft drawdown when tested at the system operating pressure of 10 pounds of pressure. This number will serve as a baseline for future tests. No further work is recommended.

I appreciate the opportunity to be of service to you with our annual inspection and testing program. A copy of the invoice for this work has been forwarded to your accounts payable and is attached to this letter. If you have any questions or would like to schedule this work, please contact me at 616-527-0050 or 616-690-8139.

Thank You,
PEERLESS-MIDWEST, INC.



Bob Masters
Project Manager



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location Behind Water Treatment Plant on Isabella Rd.

Well No. 10 Date Drilled _____ Dia. 12" Depth 77'9" Type Well _____

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 989-621-1361 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **						
AFTER LAST CLEANING						
AFTER LAST TEST						
AT PUMPS RATED FLOW	2019	13'	337 Orifice 335 Meter	31'	30#	18.7
AT SYSTEM OPERATING PSI	2019	13'	409 Orifice 402 Meter	36'	10#	17.8

Test Completed Through Meter _____ Flange Size 6" Confined Space Entry? No

Motor HP 15 Make Franklin Electric Volts 460 RPM 3450 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Franklin Electric Serial No. 07619-12-6184 Airline Length 50'

Rated Capacity: _____ GPM _____ TDH Operating Pressure 10#

Total Setting 54'3" Size of Packing SUB Date Installed 2014

Dates of Overhaul _____

THE FOLLOWING IS TO BE PERFORMED DURING EACH INSPECTION

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 409 GPM 59' TDH Projected Curve Capacity NDA GPM NDA TDH

Shut Off Pressure NDA PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 18 / 19 / 18 Amps 23.7 @ 460 v Full Load Amps

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well: Test pump, ample space for truck and trailer. (Pump is in field)

Need a Smeal to Raise Pump? No Remarks _____

Inspected By Justin Delinsky Date Inspected March 4, 2019



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location 2279 S Meridian Rd.

Well No. 3 West Date Drilled _____ Dia. 8" Depth 160' Type Well _____

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 989-621-1361 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **						
AFTER LAST CLEANING						
AFTER LAST TEST						
AT PUMPS RATED FLOW						
AT SYSTEM OPERATING PSI	2019	22'	418	60'	65#	11.0

Test Completed Through Meter _____ Flange Size 6" Confined Space Entry? No

Motor HP 30 Make Franklin Volts 230/460 RPM 3450 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Grundfos Serial No. 61416 Airline Length 109'

Rated Capacity: 400 GPM _____ TDH _____ Operating Pressure 65#

Total Setting 116'8" Size of Packing SUB Date Installed _____

Dates of Overhaul _____

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 418 GPM 210' TDH _____ Projected Curve Capacity 400 GPM NDA TDH _____

Shut Off Pressure NDA PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 43 / 42 / 43 Amps 79/39.5 @ 230/460 v Full Load Amps _____

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well Test pump, ample space for truck & trailer.

Need a Smeal to Raise Pump? No Remarks: Test Ran at 60 Hz

Inspected By Justin Delinsky Date Inspected March 6, 2019



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location 2279 S Meridian Rd.

Well No. 4 East Date Drilled _____ Dia. _____ Depth _____ Type Well _____

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 989-621-1361 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **						
AFTER LAST CLEANING						
AFTER LAST TEST						
AT PUMPS RATED FLOW						
AT SYSTEM OPERATING PSI	2019	26'	428	54'	65#	15.3

Test Completed Through Meter X Flange Size 6" Confined Space Entry? No

Motor HP 40 Make Franklin Volts 460 RPM 3450 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Grundfos Serial No. 16B19-17-06095A Airline Length 79'

Rated Capacity: 400 GPM _____ TDH _____ Operating Pressure 65#

Total Setting 86'8" Size of Packing SUB Date Installed _____

Dates of Overhaul 2002

THE FOLLOWING IS TO BE PERFORMED DURING EACH INSPECTION

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 428 GPM 204' TDH _____ Projected Curve Capacity 400 GPM NDA TDH _____

Shut Off Pressure NDA PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 49 / 50 / 49 Amps 54.9 @ 460 v Full Load Amps _____

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well Test pump, ample space for truck & trailer.

Need a Smeal to Raise Pump? No Remarks: Test ran at 53 Hz - Gate valve needs to be replaced due to running into system. 6" gate valve.

Inspected By Justin Delinsky Date Inspected March 6, 2019



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location 5150 S. Isabella Rd. _____ N. 43.56495 / W. 084.74964 _____

Well No. 7 Date Drilled 2010 Dia. 12" Depth 86'2" Type Well GW

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 989-621-1361 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **	2010	-	-	-	-	-
AFTER LAST CLEANING						
AFTER LAST TEST	2016	16.75'	701	45'	-	24.8
AT PUMPS RATED FLOW	2019	14'	674 Orifice 668 Meter	41'	30#	25.0
AT SYSTEM OPERATING PSI	2019	14'	798 Orifice 795 Meter	44'	10#	26.6

Test Completed Through Meter _____ Flange Size 6" Confined Space Entry? No

Motor HP 40 Make Grundfos Volts 480 RPM 3480 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Grundfos Serial No. 80516 Airline Length 68'

Rated Capacity: _____ GPM _____ TDH _____ Operating Pressure 10#

Total Setting 73.583 Size of Packing SUB Date Installed 2010

Dates of Overhaul 2016

THE FOLLOWING IS TO BE PERFORMED DURING EACH INSPECTION

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 798 GPM 67' TDH _____ Projected Curve Capacity NDA GPM NDA TDH _____

Shut Off Pressure _____ PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 44 / 44 / 44 Amps 61 @ 480 v Full Load Amps _____

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well: Test pump, ample
space for truck & trailer. (Pump is in Field)

Need a Smeal to Raise Pump? No Remarks: Test ran at 52 Hz

Inspected By Justin Delinsky Date Inspected March 4, 2019



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location _____

Well No. 8 Date Drilled 2010 Dia. 12" Depth 82'4" Type Well GW

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 505 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **	2010					
AFTER LAST CLEANING						
AFTER LAST TEST						
AT PUMPS RATED FLOW	2019	16'	403	48.5'	96#	12.4
AT SYSTEM OPERATING PSI	2019	16'	433	49.5'	84#	12.9

Test Completed Through Meter _____ Flange Size 6" Confined Space Entry? No

Motor HP 40 Make Franklin Volts 460 RPM 3450 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Franklin Serial No. 400SR0F8A-0564 Airline Length 73'

Rated Capacity: 400 GPM _____ TDH _____ Operating Pressure 84#

Total Setting 79.5' Size of Packing SUB Date Installed 2010

Dates of Overhaul _____

THE FOLLOWING IS TO BE PERFORMED DURING EACH INSPECTION

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 403 GPM 270' TDH _____ Projected Curve Capacity 400 GPM NDA TDH _____

Shut Off Pressure NDA PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 52 / 51 / 52 Amps 61.6 @ 460 v Full Load Amps _____

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well: Test pump, ample space for truck & trailer.

Need a Smeal to Raise Pump? No Remarks Test ran at 57 Hz

Maintenance: 50' of 6" lay flat, 8x5 orifice

Inspected By Justin Delinsky Date Inspected March 5, 2019



505 Apple Tree Drive / Ionia, Michigan 48846 / 616.527.0050 / Fax 616.527.5508

WELL & PUMP SERVICE INSPECTION REPORT

Owner _____ Charter Township of Union _____ City _____ Mt. Pleasant _____ State MI

Location _____

Well No. 9 Date Drilled 2011 Dia. 12" Depth 102' Type Well GW

Screen ID. _____ Screen Length _____ Depth to Top of Screen _____ Type Screen _____

Dates of Cleaning _____

Phone 989-621-1361 Person to Contact Shawn McBride

	DATE	STATIC	G.P.M.	PUMPING LEVEL	PRESSURE	SPECIFIC CAPACITY
ORIGINAL **	2011					
AFTER LAST CLEANING						
AFTER LAST TEST						
AT PUMPS RATED FLOW	2019	16'	403	57'	97#	9.8
AT SYSTEM OPERATING PSI	2019	16'	427	58'	84#	10.2

Test Completed Through Meter _____ Flange Size 6" Confined Space Entry? No

Motor HP 40 Make Franklin Volts 460 RPM 3450 Phase 3

Gear Drive _____ HP - Ratio - RPM Meter Required _____

Pump Mfg. Franklin Serial No. 400SR40F8A-0564 Airline Length 90'

Rated Capacity: 400 GPM _____ TDH _____ Operating Pressure 84#

Total Setting 96'8" Size of Packing SUB Date Installed 2011

Dates of Overhaul _____

THE FOLLOWING IS TO BE PERFORMED DURING EACH INSPECTION

Is Check Valve Leaking? No Change Motor Oil & Grease SUB Repack Pump SUB Grease Pump SUB

Pump is Presently Developing 403 GPM 281' TDH _____ Projected Curve Capacity 400 GPM NDA TDH _____

Shut Off Pressure NDA PSI Rated Shut Off Head NDA ft. Calculated Shut Off Head NDA ft.

Electrical Data (With Pump in Operation): 480 V 49 / 50 / 49 Amps 61.6 @ 460 v Full Load Amps _____

Location of Power Lines _____ Can Electrical Box be Locked Out? Yes

Distance From Top of Pump Pedestal to Grade _____ Materials Needed to Clean Well: Test pump, ample space for truck and trailer. (Pump in yard)

Need a Smeal to Raise Pump? No Remarks Test ran at 56 Hz

Maintenance: 50' of 6" lay flat and 8x5 orifice

Inspected By Justin Delinsky Date Inspected March 5, 2019

APPENDIX F

Tank Inspection Reports





STORAGE TANK ROOFTOP COMPONENT INSPECTION CERTIFICATION FOR COMMUNITY WATER SUPPLY

Issued under authority of 1976 PA 399, MCL 325.1001 et seq., and Administrative Rules, as amended.
Failure to submit this information is a violation of Act 399 and may subject the water supply to enforcement penalties.

EGLE surveyors are not allowed to climb standpipes or elevated storage tanks. Provide this checklist with photo documentation of each component to the surveyor at the time of the survey to avoid receiving a deficiency for the unknown integrity of the various rooftop tank components. Complete one of these forms for each storage tank in the system with inaccessible components. Only climb a tank using proper safety gear.

Water System Name:	Union Township	WSSN:	06725
Tank Name:	US-27 Broadway Tank	Tank ID:	22-39-60-01

Operator in Charge (OIC):	Shawn McBride	Date:	10/22/2020
------------------------------	---------------	-------	------------

Person and company performing the inspection:	Dixon Engineering
Date(s) rooftop components were last inspected:	2014

OIC signature certifying that the information on this form is complete and accurate:	
--	--

A) Overall Condition

1. Does the tank appear to be structurally sound?	☒ Yes ☐ No ☐ NA
2. Is the tank free of unprotected openings? (breaches, leaks, holes, cracks, etc.)	☒ Yes ☐ No ☐ NA
3. Is the mud valve in good condition? (No excess corrosion or leaks)	☒ Yes ☐ No ☐ NA

B) Air Vent

1. Does the tank have a vent separate from the overflow?	☒ Yes ☐ No ☐ NA
2. Does the vent have an intact non-corrodible #24 mesh screen?	☒ Yes ☐ No ☐ NA
3. Is the vent screen free of debris and able to effectively exchange air?	☒ Yes ☐ No ☐ NA
4. Does the vent have a vacuum and pressure relief mechanism?	☒ Yes ☐ No ☐ NA
5. Down-turned vent: Does the tank have a down-turned vent that terminates at least 24 inches above the roof surface?	☐ Yes ☐ No ☒ NA
6. Non-down-turned vent: Does the tank have a non-down-turned vent with a solid cover down to the bottom of the vent screen?	☐ Yes ☒ No ☐ NA
7. Non-down-turned vent: Is the screen at least 8 inches above the roof surface?	☒ Yes ☐ No ☐ NA

Note: If vent screen does not have a vacuum relief mechanism, caution with using #24 mesh (QB2 & B4).

C) Access Hatch

1. Is each hatch raised at least 24 inches above the roof/ground on below grade tanks or 4 inches above the roof on above ground tanks?	☒ Yes ☐ No ☐ NA
2. Does each hatch have a shoe box style cover where the lid edges extend below the lip?	☒ Yes ☐ No ☐ NA
3. Is each hatch sealed tightly with an appropriate gasket?	☐ Yes ☒ No ☐ NA
4. Is each hatch locked?	☒ Yes ☐ No ☐ NA
5. Does the tank access tube transition to the tank roof without an open gap?	☐ Yes ☒ No ☐ NA
6. If "No" to C-5, has the sanitary concern been properly addressed?	☒ Yes ☐ No ☐ NA

Provide details on all "No" responses recorded above, and include the proposed remedies and a schedule for completion:

Install solid cover to vent top and gasket on roof manway as part of the next tank maintenance project.





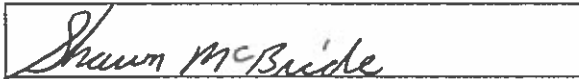
STORAGE TANK ROOFTOP COMPONENT INSPECTION CERTIFICATION FOR COMMUNITY WATER SUPPLY

Issued under authority of 1976 PA 399, MCL 325.1001 et seq., and Administrative Rules, as amended.
Failure to submit this information is a violation of Act 399 and may subject the water supply to enforcement penalties.

EGLE surveyors are not allowed to climb standpipes or elevated storage tanks. Provide this checklist with photo documentation of each component to the surveyor at the time of the survey to avoid receiving a deficiency for the unknown integrity of the various rooftop tank components. Complete one of these forms for each storage tank in the system with inaccessible components. Only climb a tank using proper safety gear.

Water System Name:	Union Township	WSSN:	06725
Tank Name:	Deerfield	Tank ID:	22-39-60-02
Operator in Charge (OIC):	Shawn McBride	Date:	10/22/2020

Person and company performing the inspection:	Dixon Engineering
Date(s) rooftop components were last inspected:	2018

OIC signature certifying that the information on this form is complete and accurate: 

A) Overall Condition

1. Does the tank appear to be structurally sound?	☒ Yes ☐ No ☐ NA
2. Is the tank free of unprotected openings? (breaches, leaks, holes, cracks, etc.)	☒ Yes ☐ No ☐ NA
3. Is the mud valve in good condition? (No excess corrosion or leaks)	☒ Yes ☐ No ☐ NA

B) Air Vent

1. Does the tank have a vent separate from the overflow?	☒ Yes ☐ No ☐ NA
2. Does the vent have an intact non-corrodible #24 mesh screen?	☒ Yes ☐ No ☐ NA
3. Is the vent screen free of debris and able to effectively exchange air?	☒ Yes ☐ No ☐ NA
4. Does the vent have a vacuum and pressure relief mechanism?	☒ Yes ☐ No ☐ NA
5. Down-turned vent: Does the tank have a down-turned vent that terminates at least 24 inches above the roof surface?	☐ Yes ☐ No ☒ NA
6. Non-down-turned vent: Does the tank have a non-down-turned vent with a solid cover down to the bottom of the vent screen?	☐ Yes ☒ No ☐ NA
7. Non-down-turned vent: Is the screen at least 8 inches above the roof surface?	☒ Yes ☐ No ☐ NA

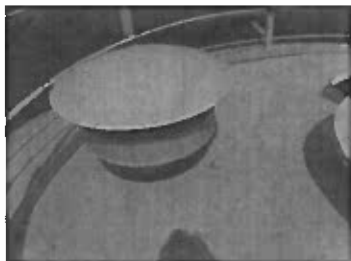
Note: If vent screen does not have a vacuum relief mechanism, caution with using #24 mesh (QB2 & B4).

C) Access Hatch

1. Is each hatch raised at least 24 inches above the roof/ground on below grade tanks or 4 inches above the roof on above ground tanks?	☒ Yes ☐ No ☐ NA
2. Does each hatch have a shoe box style cover where the lid edges extend below the lip?	☒ Yes ☐ No ☐ NA
3. Is each hatch sealed tightly with an appropriate gasket?	☐ Yes ☒ No ☐ NA
4. Is each hatch locked?	☒ Yes ☐ No ☐ NA
5. Does the tank access tube transition to the tank roof without an open gap?	☒ Yes ☐ No ☐ NA
6. If "No" to C-5, has the sanitary concern been properly addressed?	☐ Yes ☐ No ☐ NA

Provide details on all "No" responses recorded above, and include the proposed remedies and a schedule for completion:

Install solid cover to vent top and gasket on roof manway as part of the next tank maintenance project.



APPENDIX G

Water Main Inventory Spreadsheet



<u>Length</u>	<u>Date Installed</u>	<u>Size</u>	<u>Material</u>
350	201919208	16	PVC - C900
500		16	PVC - C900
8284	20150716	12	PVC - C900
2653	20150716	12	PVC - C900
425	20150716	12	PVC - C900
29	20150716	12	PVC - C900
1392	20120620	12	C900
6	19891207	12	PVC
18	20110726	12	
265	20110726	12	
421	19921105	12	PVC
421	19921105	12	PVC
318	19891207	12	PVC
126	19891207	12	PVC
296	19890821	12	PVC
132	19891207	12	PVC
132	19891207	12	PVC
225	19880527	12	PVC
43	19880527	12	PVC
62	20100302	12	
340	20100302	12	
125	20100302	12	C900
175	20100302	12	C900
170	20100302	12	C900
30	20110310	12	
10	20110310	12	
12	19930217	12	
8	20010726	12	
598	19891207	12	PVC
138	20110310	12	C-906 SD
100	19891206	12	PVC
48	19891206	12	PVC
221	19891207	12	PVC
246	19891207	12	PVC
68	19930217	12	PVC
292	19930217	12	PVC
293	19891207	12	PVC
63	19891207	12	PVC
533	20060222	12	
1616	20060222	12	
254	20060222	12	
486	20060222	12	
93	19880527	12	
30	19880527	12	
291	19891207	12	PVC
295	19990419	12	

117	19990419	12	
339		12	
256		12	
426		12	
287		12	
116		12	
144		12	
43		12	
374		12	
246	20050217	12	
52	19891207	12	PVC
326	19891207	12	PVC
73	19891207	12	PVC
481	19891207	12	PVC
332	20070801	12	
242	20070801	12	
10		12	
43	19880527	12	PVC
24	19880527	12	PVC
593	19891207	12	PVC
110	19880202	12	
585	19991231	12	PVC
359	19991231	12	PVC
391	19921105	12	PVC
710	19921105	12	PVC
287	19941216	12	PVC
221	19941216	12	PVC
506	19891207	12	PVC
1068	19891207	12	PVC
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930	19991231	12	C-900
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224	19960415	12	
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45	19891207	12	PVC
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335	19891206	8	PVC
212	20120601	8	C-900
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35	20120206	8	PVC C-900
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194	19880527	8	PVC
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219		8	PVC
283	20080101	8	
80	20080101	8	
883	20030102	8	PVC

601	20030102	8	PVC
488	20041119	8	
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141	20041119	8	
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336	20041119	8	
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254	20050531	8	
539	20050531	8	
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104	19960304	8	
93	19960415	8	
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112	20000601	8	PVC
114	20000601	8	PVC
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446	20000601	8	PVC
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234	20051213	8	
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118	19990730	8	
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269	19990730	8	
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160	19870521	8	PVC
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226	19931201	8	
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668	20060420	8	
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481	20060203	8	
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781	20060203	8	PVC
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1300	20060222	8	
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436	19890629	8	
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71	20050930	8	
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76	20060403	8	PVC
300	20040130	8	PVC
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191	20051213	8	
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546	20010101	8	PVC
360	19881231	8	PVC
275	19971215	8	PVC
323		8	PVC
444	19891207	8	PVC
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255	20050517	8	PVC
281	19930107	8	PVC
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610	20000428	8	C-900
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331	20020325	8	
380	20000828	8	PVC
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342	19890629	8	
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73	19850703	8	
718	19850703	8	
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176	19891207	8	
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378	19970513	8	PVC
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617	19950630	8	PVC
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53	19891207	8	PVC
173	19891207	8	PVC
19	19880527	8	PVC
399	19880527	8	PVC
193	19880527	8	PVC
552	19880527	8	PVC
40	19880527	8	PVC
24	19880527	8	PVC
5	19880527	8	PVC
299	19880527	8	PVC
329	19880527	8	PVC
8	19880527	8	PVC
469	19880527	8	PVC
32	19880527	8	PVC
36	19880527	8	PVC
577	19880527	8	PVC
88	19880527	8	PVC
59	19880527	8	PVC
24	19880527	8	PVC
32	19880527	8	PVC
119	19880527	8	PVC
6	19880527	8	PVC
15	19880527	8	PVC
20	19870521	8	PVC
92	19870521	8	PVC
145	19870521	8	PVC
71	19870521	8	PVC
19	19870521	8	PVC
49	19870521	8	PVC
200	19870521	8	PVC
31	19870521	8	PVC
64	19870521	8	PVC
124	19880527	8	PVC

61	19880527	8	PVC
28	19880527	8	PVC
61	19880527	8	PVC
468	19880527	8	PVC
481	19880527	8	PVC
5	19880527	8	PVC
4	19880527	8	PVC
438	19880527	8	PVC
38	19880527	8	PVC
23	19880527	8	PVC
488	19880527	8	PVC
312	19880527	8	PVC
24	19880527	8	PVC
5	19880527	8	PVC
19	19880527	8	PVC
3	19880527	8	PVC
367	19880527	8	PVC
477	19880527	8	PVC
29	19880527	8	PVC
454	19880527	8	PVC
14	19880527	8	PVC
95	19880527	8	PVC
254	19880527	8	PVC
364	19880527	8	PVC
26	19880527	8	PVC
11	19880527	8	PVC
522	19880527	8	PVC
141	19880527	8	PVC
257	19880527	8	PVC
149	19880527	8	PVC
137	19880527	8	PVC
116	19880527	8	PVC
119	19880527	8	PVC
58	19880527	8	PVC
200	19880527	8	PVC
350	19880527	8	PVC
56	19880527	8	PVC
18	19880527	8	PVC
310	19880524	8	PVC
24	19880524	8	PVC
460	19880527	8	PVC
50	19880527	8	PVC
396	19880527	8	PVC
163	19880527	8	PVC
408	19880527	8	PVC
9	19880527	8	PVC
12	19880527	8	PVC

349	19880527	8	PVC
331	19880527	8	PVC
400	19880527	8	PVC
31	19880527	8	PVC
451	19880527	8	PVC
451	19880527	8	PVC
115	19880527	8	PVC
297	19880527	8	PVC
314	19880527	8	PVC
9	19880527	8	PVC
20	19880527	8	PVC
326	19880527	8	PVC
50	19880527	8	PVC
270	19880527	8	PVC
176	19880527	8	PVC
502	19880527	8	PVC
701	19880527	8	PVC
386	19880527	8	PVC
42	19880527	8	PVC
446	19880527	8	PVC
535	19891207	8	PVC
687	19891206	8	PVC
1262	19891206	8	PVC
48	19891206	8	PVC
866	19891206	8	PVC
359	19900101	8	PVC
41	19900101	8	PVC
1002	19900101	8	PVC
296	19900101	8	PVC
20	19900101	8	PVC
262	19880527	8	PVC
288	19900101	8	PVC
122	19900101	8	PVC
396	19900101	8	PVC
93	19900101	8	PVC
215	19900101	8	PVC
170	19900101	8	PVC
12	19891207	8	PVC
172	19891207	8	PVC
297	19891207	8	PVC
12	19891207	8	PVC
15	19891207	8	PVC
1622	19891207	8	PVC
421	19891207	8	PVC
616	19891207	8	PVC
10	19891207	8	PVC
196	19891207	8	PVC

14	19891207	8	PVC
227	19891207	8	PVC
314	19891207	8	PVC
387	19891206	8	PVC
331	19891206	8	PVC
510	19891206	8	PVC
46	19891206	8	PVC
41	19891206	8	PVC
113	19891206	8	PVC
15	19891206	8	PVC
56	19891206	8	PVC
5	19891206	8	PVC
495	19891206	8	PVC
90	19891206	8	PVC
64	19891206	8	PVC
86	19891206	8	PVC
99	19891206	8	PVC
344	19891206	8	PVC
110	19891206	8	PVC
190	19891206	8	PVC
84	19891206	8	PVC
424	19891206	8	PVC
302	19891206	8	PVC
273	19891206	8	PVC
319	19891206	8	PVC
364	19891206	8	PVC
6	19891206	8	PVC
520	19891206	8	PVC
25	19891206	8	PVC
273	19891206	8	PVC
356	19891206	8	PVC
614	19891206	8	PVC
184	19891206	8	PVC
584	19891206	8	PVC
6	19891206	8	PVC
64	19891206	8	PVC
567	19891206	8	PVC
165	19891206	8	PVC
495	19920814	8	PVC
300	19920814	8	PVC
395	19970101	8	PVC
545	19970101	8	PVC
430	19970101	8	PVC
418	19970101	8	PVC
48	19870521	8	PVC
112	19950614	8	PVC
160	19950614	8	PVC

19	19950614	8	PVC
26	19950614	8	PVC
127	19950614	8	PVC
251	19950614	8	PVC
65	19950614	8	PVC
64	19950614	8	PVC
410	19950614	8	PVC
905	19950614	8	PVC
58	19950614	8	PVC
3	19921105	8	PVC
304	19921105	8	PVC
402	19920930	8	PVC
392	19921105	8	PVC
181	19921105	8	PVC
110	19921105	8	PVC
372	19921105	8	PVC
507	19920930	8	PVC
71	19920930	8	PVC
304	19921105	8	PVC
203	19921105	8	PVC
475	19921105	8	PVC
436	19921105	8	PVC
231	19921105	8	PVC
40	19921105	8	PVC
509	19921105	8	PVC
9	19921105	8	PVC
30	19921105	8	PVC
318	19921105	8	PVC
797	19921105	8	PVC
12	19921105	8	PVC
456	19921105	8	PVC
249	19921105	8	PVC
341	19921105	8	PVC
13	19921105	8	PVC
25	19921105	8	PVC
453	19920930	8	PVC
40	19921105	8	PVC
34	19921105	8	PVC
276	19921105	8	PVC
15	19921105	8	PVC
218	19921105	8	PVC
472	19900613	8	PVC
399	19900613	8	PVC
896	19900613	8	PVC
61	19900613	8	PVC
17	19900613	8	PVC
424	19900613	8	PVC

7	19900613	8	PVC
209	19900613	8	PVC
15	19880527	8	PVC
40	19880527	8	PVC
547	19891206	8	PVC
441	19900110	8	PVC
310	19880527	8	PVC
532	19880527	8	PVC
525	19880527	8	PVC
117	19891207	8	PVC
11	19891207	8	PVC
2409	20020715	8	PVC
125	2019101428	8	C900
250	2019180014	8	C900
38	20100302	6	C900
205		6	
181	19940714	6	PVC
1410	19940714	6	PVC
6		6	
95		6	
415		6	DI
84	19950630	6	
455		6	
87	19891206	6	PVC
1040	19891206	6	PVC
10		6	
315	20020325	6	
85		6	
325	20091013	6	
163	20100302	6	C900
85		6	
303		6	
5	19880527	6	
212	20110310	6	
222		6	
105		6	
136		6	
235		6	
240	19990419	6	
296	19990419	6	
23	20010101	6	
228	19880202	6	
167	19880202	6	
236	20081030	6	
172	20081030	6	
231	19891231	6	
374	19891231	6	

91	20000301	6	PVC
263	20000301	6	PVC
218		6	
93	20081203	6	
66	20030102	6	
286	20010726	6	
249		6	
496		6	
542		6	
75		6	
485		6	
517		6	
657		6	
462		6	
258		6	
241		6	
246		6	
109		6	
428		6	
410		6	
102		6	
155		6	
177		6	
71		6	
241		6	
321		6	
352		6	
146		6	
195		6	
69		6	
709		6	
185		6	
757	19691115	6	
247		6	
566	19691115	6	
69		6	
66		6	
49		6	
290		6	
245		6	
47		6	
515		6	
50	19891207	6	C900
17	20041007	6	
16	20041007	6	
15	20041007	6	
77	20041007	6	

33	20041007	6	
15	20041007	6	
10	20041007	6	
10	20041007	6	
83	20041007	6	
76	20041007	6	
3	20071228	6	
1738	19990709	6	
145	19850703	6	
532	19940714	6	PVC
249	19900815	6	PVC
258	19900815	6	PVC
50	19891207	6	PVC
388	19880524	6	PVC
477	19880524	6	PVC
451	19880524	6	PVC
5	19880527	6	PVC
407	19891207	6	PVC
584	19900110	6	PVC
109	19900110	6	PVC
382	19900110	6	PVC
266	19900110	6	PVC
352	19900110	6	PVC
412	19900110	6	PVC
133	19900110	6	PVC
409	19900110	6	PVC
121	19900110	6	PVC
444	19891206	6	PVC
392	19891207	6	PVC
199	19891207	6	PVC
511	19880101	6	PVC
579	19900110	6	PVC
29	19900110	6	PVC
20	19891207	6	PVC
170	19891207	6	PVC
29	19891207	6	PVC
100	19891207	6	PVC
480	19891207	6	PVC
35	19871103	6	PVC
1056	19871103	6	PVC
15	19871103	6	PVC
8	19891206	6	PVC
10	19891206	6	PVC
12	19891206	6	PVC
10	19891206	6	PVC
10	19891206	6	PVC
10	19891206	6	PVC

10	19891206	6	PVC
12	19891206	6	PVC
10	19891206	6	PVC
10	19900815	6	PVC
8	19900815	6	PVC
11	19900815	6	PVC
9	19900815	6	PVC
148	19891206	6	PVC
50	19891206	6	PVC
45	19891206	6	PVC
128	19891207	6	PVC
75	19891207	6	PVC
10	19891206	6	PVC
10	19891206	6	PVC
10	19891207	6	PVC
12	19891207	6	PVC
206		4	PVC C-900
87		4	PVC C-900
46		4	PVC C-900
630		4	PVC C-900
36		4	PVC C-900
39		4	PVC C-900
104		4	PVC C-900
51		4	PVC C-900
161		4	PVC C-900
764		4	PVC C-900
127		4	PVC C-900
142	20120206	4	PVC C-900
267	20060908	4	C-900
6		4	
151		4	
269		4	
586		4	
416		4	
223		4	
172		4	
442		4	
291		4	
292		4	
512		4	
287		4	
396		4	
642		4	
221		4	
173		4	
633		4	
404		4	

395		4	
465		4	
428		4	
228		4	
446	19691115	4	
463		4	
248		4	
244		4	
420		4	
222		4	
245		4	
832		4	
416		4	
482		4	
229	19691115	4	
418		4	
6	19950614	4	PVC

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX G



2021
Annual Drinking Water Quality Report
Charter Township of Union

The Charter Township of Union Water Department is pleased to present to you this year's Annual Drinking Water Quality Report. This report is designed to inform you about the quality water and services we deliver to you every day. Our constant goal is to provide you with a safe and dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. Union Township has three separate well fields, with wells ranging in depth from 56'6" to 160'.

We are pleased to report that our drinking water meets federal and state requirements.

If you have any questions regarding this report or concerning your water utility, please contact Kim Smith, Public Services Director, at 5228 South Isabella Road, Mt. Pleasant, MI 48858, 989-772-4600 ext. 224. We want our valued customers to be informed about their water utility. If you want to learn more, please attend any of our regularly scheduled meetings. They are held on the second and fourth Wednesday of every month at 7:00 p.m. at the Union Township Hall. The Union Township Hall is located at 2010 S. Lincoln Road, Mt. Pleasant, MI 48858.

The Charter Township of Union routinely monitors for constituents in your drinking water according to Federal and State laws. This table shows the results of our monitoring for the period of January 1, 2021 to December 31, 2021. In this table you will find many terms and abbreviations you might not be familiar with. To help you better understand these terms we've provided the following definitions:

Non-Detects (ND) - laboratory analysis indicates that the constituent is not present.

Parts per million (ppm) or Milligrams per liter (mg/l) - one part per million corresponds to one minute in two years or a single penny in \$10,000.

Parts per billion (ppb) or Micrograms per liter - one part per billion corresponds to one minute in 2,000 years, or a single penny in \$10,000,000.

Micrograms per liter (ug/l) – a measure of the concentration of a substance in water equivalent to parts per billion (ppb)

Parts per trillion (ppt) or nanograms per liter – is a measurement of the quantity of a substance in the air, water or soil. A concentration of one part per trillion means that there is one part of that substance for every one trillion parts of either air, water or soil in which it is contained.

Action Level - the concentration of a contaminant, which, if exceeded, triggers treatment or other requirements which a water system must follow.

Maximum Contaminant Level - The "Maximum Allowed" (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum residual disinfectant level goal or MRDLG – The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Maximum residual disinfectant level or MRDL – The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Contaminant Level Goal - The "Goal" (MCLG) is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Monitoring schedule set by State of Michigan.

TEST RESULTS							
Regulated Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination	
Inorganic Contaminants							
Arsenic 2020 date of detect	N	ND	Ppb	0	10	Erosion of natural deposits These arsenic values are effective January 23, 2006. Until then the MCL is 50 ppb and there is no MCLG.	
Barium 2020 date of detect	N	.07-.11	Ppm	2	2	erosion of natural deposits	
Copper (90 th Percentile) 2021 date of detect Copper Range = 2021 date of detect	N	500 0 - 800	Ppb	1300	AL=1300	Corrosion of household plumbing systems	
Fluoride 2021 date of detect	N	.32	Ppm	4	4	Erosion of natural deposits	
Sodium 2021 date of detect	N	15-96	Ppm			Naturally occurring, erosion of natural deposits	
Lead (90 th percentile) 2021 date of detect Lead Range = 2021 date of detect	N	2 0-33	Ppb	0	AL=15	Lead service lines, corrosion of household plumbing including fittings and fixtures; erosion of natural deposits	
Free Chlorine – Range = Maximum = 2021 date of detect	N	.02 – 1.47	Ppm	MRDLG 4	MRDL 4	Water additive used to control microbes.	
TTHM	Previous Year			Year Covered by the CCR			
	2 QTR	3 QTR	4 QTR	1 QTR	2 QTR	3 QTR	4 QTR
Distribution Site		2.2 -26.4 ppb				17.4 ppb	
RAA (running annual average)		14.3 ppb				17.4 ppb	

Per- and polyfluoroalkyl substances (PFAS)

Regulated Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination	
Hexafluoropropylene oxide dimer acid (HFPO-DA) (ppt) 2021 date of detect	N	ND	ppt	NA	370	Discharge and waste from industrial facilities utilizing the Gen X chemical process	
Perfluorobutane sulfonic acid (PFBS) (ppt) 2021 date of detect	N	ND	ppt	NA	420	Discharge and waste from industrial facilities; stain-resistant treatments	
Perfluorohexane sulfonic acid (PFHxS) (ppt) 2021 date of detect	N	ND	ppt	NA	51	Firefighting foam; discharge and waste from industrial facilities	
Perfluorohexanoic acid (PFHxA) (ppt) 2021 date of detect	N	2.1	ppt	NA	400,000	Firefighting foam; discharge and waste from industrial facilities	
Perfluorononanoic acid (PFNA) (ppt) 2021 date of detect	N	ND	ppt	NA	6	Discharge and waste from industrial facilities; breakdown of	

						precursor compounds
Perfluorooctane sulfonic acid (PFOS) (ppt) 2021 date of detect	N	2	ppt	NA	16	Firefighting foam; discharge from electroplating facilities; discharge and waste from industrial facilities
Perfluorooctanoic acid (PFOA) (ppt) 2021 date of detect	N	2.3	ppt	NA	8	Discharge and waste from industrial facilities; stain-resistant treatments

One (1) lead and Zero (0) copper samples exceeded the action level.

Infants and children who drink water containing lead could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Union Township is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you have a lead service line it is recommended that you run your water for at least 5 minutes to flush water from both your home plumbing and the lead service line. If you are concerned about the lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at 1-800-426-4791 or at <http://www.epa.gov/safewater/lead>.

Number of Lead Service Lines	Number of Service Lines of Unknown Material	Total Number of Service Lines
1	466	1930

The average sodium concentration was 48.000 Ppm.

We're proud that your drinking water meets or exceeds all Federal and State requirements. We have learned through our monitoring and testing that some constituents have been detected. The EPA has determined that your water **IS SAFE** at these levels.

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

The sources of drinking water (both tap and bottled water) include rivers, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground it dissolves naturally occurring minerals and, in some cases, radioactive materials, and can pick up substances resulting from the presence of animals or from human activity.

Your water comes from seven groundwater wells; they range from 56'6" to 160' drawing from a drift aquifer. The State of Michigan performed an assessment of our source water in 2003 to determine the susceptibility or the relative potential contamination. This report determines the susceptibility of or the relative potential of contamination. The susceptibility rating is on a seven-tier scale from "very-low" to "very-high" based primarily on geologic sensitivity, water chemistry, and contamination sources. The susceptibility of our well's ranges from low to moderate. Wells number three and four have a low rating and wells number one, two, five, and six have a

moderate rating. We are making efforts to protect our sources by monitoring the use of surrounding land areas. If you would like to know more about the report a copy can, be obtained from The Charter Township of Union Public Services Department located at 5228 South Isabella Road, Mt. Pleasant MI 48858. Or call 989-772-4600 ext. 224 if you wish to have a copy of this report mailed to you.

EPA is reviewing the drinking water standard for arsenic because of special concerns that it may not be stringent enough. Arsenic is a naturally occurring mineral known to cause cancer in humans at high concentrations.

Unregulated contaminants are those for which EPA has not established drinking water standards. Monitoring helps the U.S. EPA to determine where certain contaminants occur and whether it needs to regulate those contaminants. We monitor for these contaminants and the results of monitoring are available on request.

Contaminants that may be present in source water.

Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salt and metals, which can be naturally-occurring or result from urban storm water runoff, industrial, or domestic wastewater discharges, oil and gas production, mining and farming.

Pesticides and herbicides, which may come from a variety of sources such as agricultural, urban storm water runoff, and residential uses.

Organic chemical contaminants, which can be naturally occurring or be the result of oil and gas production mining activities.

Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water, which must provide the same protection for public health.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

Copies of this report will be mailed to each customer. If you wish to obtain an additional copy of this report it can be obtained from the Charter Township of Union Hall located at 2010 South Lincoln Road, Mt. Pleasant, MI 48858. You can also call 989-772-4600 ext. 224 if you wish to have a copy of the report mailed to you. It is also available on line <http://www.uniontownshipmi.com/Departments/PublicServicesDepartment.aspx>.

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX H





GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING



DANIEL EICHINGER
ACTING DIRECTOR

TO: Shane Mudd, District Engineer, Bay City District Office, Field Operations
Section, Drinking Water and Environmental Health Division

FROM: Travis Bauer, Geologist, Source Water Unit, Environmental Health Section,
Drinking Water and Environmental Health Division

DATE: March 27, 2023

SUBJECT: Part 327 SSR Pre-screening Result – Proposed Type I Public Water Supply
Well – Union Township, Isabella County, WSSN 06725

SUMMARY

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division, Water Use Assessment Unit (WRD-WUAU) has completed a Part 327 SSR Pre-screening for Union Township, based upon the location, with the following characteristics:

Proposed Well TW-12

Latitude	43.56581
Longitude	-84.76984
Pumping Capacity	400 gpm*
Well Casing Depth	280 feet
Withdrawal Source	Groundwater
Aquifer Type	Glacial
Pumping Frequency	Continuous
Hours Per Day	24
Days Per Week	7
Months of the Year	January to December

*gpm = gallons per minute

The proposed withdrawal has passed the pre-screening process using the Water Withdrawal Assessment Tool parameters, without modifications. Based on the information provided and the current balance of water available within the watershed, the proposed withdrawals lie within **'Zone B.'**

Note that this is a pre-screening process and that the results are only valid for the withdrawal characteristics listed here. The zone determination will be updated if or as new information becomes available. Changes that may impact the zone determination must be approved by the WRD-WUAU.

Pre-screening estimates the likely impact of a proposed water withdrawal on nearby streams only and does not address other applicable requirements. Pre-screening does not include any of the following:

- Approval of deviations to the minimum isolation distance.

Criteria for issuance of a deviation are set in Rule 809 (R325.10809) of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and rules (Act 399).

- Establishing aquifer capacity, nor granting approval for any particular withdrawal rate.

The withdrawal rate for Type I wells is approved through the Act 399 permitting process, which is overseen by the appropriate EGLE, Drinking Water and Environmental Health Division (DWEHD) District Office. High-capacity wells are subject to DWEHD policy and procedure ODWMA-399-003, *"Aquifer Test Requirements for Public Water Supply Wells,"* under Act 399.

Note that each water system is responsible for compliance with other applicable laws and to obtain any requisite approvals as required.

cc: Sara Pearson, EGLE
Jill VanDyke, EGLE
Brock Howell, EGLE

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX I





GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
BAY CITY DISTRICT OFFICE



DANIEL EICHINGER
ACTING DIRECTOR

March 22, 2023

Kim Smith
Union Township
2010 South Lincoln Road
Mt. Pleasant, MI 48858

WSSN: 06725
County: Isabella

Dear Kim Smith:

SUBJECT: Union Township – Test Well 12 Approval

The Department of Environment, Great Lakes, and Energy (EGLE), Drinking Water and Environmental Health Division (DWEHD) has reviewed the documentation submitted, and completed a site inspection of the proposed test well 12 (TW-12) location on March 13, 2023. EGLE representative Shane Mudd performed the site investigation. The proposed capacity of the finished well is to be at least 400 gallons per minute. However, the **allowable final capacity of the proposed TW-12 will depend on the results of the Adverse Resource Impact (ARI)** completed by EGLE's Source Water Unit. The request for an ARI was submitted by Shane Mudd on March 10, 2023.

During the site investigation, it was determined TW-12 was able to meet the minimum isolation distance requirements from major sources of contamination. The Township is also the owner of the minimum 200-foot isolation radius around the wellhead. No isolation distance variance will be required for TW-12.

This letter grants drilling approval to conduct TW-12 site investigation work for the Union Township Community Water Supply. TW-12 site investigation work will be completed at approximately 43.5659, -84.7698. According to a proposal submitted by Gourdie Fraser, TW-12 will utilize a 6-inch PVC casing that will extend to a depth no greater than 280 feet. TW-12 is slated to be equipped with a screen extending 20 feet below the PVC casing.

The purpose of TW-12 is to establish the sustainability of a high capacity well in this area. Union Township is looking to install a 6-inch PVC monitoring well (TW-12) prior to the construction of a larger 12-inch PVC production well. This production well is to be placed on the same site as TW-12, and will utilize a PVC casing of roughly 200-feet. Screen length is projected to be 40-feet. Should conditions prove favorable during the testing and construction of TW-12, Union Township will apply for an Act-399 permit to construct the 12-inch production well.

Once the test well has been drilled, the following documentation must be submitted prior to applying for an Act-399 permit:

1. A final site plan showing the exact location of the test well relative to all major and potential sources of contamination. Additionally, the site plan should indicate the 100-year flood elevations relative to the wells.
2. A log of the test well. A pump record must also be included.
3. The results of a 72-hour pump test. According to EGLE standard policy *ODWMA-399-003 Aquifer Test Requirement for Public Water Supply Wells*, a 72-hour pump test must be completed to determine the reliability of the water source. A copy of the forementioned policy is included in this letter. The final permit will not be issued until the results of the required 72-hour pump test are completed and reviewed by this office. Final pumping capacity of the proposed TW-12 will depend on the findings of the ARI performed by EGLE's Source Water Unit.
4. Evidence that the annular space between the drill holes and well casings have been properly filled with neat cement grout. This requirement also applies to any observation wells that will remain in the standard isolation area.
5. Chemical monitoring must be done on the water from the proposed test well to help determine if there are similarities between the existing observation wells and the proposed test well, and to determine the potability of the water produced from the new well. A copy of the required chemical monitoring is included with this letter. The final permit will not be issued until the chemical monitoring has been completed and reviewed by this office.
6. Detailed plans and specifications must be submitted for the test well including depth, diameter, pump setting, pump curves, etc. must be collected at the end of the pump test for analysis. Copies of the analytical results along with conclusions and recommendations on the water quality will need to be included in the Report. Information on EGLE's Drinking Water Laboratory and list of other certified laboratories can be viewed at www.michigan.gov/drinkingwater.

This test well approval letter does not approve TW-12 for use as a production well or connection to a community water supply system. Installation of pump equipment and related appurtenances enabling a connection to the water system is prohibited. Before construction of the proposed 12-inch production well can begin, an Act-399 permit must be submitted to the Bay City District Office. A Permit Application for Water Supply Systems can be downloaded from www.michigan.gov/drinkingwater open Community Water Supply then under Manuals, Forms, and Brochures open Water Supply Permit Application. The permit application, construction specifications, and plans will need to be completed by an engineer registered in the State of Michigan.

This test well approval letter expires in two years of the date of this letter. This letter does not remove the need for other applicable local, state, or federal approvals or permits. If you should have any questions regarding this letter, please contact me by email at mudds@michigan.gov or by using the information below.

Sincerely,



Shane Mudd
District 22 Engineer
Bay City District Office
Drinking Water and Environmental Health
Division
517-388-3582

Enclosure(s)

New Well Chemical Monitoring Requirements

ODWMA-399-003 Aquifer Test Requirement for Public Water Supply Wells

cc: Shawn McBride, OIC
Andrea Belanger, Gourdie Fraser
Central Michigan Health Department

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX J





CHARTER TOWNSHIP OF UNION TYPE I WELL FEASIBILITY STUDY

November 2021



1 INTRODUCTION

Perhaps one of the most critical long-term issues facing any municipality is that of source water. Therefore, it is important to protect the existing water source and ensure adequate capacity for future additional water wells are continually explored to secure supply for the future. The Township recognizes this and has invested heavily in the construction of the necessary infrastructure to supply water to its residents over the years.

Determining an ideal location for future wells is a critical first step and requires extensive consideration and research to be completed before arbitrarily making the decision. To begin this process, GFA was requested by Union Township to conduct a preliminary assessment of potential sites and prepare a report of findings identifying potential viable parcels within existing proximity of the existing Isabella Water Treatment Plant. Our scope includes the following as outlined in this report.

1. Research
2. Evaluation
3. Findings and Recommendations
4. Next Phase and Process

2 PROJECT BACKGROUND

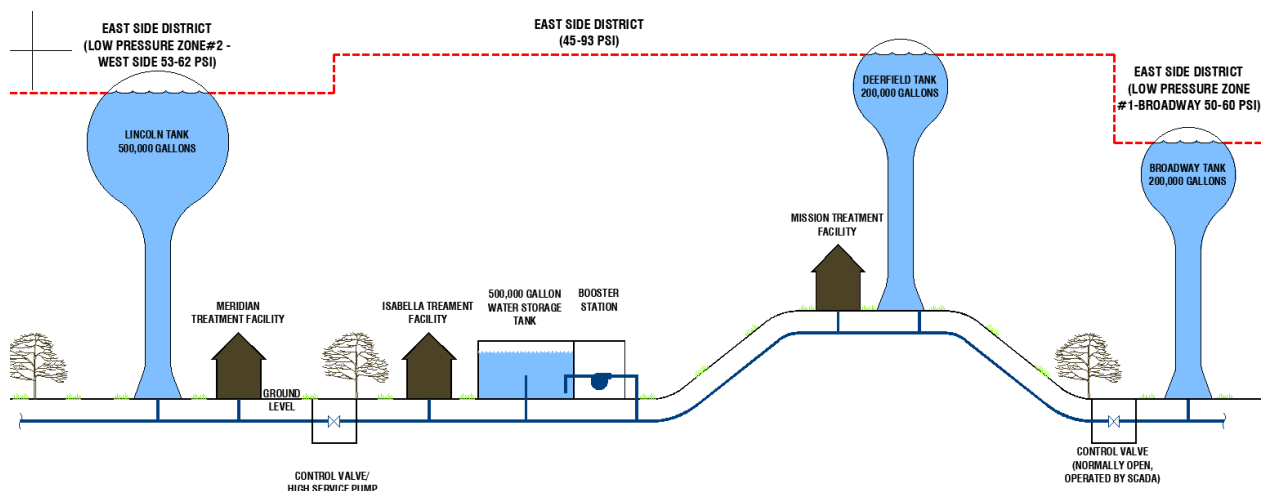
2.1 EXISTING OPERATIONS

The Charter Township of Union water distribution system construction began in the late 1980's initiated by the need for reliable potable water for domestic use. Growth in population and construction in select commercial and residential locations generated the need to expand the system through the years. Historically, the Charter Township of Union has been segregated into three (3) independent water districts. Starting in 2010 the water system was reorganized and interconnected by installing a watermain extension and two (2) control valve stations.

Presently the entire distribution system operates as one (1) primary centralized Service District referred to as the Southside Upper District. This district is the primary source of water to meet the domestic and fire demands for all the users of the system. This district contains two (2) secondary lower pressure zones referred to as (#1) the Broadway zone and (#2) West Side Zone. The limits of service are defined by the pressure limitations of their primary infrastructure that supplies the users and is as follows:

- South Side: 45- 93 psi operating range
 - Lower Pressure Zone #1 (Broadway): 50 - 60 psi
 - Lower Pressure Zone #2 (WestSide): 53 - 62 psi

The final phase of this project is proposed to be completed in 2022 and will include the installation of a high service pump in one (1) of the control valve stations to allow for a reliable means for water to move both east and west without restriction.



2.2 EXISTING FACILITIES

The Charter Township of Union provides the treatment and supply of water for their water customers with three (3) treatment facilities located throughout the Township. Each facility has onsite Type I water wells, each treated by gravity, continuous regeneration (pressure) filtration or combination thereof. In addition, chemicals are added at each facility including Phosphate to maintain water quality and Sodium Hypochlorite (NaCl) for disinfection, to maintain chlorine residual levels, and to assist with iron/manganese oxidation. The three (3) facilities are regarded as Mission Road, Isabella Road and Meridian Road for purposes of this report. The Townships infrastructure is comprised of 61 miles of water main ranging in diameter from six inches to twelve inches. In addition, the Township has seven (7) water wells, three (3) elevated water storage tanks/towers, one (1) ground storage tank, two (2) valve stations, and three (3) iron removal treatment plants.

The Township's water firm pumping capacity is 2.36 million gallons per day (MGD). The Township has a population of approximately 10,700 (as of 2010 census) residents equating to 6,200 residential equivalent benefits with a projected growth rate of less than 2 percent per year. The current average water production is .963 MGD.

The table on the next page summarizes the water supply characteristics.

	South Side Service District						
	West Side Lower Pressure Zone		Upper Pressure Zone				
Location	Meridian Treatment Facility		Isabella Treatment Facility			Mission Treatment Facility	
Well I.D	Well No. 3	Well No. 4	Well No. 11*	Well No. 10*	Well No. 7	Well No. 8*	Well No. 9*
Year Drilled	1988	1987	2019	2014	2008	2011	2011
Casing Diameter	8"	8"	12"	12"	12"	12"	12"
Depth	160'	125'	97'	77'9"	86'	71'	89'
Motor Depth	109'	85.6'	70'	49'	60'	60'	78.5'
Static Water Level (SWL)	23'	26.3'	8.2'	14'	16'9"	4'	5'
Pump Motor	30 Hp	40 Hp	15 Hp	15 Hp	40 Hp	40 Hp	40 Hp
Permitted Capacity	380 gpm	380 gpm	396 gpm	400 gpm	700 gpm	400 gpm	400 gpm
Actual Capacity	385 gpm	450 gpm	396 gpm	390 gpm	701 gpm	400 gpm	400 gpm
Aquifer Restriction	One (1) Well in operation at a time		1,100 GPM (Able to run only 2 wells at a time)			None	

*Well 8 and 9 are replacements for abandoned Wells No. 5 and No. 6.

*Well 10 Replacement for abandoned Well No. 2.

*Well 11 Replacement for abandoned Well No. 1

2.3 PROPOSED FACILITIES

The Charter Township of Union has continued to implement maintenance and improvements to their facilities to ensure regulatory compliance and meet the demands of the growing community. As identified in past studies the Townships' primary focus currently is seeking additional water sources. The Isabella Road Treatment Site is critical in their systems operation providing a significant amount of the water supply to the customers with supplement from the other treatment facilities. This location is deemed their central facility and when constructed in 2010 was created to accommodate future expansions. Logically the ability to install wells in this region would prove to be most cost effective and efficient.



2.4 REGULATIONS AND PAST STUDIES

As an owner and operator of a municipal water system, the Township is required to regularly monitor, sample, and report on essential items, to ensure the public's health and safety. The Safe Drinking Water Act is the principal federal law in the United States intended to ensure safe drinking water for the public. Pursuant to the act, the Environmental Protection Agency (EPA) is required to set standards for drinking water quality and oversee all states, localities, and water suppliers that implement the standards. The Michigan Department of Environment, Great Lakes and Energy (EGLE) is responsible to enforce and ensure compliance. The comprehensive list below provides a summary of those documents that have been completed and reported.

- Water Reliability Studies: Required under the Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE), specifically amendments to Rules 1203 and 1601-1606, Water Reliability Studies and General Plans are to be completed every 5 years.
 - Status: Completed July 2017.
- Asset Management Studies: Required under the Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE). Required for communities that service populations over 1,000 people.
 - Status: Completed May 2019
- Emergency Response Plan: Required under the Michigan Safe Drinking Water Act (SDWA) under Part 399 as enforced by the Michigan Department of Environment, Great Lakes and Energy (EGLE), specifically amendments to Rules 1203 and 1601-1606
 - Status: Completed January 2020
- Risk & Resilience Plan / Emergency Response Plan: Required America's Water Infrastructure Act (AWIA) Section 2013 as enforced by the Environmental Protection Agency (EPA).
 - Status: Completed December 2021

The Township is committed to ensuring they provide quality water to their residents. As groundwater is instrumental part of their water system, the Township is proactive in protecting and maintaining this water source. In addition, the Township routinely implements and participates in varying programs and studies to ensure compliance with local, state and federal requirements. A list below provides a summary of those documents.

- Wellhead Protection Program (WHPP)

The groundwater source is a fragile resource that if impacted by outside contaminants could result in the introduction of impurities to the ground water distribution system and exposure to its residents. If contaminants were to reach the wells and even if they were immediately detected before they reached the residents, the sampling does nothing to address how the water source would be replaced. If the water source supplying water to these wells were impacted, the Township would suffer great financial

burden reconstructing the water system to ensure safe water is supplied to its residents. Therefore the Township has participated in a WHPP for many years with recent updates in 2019 to protect their existing groundwater resources. WHPP is a two (2) part process comprising of delineation and public participation. Wellhead protection area (WHPA) delineation is an assessment of the time-related zones of groundwater transport for a well or well field. The public process engages everyone from customers to a local planning team in the community to engage public participation, education projects and training.

Based upon information collected including static water level measurements, and groundwater flow direction around the Isabella Road well field area was determined to be to the northeast.

➤ Aquifer Analysis

As infrastructure ages and near its' life expectancy it needs to be replaced. Furthermore, the infrastructure needs to be of adequate size to meet the current and future demands of the community. The installation of any replacement or new water supply (withdrawal) requires evaluation of the underlying aquifer to ensure it can meet these demands over an extended period. For this the Service District, the following recent analyses were reviewed with information relevant and applicable for future well construction identified below:

Meridian Road Site: Well No. 3 & 4

These wells were constructed in 1988 and upgrades were performed in 2004 to increase supply capacity resulting in a need to complete an Aquifer Analysis for Well 4. Beneath the well field, medium textured till with a matrix of glacial debris dominated with silty loam texture. Lithology samples collected during drilling indicated sandy clay was encountered from the surface to a depth of 20 feet with clay encountered from 20 to 75 feet, more sand encountered from 75 to 160 feet. The wells were terminated at depths of 125 feet (Well No. 4) and 180 feet (Well No. 3). Bedrock underlying the Mount Pleasant area comprised of sandstones and shales are at depths 400 feet and greater.

Testing indicated the groundwater flow gradient aquifer had a flow direction southwesterly toward the North Branch of the Chippewa River. Result of the analysis demonstrated ability to yield up to 780 GPM for Well No. 3 due to increased depth however Well No. 4 was limited to 440 GPM. The increase capacity would be subject to additional testing to verify. Further recommendations were noted to discourage simultaneous pumping due to proximity to one another and operate lead / lag. Overall the hydraulic characterization of the aquifer was considered to be low geologic sensitivity by EGLE. Sampling was completed and no analytes exceeded their respective U.S. Environmental Protection Agency's maximum contaminant level.

Mission Road Site: Well No. 8 & 9 (Well No. 5 & 6 Replacements)

*These wells were constructed to replace Well No. 5 and 6 in 2011. Beneath the well field, medium textured glacial till containing a viable sand and gravel aquifer overlain by discontinuous clay units (leaky confined) was identified. Lithology samples collected during drilling indicated sands and gravels were encountered from the surface to a depth of 35 feet with gravelly clay encountered from 35 to 57 feet, more sands and gravels encountered from 57 to 81 feet and clay encountered from 81 to 84 feet. The wells were terminated at depths of 80 (above the clay). Bedrock underlying the Mount Pleasant area comprised of sandstones and shales are at depths greater than 300 feet. **Testing indicated the groundwater flow gradient aquifer had a flow direction from the north to the south toward Potter County Drain. Result of the analysis demonstrated ability to yield 550 GPM per well and EGLE permitted at 400 GPM as they were considered replacement. Impact to City of Mt. Pleasant existing wells in the vicinity was evaluated as they are 650 feet away and found to be negligible.** Sampling was completed and no analytes exceeded their respective U.S. Environmental Protection Agency's maximum contaminant level.*

Isabella Site: Well No. 7

*This well was constructed as new water supply to meet the growing demands of the Township. The results of the aquifer analysis completed in 2009 for the construction of this well identified that the existing Isabella Site aquifer is characterized as a leaky-confined to unconfined aquifer receiving significant amounts of recharge from the adjacent Potter Creek with good yield. The aquifer consists of a narrow band of glacial outwash sand and gravel and postglacial alluvium. The material consists of pale brown to pale reddish brown, fine to coarse sand alternating with layers of small gravel to heavy cobbles. Bedrock for the area is mapped as late Jurassic "red beds" at depths in elevation in the range of 400 to 450 ft. **Hydraulic testing indicated a northwest flow direction toward the Chippewa River whereas the direction of groundwater flow is northeast for other Type I water supply wells located one to two miles northwest of this area.** The well was approved to be rated at 700 GPM terminated at a depth of 66 feet. The entire aquifer was approved to be rated at a capacity of 1100 GPM allowing the Township to have the flexibility to use this well with one of the other wells (well #11 or #10 – operating lead / lag). **EGLE identified the well yield may be enhanced by an unconfined aquifer condition east and southeast of Well 7 and potential leakage from Potter Creek. The groundwater flow direction and other pertinent data indicate the area southeast of the wellfield is of greatest concern relative to potential sources of contamination and the aquifer possesses a "moderate" to "high" geologic sensitivity.** Sampling was completed and no analytes exceeded their respective U.S. Environmental Protection Agency's maximum contaminant level.*

Isabella Site: Well No. 11 (Well No. 1 Replacement)

*This well was constructed to replace Well No. 1 that was installed in a shallow aquifer. The results of the aquifer analysis completed in 2019 for the construction of this well identified the existing Isabella Site aquifer is characterized as a leaky-confined having a “moderate” geologic sensitivity to contamination. Geology consists of a narrow band of glacial outwash sand and gravel. The material consists of pale brown to pale reddish-brown, fine to coarse sand alternating with layers of small gravel to heavy cobbles. Bedrock for the area is mapped at depths in elevation in the range of 419 ft. **Hydraulic testing indicated an east to west flow direction toward the Potter Brodie County Drain. Result of the analysis demonstrated ability to yield 480 GPM however due to the vulnerability of the aquifer EGLE permitted at 396 GPM terminated at a depth of 70 feet as it was considered a replacement well and due to vulnerability of the aquifer.** Sampling was completed and no analytes exceeded their respective U.S. Environmental Protection Agency’s maximum contaminant level.*

3 DEMAND AND CAPACITY

3.1 GENERAL

The capacity and sizing of a water supply system are based upon the levels of water demand predicted over the planning period, typically 20-year. Projections of future water demand are utilized to judge the adequacy of the facilities and to determine the capacities required for any proposed improvements.

3.2 WATER USAGE

The water system pumping and usage records as recorded by Union Township DPW for the wells and booster pumps have been tabulated and are presented below. All data was extrapolated directly from the Monthly Operating Reports submitted to the EGLE.

Supply: Maximum Day Demand, Gallons per Day

	2018	2019	2020	2026	2036
	MDD	MDD	MDD		
Total System	1,653,000	1,668,000	2,127,000	2,860,000	3,490,000

*Projected values are based upon 2017 Water Study projections accounting for 1.7% growth

3.3 SUPPLY CAPACITY

The evaluation of their capacity is limited to the smallest rated capacity of each of these. The capacity of this raw water supply is defined by the existing firm capacity of the wells. *Firm capacity* is the wells' ability to meet maximum daily demand with the largest pump out of service. The tables below present the available firm capacity for the water system and a comparison to current and future maximum day demands.

Supply: Capacity

	Rated Capacity	Existing Firm Capacity
	GPM	GPM
Meridian Treatment Facility		1,590.00
Well No. 3	385	
Well No. 4	450	
Isabella Treatment Facility		
Well No. 11	400	
Well No. 10	390	
Well No. 7	701	
Misssion Treatment Facility		
Well No. 8	400	
Well No. 9	400	

⁵Assumes Meridian Treatment Facility is offline and all water supplies are from Mission / Isabella to supply the upper and both lower pressure zones. Meridian wells are available only for backup / emergency

Supply: Firm Capacity VS. Maximum Day Demand

	2018	2019	2020	2026	2040
Maximum Day Demand, MGD	1,653,000	1,668,000	2,127,000	2,860,000	3,490,000
Existing Firm Capacity, MGD	2,289,600.00	2,289,600.00	2,289,600.00	2,289,600.00	2,289,600.00
Excess, MGD	636,600.00	621,600.00	162,600.00	(570,400.00)	(1,200,400.00)
Excess, GPM	442.08	431.67	112.92	(396.11)	(833.61)
Proposed Firm Capacity, GPD	3,492,000.00	3,492,000.00	3,492,000.00	3,492,000.00	3,492,000.00
Excess, MGD	1,839,000.00	1,824,000.00	1,365,000.00	632,000.00	2,000.00
Excess, GPM	1,277.08	1,266.67	947.92	438.89	1.39

Upon review of the information above, it is apparent the wells are the limiting component with respect to capability to meet the future maximum daily demands for the entire service district including both lower pressure zones. The table above reiterates the purpose of this report and the need to begin planning upgrades to source infrastructure now with ability to obtain initially 400 GPM additional supply capacity and up to 850 GPM long term.

4 POTENTIAL SITE LOCATIONS

4.1 GENERAL

Many considerations must be accounted for to identify a suitable location for a Type 1 Water Supply both environmental and cultural.

Environmental Factors are considered natural occurrences or inherit with the property and should be accounted for when located a well site. Examples of these factors include:

- a) If groundwater flow direction is known, it is best to place the wells up-gradient from sources of contamination.
- b) Consistent lithology that is compatible with existing wells is important. Constructing a well in bedrock as opposed to sand or gravel will produce differing aesthetics drinking water.
- c) Surface waters, like streams, rivers, and ponds, may contain biological, agricultural, or industrial contamination so maintaining well isolation is important.
- d) Avoid areas that get flooded, since people cannot get to the well during times of high water and the well may be contaminated by floodwaters overflowing and seeping into the well.
- e) Naturally occurring chemicals, like arsenic, boron, and selenium can affect groundwater quality, so water should be tested in areas where this may be a problem.

Cultural factors can be thought of as anything related to human activity that should be considered when locating a well site. Examples of these factors include:

- a) Proximity to the existing treatment facility (Isabella Road)
- b) Vicinity to areas in or around the community that are considered sacred or sensitive such as cemeteries.
- c) Avoiding known areas of potential contamination such as wastewater treatment facilities, industrial facilities, garbage dumps,
- d) Site size and access including utilities.
- e) Zoning and Future Land Use
- h) Proximity to other municipal wells and potential for interfere with each other. This can reduce the amount of water that each well is able to produce. The appropriate separation distance depends on the pumping rate of the wells and the characteristics of the aquifer.

4.2 SELECTION PROCESS

The Township currently has limited available properties within the Isabella Treatment Site of adequate size to be utilized as a new water source. Therefore considerations and opportunities to seek a possible new location for a long term water source for the Township to acquire is prudent. Selection efforts were immediately focused on identifying parcels currently owned by the Township, located within a preservation easement or vacant / for sale with agricultural zoned areas that were 10 acres or larger in size. This list was further refined and narrowed down accounting for the environmental and cultural factors noted above in Section 4.1. Therefore sites reviewed and considered highly probable were very carefully selected were limited to those either actively listed for sale or potential opportunities to be purchased; accounting for the environmental and cultural factors noted above. The majority of parcels available were immediately eliminated from consideration as they were either too small, zoned for residential, within an existing residential development or too far away from the Isabella Treatment facility.

GFA utilized several sources to guide and assist with selection of the most ideal sites for a new water source. The data obtained was relevant to critical factors that impact the selection process for a new water source location and is illustrated on a map located in the Appendix for easy reference.

These sources and factors included the following:

- a) Township Zoning and Future Land Use Maps: Properties reviewed to develop a wellfield site were limited to those zoned Agricultural and vacant to not impede future growth and targeted for growth areas in the Township such as commercial or residential. Furthermore, locations away from planned industrial were avoided to ensure separation from potential areas of contamination.
- b) State of Michigan Geographic Information Systems (GIS) and Mapping Site to gain access to GIS data, and information across the GIS community in Michigan: The site is maintained by the Department of Technology, Management and Budget's Center for Shared Solutions in collaboration with State agencies and other partners. The website is a clearing house of data collected and maintained by many regulatory agencies including EGLE and local Health Department. Data collected related to:
 - 1) Contamination: Information within the vicinity of the parcels was collected and are depicted on the Proposed Location Map included in the Appendix. These included wastewater treatment facilities, Underground Storage Tank sites, Oil and Gas Wells, etc. Michigan law requires that certain minimum isolation distances be maintained when constructing a new water well (private or public) near a potential contamination source; typically, 2,000 feet from major sources and 200 feet from minor sources.
 - 2) Wetlands, Surface Water and Watershed information: Wetlands, surface water and area of the watershed have impact on potential to contaminate an aquifer,

especially when a high rate of withdrawal is proposed. For the Isabella Treatment Site, the existing wells are located in a vulnerable aquifer susceptible to contamination from the Potter Drain and its' surrounding watershed. A minimum of 200 feet isolation distance is required.



- c) **Site Access / Utility Service:** Proximity, accessibility, and access to utility service including electric can be a critical defining factor for a new well location. Locations were reviewed with respect to access, distance to the Isabella Treatment Facility and availability of three (3) phase power supply were all considered. The Miss Dig system was utilized to obtain information on available existing utilities and limits so we could quantify and estimate costs to provide service for a new well.
- d) **Local Health Department:** Existing well logs in the area were collected and provided available lithology for the areas to assist with determining depths for the static water levels, aquifers and bedrock. A profile of select wells in the areas identified as potential new location is included in the Appendix. Bedrock is present at depths varying 330 to 400 feet which is encouraged to be avoided as it would have an impact on water quality that differs from the Townships current water quality of moderate iron and hardness. Bedrock wells in this area demonstrate characteristics of extreme hardness and treatment would be required. To maintain consistency, wells terminating at depths of 70 to 90 feet would be expected to encounter a viable sand and gravel aquifer.
- e) **Historical Aquifer Testing Results**
 - 1) Aquifer Testing results for wells near the Mission Treatment Facility demonstrated favorable results and potential to provide some additional capacity. Groundwater patterns demonstrated flow from North to South toward Potter Drain however they are within proximity to the City of Mt. Pleasant. Original testing did not indicate presence of interference with one another however, with the introduction of a new additional withdrawal, it is possible. Location of the well would need to be optimized to ensure maximum separation and isolation are maintained.
 - 2) Aquifer Testing results for the wells near the Isabella Treatment Facility proved challenging to obtain additional capacity from EGLE. Replacement wells were permitted, and a new withdrawal (Well 7) was approved however it was reiterated that this aquifer is vulnerable and susceptible to contamination. The wells are in close proximity to the Potter Brodie Drain with groundwater patterns determined to flow southeast / east to northwest / west and future additional wells in this area

could increase the influence of the drain on water quality. Therefore, it is highly unlikely additional wells would be permitted. Wells in this proximity would need to be strategically located outside the influence of the watershed.

- f) Anyone proposing to make a new or increased large quantity withdrawal from the waters of the state, including all groundwater and surface water sources are subject to the adverse resource impact (ARI) criteria of Part 327, Great Lakes Preservation, 1994 PA 451, as amended. This is required for large quantity withdrawals from a groundwater or surface water withdrawal pumping at least 100,000 gallons per day (or approximately 70 gallons per minute) averaged over any 30-day period. GFA utilized Michigan's Water Withdrawal Assessment Tool (WWAT) for the potential site locations to determine if it caused an ARI. Although does not guarantee approval for a production well from EGLE, it does assist with the first step of approval to ensure the well withdrawal will not impact nearby streams and rivers.

4.3 SITE LOCATIONS: DEMOGRAPHICS AND CHARACTERISTICS

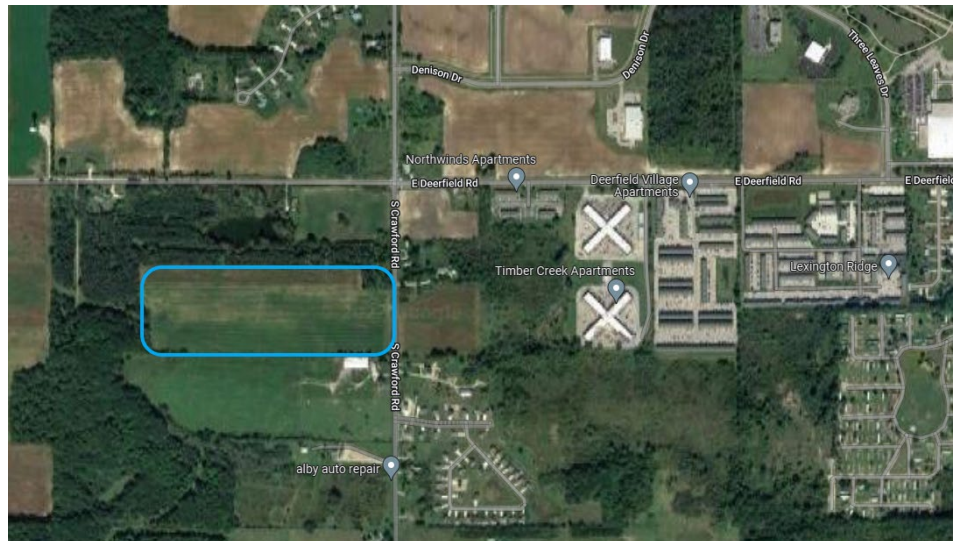
The following list identifies parcels that we have determined through our research to be viable and potential locations to consider. Specifics for each are provided below. An overall location map is provided in the Appendix depicting location along with known surface and below ground features and areas of contamination. Budgetary cost estimates to facilitate improvements for each site were also prepared and are provided in the Appendix for reference.

Location 1

A 20.2 acre agriculturally zoned piece of property currently listed for sale. The site is located approximately 2.8 miles west of the existing Isabella Treatment Plant along South Crawford Road.

Zoning: The parcel is currently zoned agricultural however is identified to be zoned residential per the

Future Land Use Map and within the boundary identified for future growth per the current Master Plan. If pursued, it is recommended that coordination with the Planning Commission and Planning Department occur.



Access: The site is accessible off a county road with minimal tree cover and is immediately accessible with frontage access to both water and three (3) phase electric. Unfortunately, the site would require a significant amount of watermain infrastructure to be installed to send water to Isabella Treatment facility for processing.

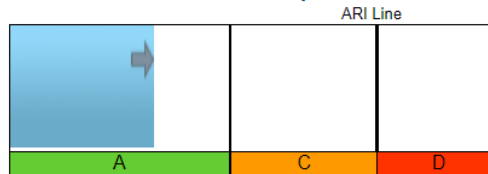
Soils: The geological composition in this area is a medium textured glacial till. Tills are very clay rich and can make thick sand and gravel deposits difficult to find and challenging to find a plentiful aquifer. Due to the distance of this location from the nearest large production wells, it is anticipated the aquifer in this area would impose negligible influence and interference on surrounding municipal wells as there are only residential water wells in the area.

Contamination: Review of the information available, this location is outside of discernable areas of known contamination and well isolation can be maintained.

ARI: The state of Michigan provides a water withdrawal screening analysis that outputs the anticipated impact of the proposed withdrawal on any affected stream and its potential for causing an adverse resource impact (ARI). A water withdrawal analysis was performed on this location reflecting the groundwater as a source, in a glacial aquifer, at a depth of 85 ft and a pumping rate of 850 gpm 12 hours per day, to reflect a realistic-case scenario of the new well. The analysis resulted in a Zone A: Passing

Water withdrawal screening results

ARI Zone Graph



The graph above illustrates the estimated impact of the proposed withdrawal on the affected stream, and its potential for causing an adverse resource impact (ARI).

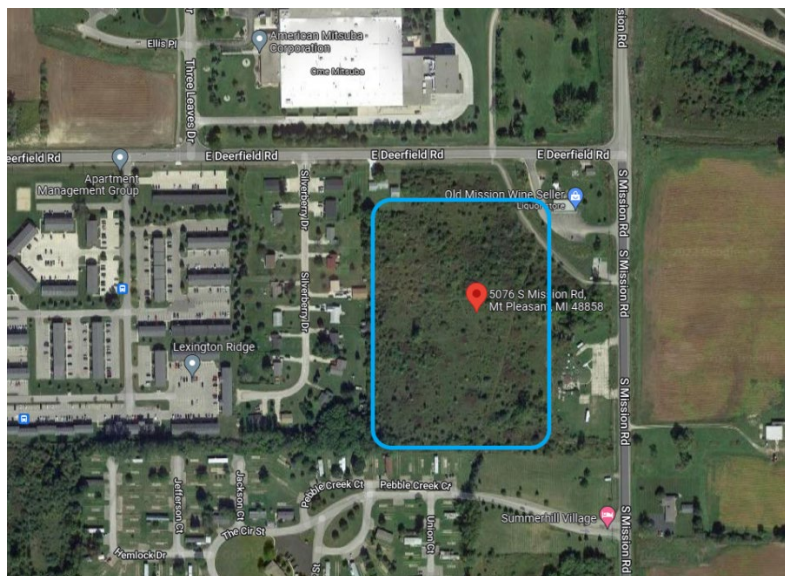
Result: Zone A

The proposed withdrawal has passed the screening process. You must register below in order to begin using this withdrawal.

Cost: Budgetary Cost to test and construct Well including transmission piping is The parcel currently is listed for sale for \$182,000 which is approximately \$9,000 per acre. The budgetary cost to test and construct the well, including transmission piping, is estimated to be around \$2,650,000.

Location 2

The Township currently owns a 14 acre property on addressed 5076 South Mission Road, Mount Pleasant. The site is located approximately 1.7 miles west of the existing Isabella Treatment Plant at the Southwest intersection of Mission and Deerfield Road.



Zoning: The parcel and corridor in this area is zoned neighborhood service and intended to remain dedicated to providing water and sewer service to the residents in the Township.

Access: The site is accessible off of both Deerfield and Mission Roads accessible with frontage access to both water and three (3) phase electric. Site would require some clearing and grubbing but overall is traversable. Some watermain infrastructure would need to be installed to send water to Isabella Treatment Facility for processing however flows from the existing water wells at the Mission Treatment Facility nearby could be combined.

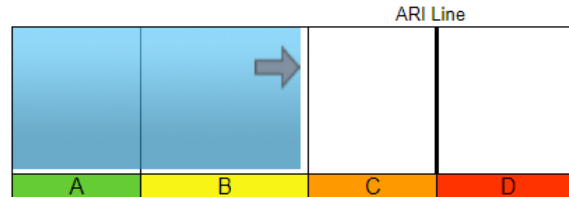
Soils: The geological composition in this area is an end moraine of medium textured till. Tills are very clay rich and can make thick sand and gravel deposits difficult to find and challenging to find a plentiful aquifer. This parcel is adjacent to both the City of Mt. Pleasant (Well No. 17) and Mission Treatment Facility Wells (No. 8 and 9). Interference although not detected with the original aquifer testing is possible with additional withdrawal. Location of a proposed well would need to be as far as possible from the existing wells to minimize interference. Original aquifer testing for Well 8 and 9 did provide supporting data to demonstrate ability to support additional capacity of approximately 300 GPM.

Contamination: Review of the information available, the existing Potter Brodie Drain and a sanitary sewer pump station are located within the vicinity of this parcel. The site currently has a sanitary lift station (No. 6) located on the east side of the property and the Potter Brodie Drain is located within the vicinity. The production well would need to be located on the southwest side of the property to adhere to the required 2,000 ft and 200 ft isolation distances.

ARI: The state of Michigan provides a water withdrawal screening analysis that outputs the anticipated impact of the proposed withdrawal on any affected stream and its potential for causing an adverse resource impact (ARI). A water withdrawal analysis was performed on this

Water withdrawal screening results

ARI Zone Graph



Result: Zone B

The proposed withdrawal has passed the screening process.
You must register below in order to begin using this withdrawal.

The graph above illustrates the estimated impact of the proposed withdrawal on the affected stream, and its potential for causing an adverse resource impact (ARI).

location reflecting the groundwater as a source, in a glacial aquifer, at a depth of 85 ft and a pumping rate of 850 gpm 12 hours per day, to reflect a realistic-case scenario of the new well. The analysis resulted in a Zone B: Passing

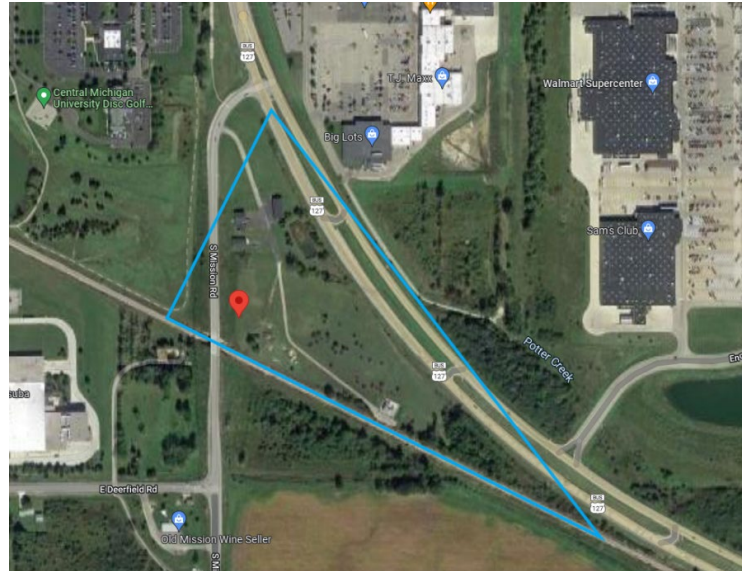
Cost: Budgetary Cost to test and construct Well including transmission piping is The parcel is already owned and maintained by the Township and no additional land purchase costs are anticipated. The budgetary cost to test and construct the well, including transmission piping, is estimated to be around \$1,750,000.

Location 3

The Township currently owns a 29.6 acre property on addressed 4795 South Mission Road, Mount Pleasant. The site is located approximately 1.5 miles west of the existing Isabella Treatment Plant at the Southwest intersection of Mission and US -127.

Zoning: The parcel and corridor in this area is zoned neighborhood service and intended to remain dedicated to providing water and sewer service to the residents in the Township.

Access: The site is accessible off of both Deerfield and Mission Roads and is immediately accessible with frontage access to both water and three (3) phase electric. Some watermain infrastructure would need to be installed to send water to Isabella Treatment Facility for processing however flows from the existing water wells at the Mission Treatment Facility nearby could be combined.

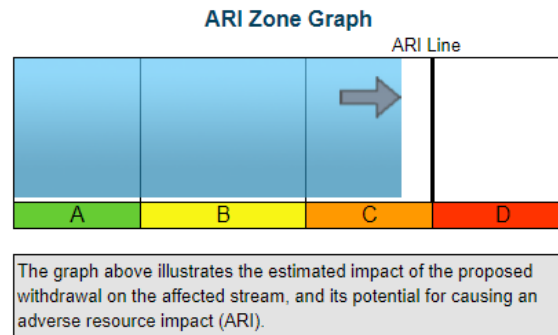


Soils: The geological composition in this area is an end moraine of medium textured till. Tills are very clay rich and can make thick sand and gravel deposits difficult to find and challenging to find a plentiful aquifer. This parcel is adjacent to both the City of Mt. Pleasant (Well No. 17) and Mission Treatment Facility Wells (No. 8 and 9). Interference, although not detected with the original aquifer testing, is possible with additional withdrawal. Location of a proposed well would need to be as far to the east as possible to minimize interference. Original aquifer testing for Well 8 and 9 did provide supporting data to demonstrate ability to support additional capacity of approximately 300 GPM.

Contamination: Review of the information available, the existing Potter Brodie Drain is located within proximity to this parcel. The production well location to the east to avoid well interference would locate it closer to the drain and 200 foot isolation may not be plausible.

ARI: The state of Michigan provides a water withdrawal screening analysis that outputs the anticipated impact of the proposed withdrawal on any affected stream and its potential for causing an adverse resource impact (ARI). A water withdrawal analysis was performed on this location reflecting the groundwater as a source, in a glacial aquifer, at a depth of 85 ft and a pumping rate of 850 gpm 12 hours per day, to reflect a realistic-case scenario of the new well. The analysis resulted in a Zone C: Failing

Water withdrawal screening results



Result: Zone C

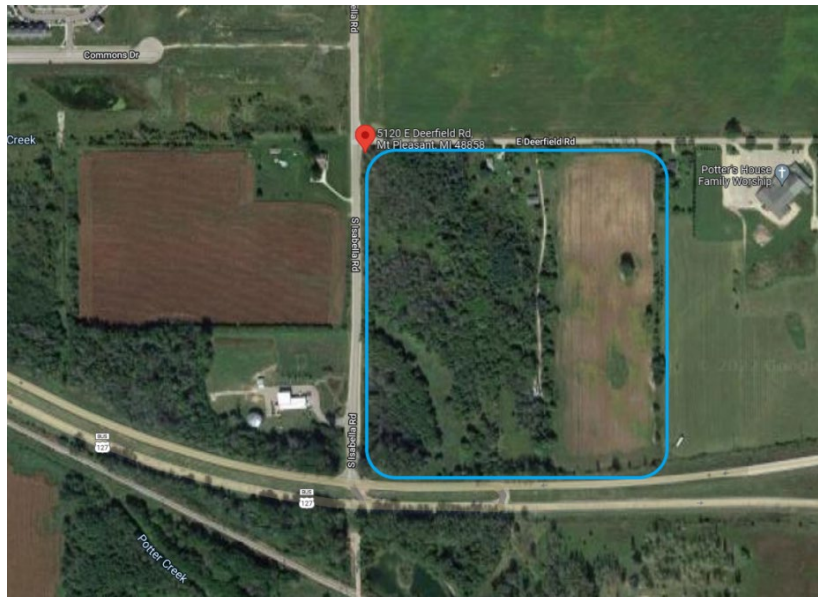
The proposed withdrawal has failed the screening process.

You must request a site specific review below in order to begin using this withdrawal.

Cost: Budgetary Cost to test and construct Well including transmission piping is The parcel is already owned and maintained by the Township and no additional land purchase costs are anticipated. The budgetary cost to test and construct the well, including transmission piping, is estimated to be around \$1,600,000.

Location 4

An agriculturally zoned piece of property is potentially seeking to convert lands into Preservation Status located at 5120 East Deerfield Road. The parcel is 49.6 acres and directly across the street from the Isabella Water Treatment Plant on the east side of Isabella Road. The conversion could create an opportunity for both the Township and property owner to preserve land from future development.



Zoning: The parcel and corridor in this area is zoned rural buffer and future development is not planned for this area.

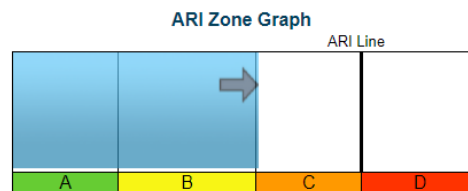
Access: The site is accessible off of Isabella Road and is immediately accessible with frontage access to both water and three (3) phase electric. The site does appear to be overgrown with trees and clearing / grubbing would be anticipated to Minimal watermain infrastructure would be required to send water to Isabella Treatment Facility for processing.

Soils: The geological composition in this area is outwash sand and gravel with intermittent layers of clay throughout depicting leaky confine to unconfined aquifer. Recent aquifer testing for the wells in this vicinity restricted the capacity to 1100 gpm which is currently met. In addition, the aquifer has been described as vulnerable and sensitive to contamination. It is expected that another well in this location with increased capacity would not be permitted by EGLE.

Contamination: Review of the information available, the existing Potter Brodie Drain and corresponding watershed is located within proximity to this parcel. A proposed production well would need to be located at the northern boundary to minimize impact and affect from the watershed.

ARI: The state of Michigan provides a water withdrawal screening analysis that outputs the anticipated impact of the proposed withdrawal on any affected stream and its potential for causing an adverse resource impact (ARI). A water withdrawal analysis was performed on this location reflecting the groundwater as a source, in a glacial aquifer, at a depth of 85 ft and a pumping rate of 850 gpm 12 hours per day, to reflect a realistic-case scenario of the new well. The analysis resulted in a Zone C: Failing

Water withdrawal screening results



Result: Zone C

The proposed withdrawal has failed the screening process.

You must request a site specific review below in order to begin using this withdrawal.

The graph above illustrates the estimated impact of the proposed withdrawal on the affected stream, and its potential for causing an adverse resource impact (ARI).

Cost: Budgetary Cost to test and construct Well including transmission piping is The parcel is potentially proposed to be placed in Preservation Status and costs for land purchase are not anticipated. For reference, the assessed value of the parcel per acre is \$2,000. The budgetary cost to test and construct the well, including transmission piping, is estimated to be around \$600,000.

Location 5

An agriculturally zoned piece of property located at 5556 East Deerfield Road or within this immediate vicinity is proposed. The parcels in this area are actively farmed but suggested for future consideration and opportunity. The purchase of a 5 acre+ split for location of a future production well would be proposed. The parcel is 3 miles from the Isabella Treatment facility by vehicle but only 1 mile as the crow flies.



Zoning: The parcel and corridor in this area is zoned rural buffer and future development is not planned for this area.

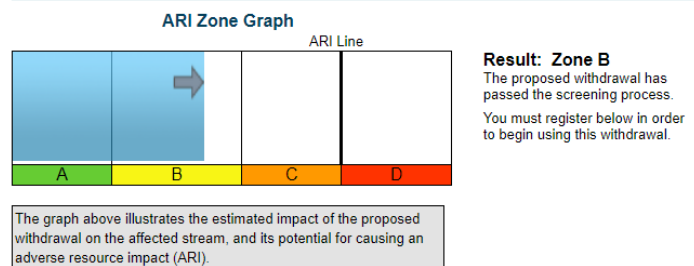
Access: The site is accessible off of Summerton Road. The site does appear traversable with negligible trees and minimal clearing / grubbing would be anticipated. Municipal water and (3) phase power supply is not readily available, and installation of both services would need to be provided. Existing (3) phase power would require about a three mile extension and municipal watermain would require about one and a half mile extension.

Soils: Lithology for surrounding wells indicate sand / gravel aquifer at depths of 80 to 150 feet along with varying seams of clay to depth of around 300 feet. There are a couple irrigation wells in the area with favorable capacities of around 300 GPM. This area is outside the current wellhead protection areas.

Contamination: Review of the information available, the existing Potter Brodie Drain and corresponding watershed is located outside the proximity to this parcel. There does not appear to be any other impeding sources of potential contamination aside from oil and gas wells that are outside the mandatory 2,000 foot isolation zone.

ARI: The state of Michigan provides a water withdrawal screening analysis that outputs the anticipated impact of the proposed withdrawal on any affected stream and its potential for causing an adverse resource impact (ARI). A water withdrawal analysis was performed on this location reflecting the groundwater as a source, in a glacial aquifer, at a depth of 85 ft and a pumping rate of 850 gpm 12 hours per day, to reflect a realistic-case scenario of the new well. The analysis resulted in a Zone B: Passing

Water withdrawal screening results



Cost: Budgetary Cost to test and construct Well including transmission piping is The parcel(s) in this vicinity are not currently listed for sale but based upon assessment records are valued at \$2,700 per acre. The budgetary cost to test and construct the well, including transmission piping, is estimated to be around \$2,500,000.

5 RECOMMENDATIONS

5.1 SELECTION

Based on the composition of the geology around the Isabella Treatment Facility, there is no location that we can justifiably confirm will produce groundwater at a continuous rate of 850 gpm. Many considerations are given to determining an ideal location for a new water source. Based upon the information provided in this report, the following are imperative:

1. Location away from any major sources of contamination
2. Location outside the Potter Brodie Drain / Watershed influence
3. Location away from existing wells causing interference
4. Consideration to ensure consistent water quality and blending with existing water sources and avoid bedrock well construction.
5. Site of adequate size to accommodate future source expansion and has access to utility service with minimal cost (water and electric)

A summary of the five (5) sites identified is provided on the table on the next page. Each unique with associated benefits and concerns listed to aid the Township with making the best decision moving forward.

Overall review of the information collected, analyzed, and quantified by GFA two (2) sites out of the five (5) demonstrated the most favorable opportunities for the Township.

- Site No. 2, from a short-term planning perspective, demonstrates a strong potential for a production well to meet the immediate future needs with negligible investment. Preliminary evaluations and historical research indicate a new well would have the ability to produce around 300 GPM and possibly more.
- Site No. 5, from a long-term planning perspective, demonstrates a strong potential for large production to meet future needs. Preliminary evaluations and research indicate this area could have the ability to produce a large capacity with more planning and preparation with the property owners.

Site	Distance to Isabella WTP	Demographics	Costs	Pros	Cons
No. 1 Crawford Road	2.8 mile	-20.2 Acres -Ag Zoned		-Accessible Site with amenities (water / electric) -Outside known areas of contamination -Best ARI rating -No nearby well interference	-Far away from Isabella Treatment Facility -Requires property purchase and long transmission line -Most costly option
No. 2 5076 S Mission Road	1.7 miles	-14 Acres -Neighborhood Service Zoned	-	-Accessible Site with amenities (water / electric) -Twp owned parcel -Passing ARI rating -Outside known areas of contamination -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Potential nearby well interference -May not produce large withdrawal up to 300 GPM
No. 3 4795 Mission Road	1.5 mile	-29.6 Acres -Neighborhood Service Zoned	-	-Accessible Site with amenities (water / electric) -Twp owned parcel -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Failing ARI Rating -Potential nearby well interference -Potential contamination within isolation zone -May not produce large withdrawal up to 300 GPM
No. 4 5120 Isabella Road	0.1 mile	-49.6 Acres -Rural Buffer Zoned	-	-Close proximity to Isabella Treatment Facility Accessible Site with amenities (water / electric) -Transmission line can accommodate additional flows to Isabella Treatment Plan - Cost effective	-Failing ARI Rating -Potential contamination within isolation zone within watershed -Aquifer capacity limited per EGLE -Clearing and Grubbing Required
No. 5 5556 Deerfield Road	1 mile	-10 acres (min) -Rural Buffer zoned	-	-Close proximity to Isabella Treatment Facility Accessible Site with amenities (water / electric) -Outside known areas of contamination -Passing ARI rating -No nearby well interference	-Requires property purchase and water / electric transmission installation -More Costly

6 NEXT STEPS

6.1 GENERAL

High capacity wells (greater than 70 gpm) are subject to Drinking Water and Environmental Health Division (DWEHD) policy and procedure ODWMA-399-003, “Aquifer Test Requirements for Public Water Supply Wells,” under Act 399. Furthermore, a proposed withdrawals from community wells are accounted for when DWEHD initiates the approval process through EGLES’ Water Resource Division via the local District Engineer. The typical steps are provided below. A flow diagram of the overall process is provided in the Appendix

- Step 1: Preliminary Investigation (Water Usage / Availability)
- Step 2: Test Well
- Step 3: Pump Test and Aquifer Analysis
- Step 4: Type I water wells, Wellhouse, and Distribution Piping Design
- Step 5: Construction Permit (includes the Technical Capacity Assessment)
- Step 6: Technical, Managerial, and Financial Capacity Assessment
- Step 7: Operation of System

With Step 1 completed, we recommend the Township proceed with Step 2 related to Site No. 2 while continuing investigation and research related to Site No. 5.

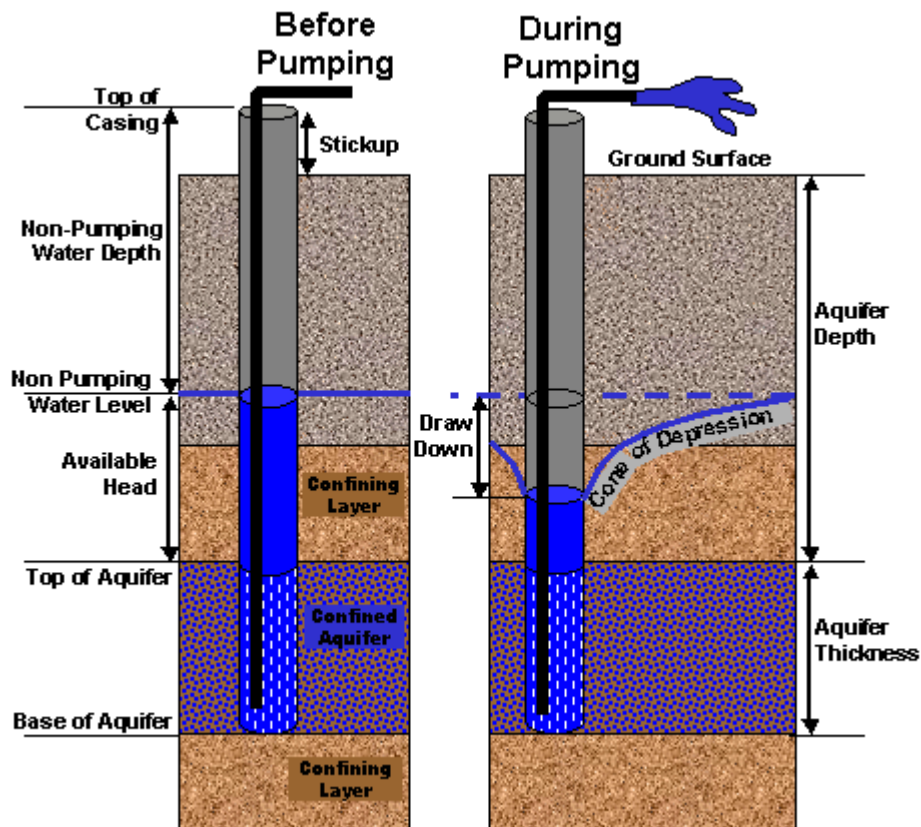
6.2 STEP 2, SITE 2

The construction of a test well will need to occur prior to its’ or any other wells’ conversion to a permanent production well. The scope of work to conduct the construction of a test well includes the following:

- Coordination with the local EGLE Water Division Office to notify them of the owner’s intended development and water supply intentions.
- Submittal of a preliminary site layout map indicating the proposed well locations and possible sources of contamination to the EGLE Water Division. This will also include Registration of proposed withdrawal for compliance with ARI. This may require a Site-Specific Review (SSR)
- Selection of a location within the boundaries of the property for the proposed well field to ensure meets regulated isolation variances and is accessible.
- Scheduled site visit with the owner, engineer, and EGLE to inspect the anticipated well location. Please note that it is recommended to discuss with the EGLE at this time regarding their recommendations for the number of test wells and monitoring wells, aquifer analysis methodology, etc.
- Approval letter from EGLE to perform test well drilling. This typically would include drilling one (1) test well and two (2) observation wells, three (3) wells total. However, exceptions maybe granted due to proximity to existing Mission Road Wellfield. One (1) of the monitoring wells is assumed to be converted to a production well upon

confirming adequate capacity of aquifer to handle the design flows. Please note this may vary depending on site conditions and EGLE recommendations. Typically, it is recommended to initially install one (1) pilot test well (soil boring) prior to installation of cased test well however in this situation it would provide limited data related to hydraulics and soil conditions are already known. Further information can be obtained from a cased test well that is installed for investigation purposes to analyze water quality in addition to the pilot test well information, approximate costs are \$100 per foot. However, this option provides the client with a test well that can be converted over to either a production well or monitoring well upon final approval from EGLE.

- **For initial investigative purposes, it is recommended that the Township construct only (1) 6-inch cased test well to conduct testing while simultaneously monitoring water levels at the City Well and Wells 8 and 9. Costs to construct and conduct this high-level evaluation are estimated to be \$30,000. If results prove satisfactory, then we would recommend proceeding with complete test well drilling and Step 3. This well can be repurposed and utilized as a monitoring well in the future.**
- Proceed to Step 3, Pump Test and Aquifer Analysis



6.3 ALTERNATE CONSIDERATION

Although emphasis has been placed to evaluate and determine a suitable water source location within the vicinity of the Isabella Treatment Facility, the Meridian Facility does also present an opportunity. The existing wells at this location are the oldest infrastructure in the system (30 years) and upgrades will be needed in the next 10 years as the infrastructure nears its' life expectancy. Based upon review of the available aquifer information, it was apparent the aquifer poses low sensitivity to contamination and demonstrated a strong potential for a production well to meet the future needs. Well No. 3 was noted to have the ability to yield an additional 300 GPM due to depth and with the replacement of Well No. 4 at similar depths and maximum separation could yield higher capacity as well. Pursuing this route would require expansion of the existing water treatment plant including iron removal filters, mechanical piping, and site upgrades but ability to increase the water supply for the system in this location may be the least complex process. The process to proceed with this route would be similar to that identified in Section 6.2.



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Testing &
Operations

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231.946.3703 



Existing and Potential Water Supply Location Maps

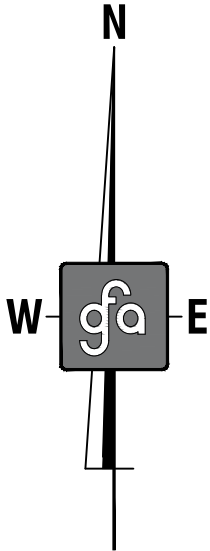
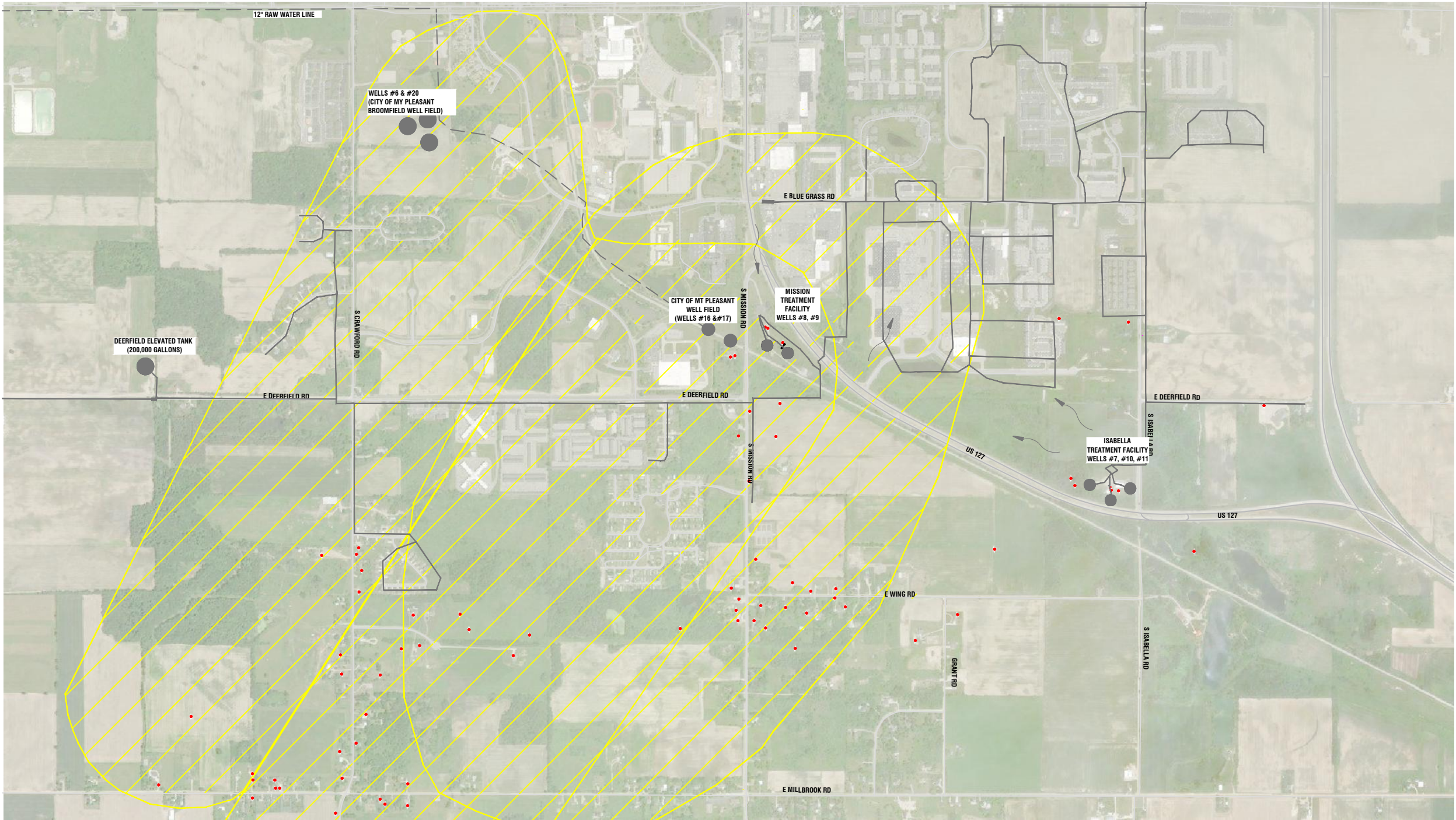
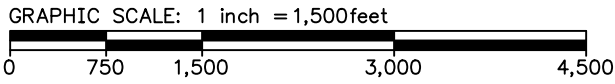
SOURCE WATER SUPPLY ANALYSIS

EXISTING WATER SUPPLY LOCATION MAP

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<http://gfa.lc>
231.346.5874 (p)
231.346.3703 (f)



LEGEND

- | | | | |
|---|---|---|----------------------------|
|  | WATER WELL- RESIDENTIAL, TYPE I AND TYPE II |  | EXISTING WATERMAIN |
|  | WELLHEAD PROTECTION AREA |  | GROUNDWATER FLOW DIRECTION |

SOURCE WATER SUPPLY ANALYSIS

POTENTIAL WATER SYSTEM SUPPLY LOCATION MAP

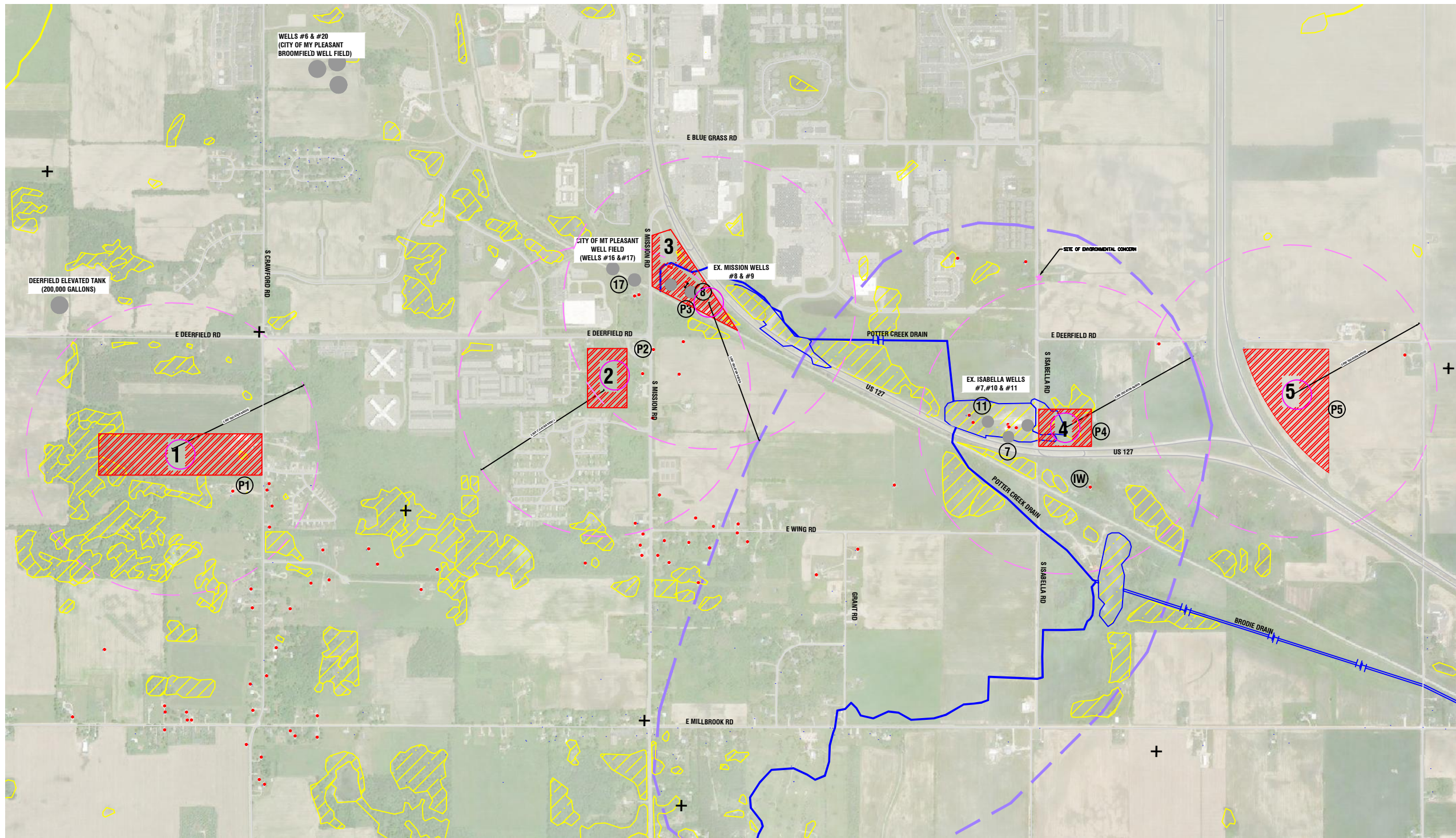
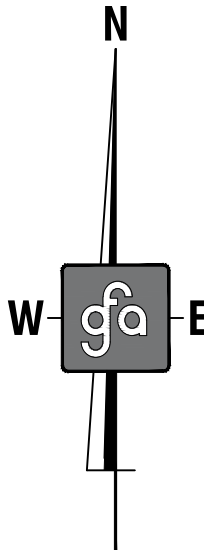
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SURVEYING
TESTING & OPERATIONS



<http://gfa.lc>
231.944.5874 (p)
231.944.3703 (f)

GRAPHIC SCALE: 1 inch = 1,500 feet

0 750 1,500 3,000 4,500



LEGEND

- WATER WELL— RESIDENTIAL, TYPE I AND TYPE II
- AREA OF ENVIRONMENTAL CONCERN
- WETLAND BOUNDARY

- WATERSHED
- 2,000 FT ISOLATION ZONE
- 200 FT WELL ISOLATION ZONE
- COUNTY DRAIN

- WELL ID NUMBER
- OIL / GAS WELL



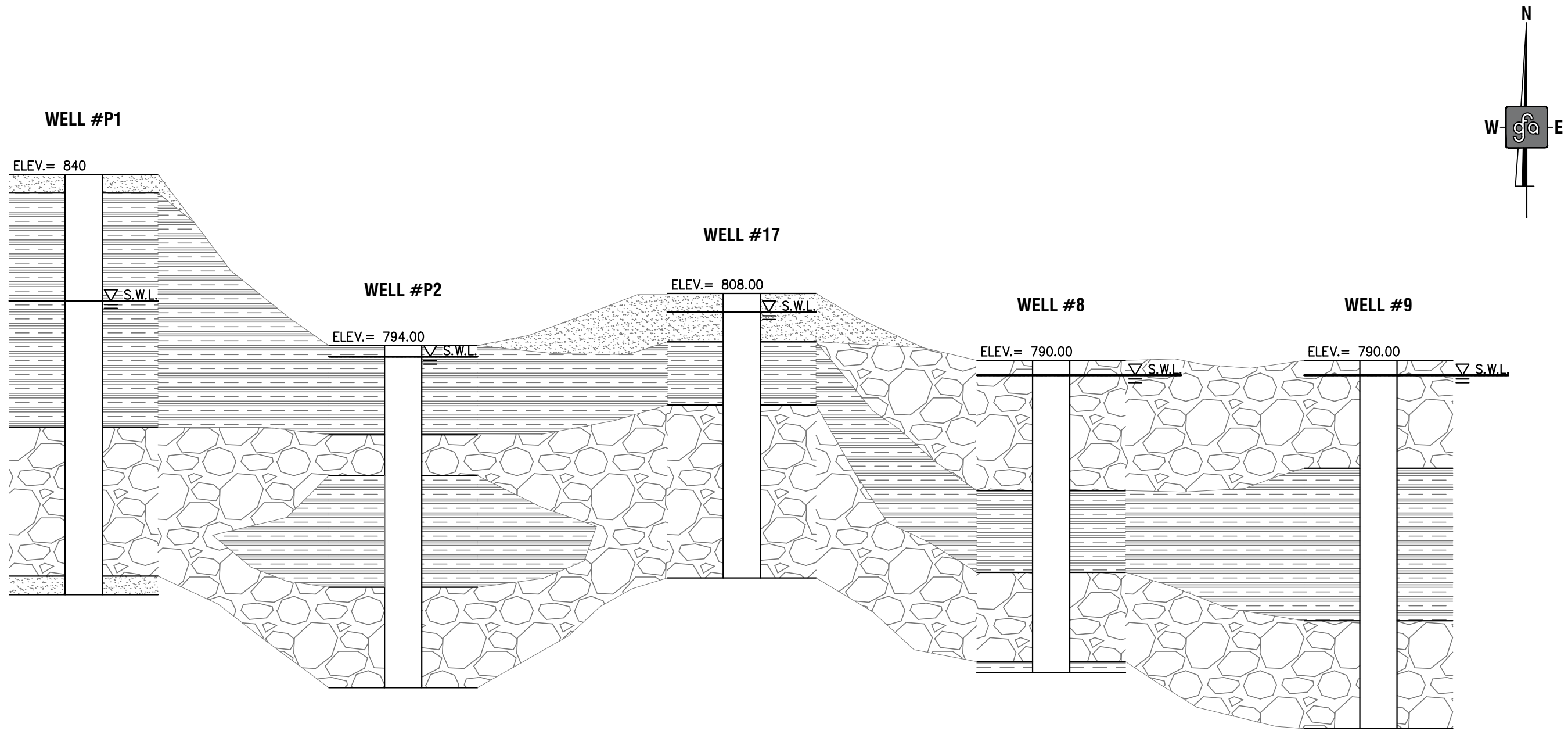
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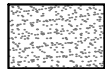
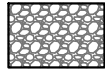


Existing and Proposed Well Lithology Profiles

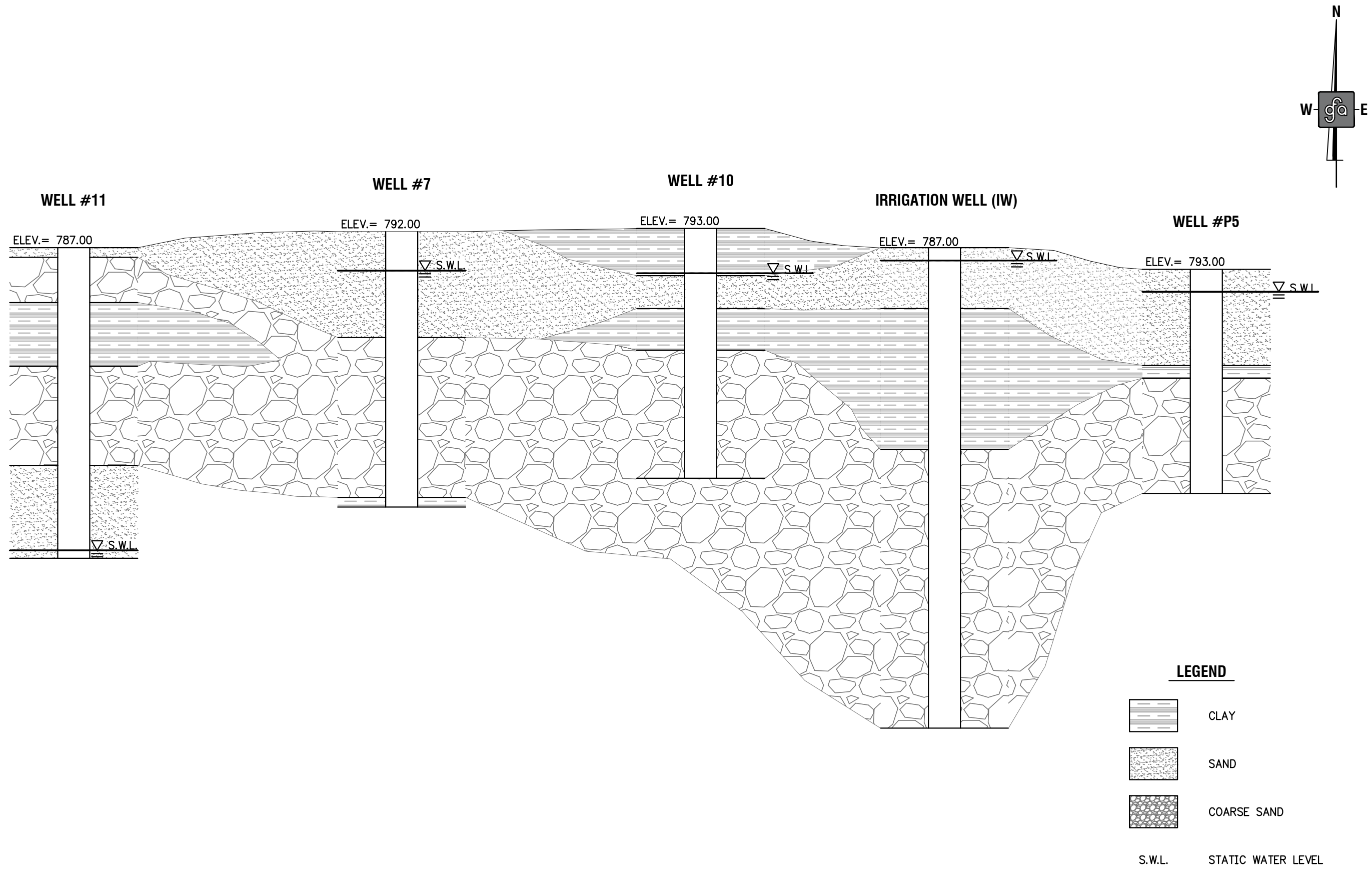
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LEGEND

- | | |
|---|--------------------|
|  | CLAY |
|  | SAND |
|  | COARSE SAND |
| S.W.L. | STATIC WATER LEVEL |

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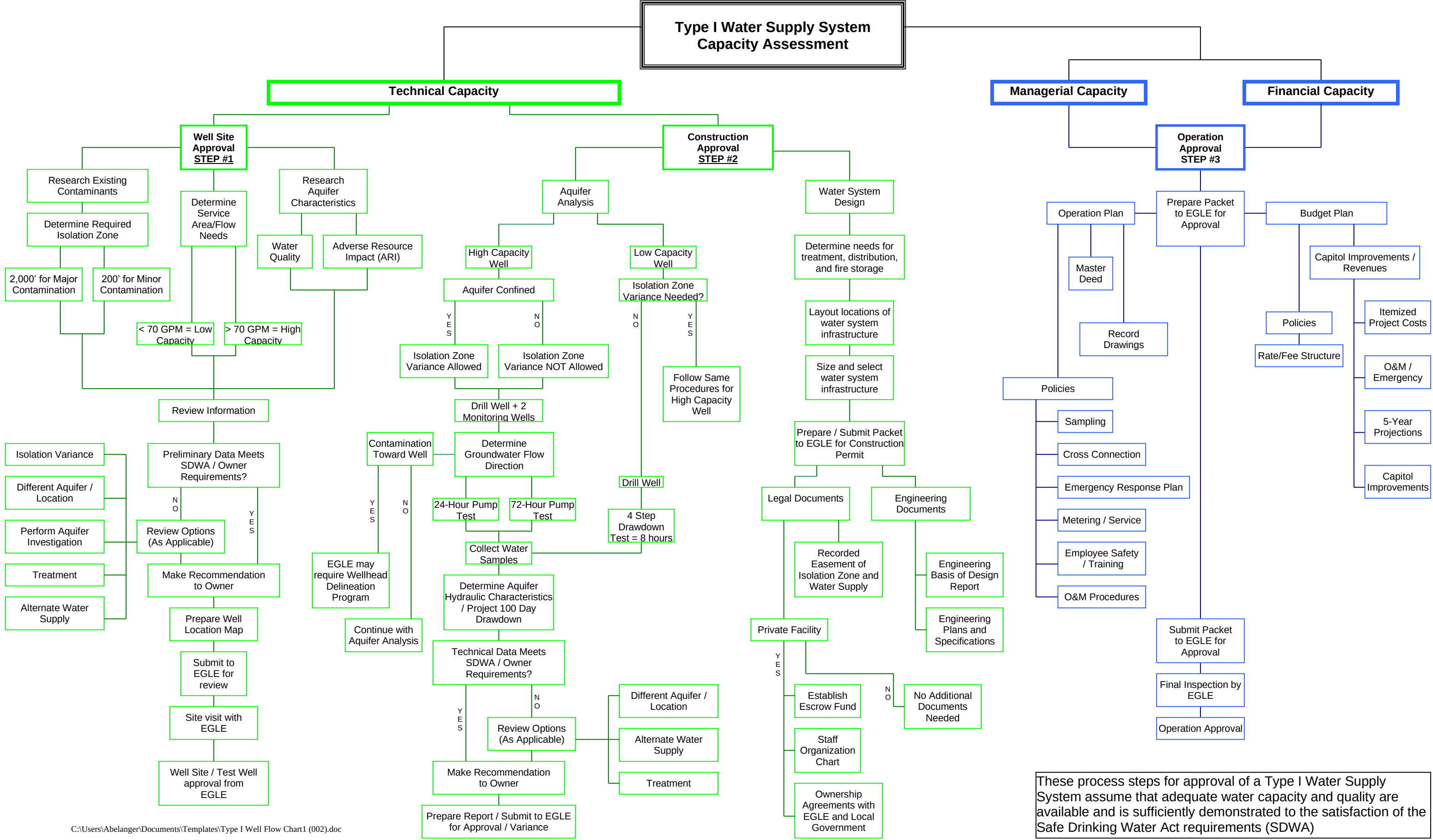
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Procedure Flow Chart for Approval of New Type 1 Water Supply Well

**Procedures for Approval of a New Community Public
Type I Water Supply System**





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Proposed Type 1 Well Locations Opinion of Probable Cost

OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION
Potential Water Supply - Site No. 1
GFA PROJECT NO. 21096
February 22, 2022

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.5	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	4840	SYD	\$ 5.00	\$ 24,200.00
4	Driveway, Gravel	1333	SYD	\$ 15.00	\$ 20,000.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	800	LF	\$ 32.00	\$ 25,600.00
PRODUCTION WELL					
Phase I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
Phase II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
Phase III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	15,000	LF	\$ 85.00	\$ 1,275,000.00
2	Gate Valve & Box, 12"	15	EA	\$ 7,500.00	\$ 112,500.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$189,000.00
ESTIMATED CONSTRUCTION COST					\$1,722,800.00
TOTAL ESTIMATED CONSTRUCTION COST (INCLUDING 10% CONTINGENCY)					\$1,895,080.00
TOTAL ENGINEERING, CONSTRUCTION ADMINISTRATION AND INSPECTION COSTS					\$723,576.00
TOTAL PROJECT COST					\$2,618,656.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- Assumed 3 phase power readily available

OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION
Potential Water Supply - Site No. 2
GFA PROJECT NO. 21096
February 22, 2022

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.50	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	2000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	500	LF	\$ 32.00	\$ 16,000.00
PRODUCTION WELL					
Phase I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
Phase II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
Phase III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	9,000	LF	\$ 85.00	\$ 765,000.00
2	Gate Valve & Box, 12"	9	EA	\$ 7,500.00	\$ 67,500.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$0.00
ESTIMATED CONSTRUCTION COST					\$1,136,500.00
TOTAL ESTIMATED CONSTRUCTION COST (INCLUDING 10% CONTINGENCY)					\$1,250,150.00
TOTAL ENGINEERING, CONSTRUCTION ADMINISTRATION AND INSPECTION COSTS					\$477,330.00
TOTAL PROJECT COST					\$1,727,480.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- Assumed 3 phase power readily available

OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION
Potential Water Supply - Site No. 3
GFA PROJECT NO. 21096
February 22, 2022

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.0	ACRE	\$ 2,500.00	\$ -
3	Site Grading	2000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	500	LF	\$ 32.00	\$ 16,000.00
PRODUCTION WELL					
Phase I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
Phase II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
Phase III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	8,000	LF	\$ 85.00	\$ 680,000.00
2	Gate Valve & Box, 12"	8	EA	\$ 7,500.00	\$ 60,000.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$0.00
ESTIMATED CONSTRUCTION COST					\$1,042,750.00
TOTAL ESTIMATED CONSTRUCTION COST (INCLUDING 10% CONTINGENCY)					\$1,147,025.00
TOTAL ENGINEERING, CONSTRUCTION ADMINISTRATION AND INSPECTION COSTS					\$437,955.00
TOTAL PROJECT COST					\$1,584,980.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- Assumed 3 phase power readily available

OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION
Potential Water Supply - Site No. 4
GFA PROJECT NO. 21096
February 22, 2022

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	2.0	ACRE	\$ 2,500.00	\$ 5,000.00
3	Site Grading	4840	SYD	\$ 5.00	\$ 24,200.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	500	LF	\$ 32.00	\$ 16,000.00
PRODUCTION WELL					
Phase I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
Phase II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
Phase III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	600	LF	\$ 85.00	\$ 51,000.00
2	Gate Valve & Box, 12"	1	EA	\$ 7,500.00	\$ 4,500.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$0.00
ESTIMATED CONSTRUCTION COST					\$377,450.00
TOTAL ESTIMATED CONSTRUCTION COST (INCLUDING 10% CONTINGENCY)					\$415,195.00
TOTAL ENGINEERING, CONSTRUCTION ADMINISTRATION AND INSPECTION COSTS					\$158,529.00
TOTAL PROJECT COST					\$573,724.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- Assumed 3 phase power readily available

OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION
Potential Water Supply - Site No. 5
GFA PROJECT NO. 21096
February 22, 2022

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
ACCESS					
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.5	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	2,000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase	15,000	LF	\$ 32.00	\$ 480,000.00
PRODUCTION WELL					
Phase I					
1	Test Drilling to 200'	1	LS	\$ 30,000.00	\$ 30,000.00
2	Gamma Logging Test Boring	1	LS	\$ 250.00	\$ 250.00
Phase II					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 52,500.00	\$ 52,500.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 8,000.00	\$ 8,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
Phase III					
1	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 12,500.00	\$ 12,500.00
2	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
3	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
TRANSMISSION LINE					
1	Water Main, C900, 12"	8,000	LF	\$ 85.00	\$ 680,000.00
2	Water Main, C900, 12" Bore and Jack	500	LF	\$ 185.00	\$ 92,500.00
3	Gate Valve & Box, 12"	8	EA	\$ 7,500.00	\$ 60,000.00
4	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
5	Connect to Existing, Wellhead	1	EA	\$ 5,500.00	\$ 5,500.00
6	Live Tap and Valve, 12"	1	EA	\$ 8,500.00	\$ 8,500.00
7	Site Restoration	1	LS	\$ 45,000.00	\$ 45,000.00
PROPERTY PURCHASE					\$27,000.00
ESTIMATED CONSTRUCTION COST					\$1,600,500.00
TOTAL ESTIMATED CONSTRUCTION COST (INCLUDING 10% CONTIGENCY)					\$1,760,550.00
TOTAL ENGINEERING, CONSTRUCTION ADMINISTRATION AND INSPECTION COSTS					\$672,210.00
TOTAL PROJECT COST					\$2,432,760.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices or items.
- Costs for financing, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- Assumed 10 Acre purchase negotiated at current assessed values
- Assumed 3 phase power NOT readily available

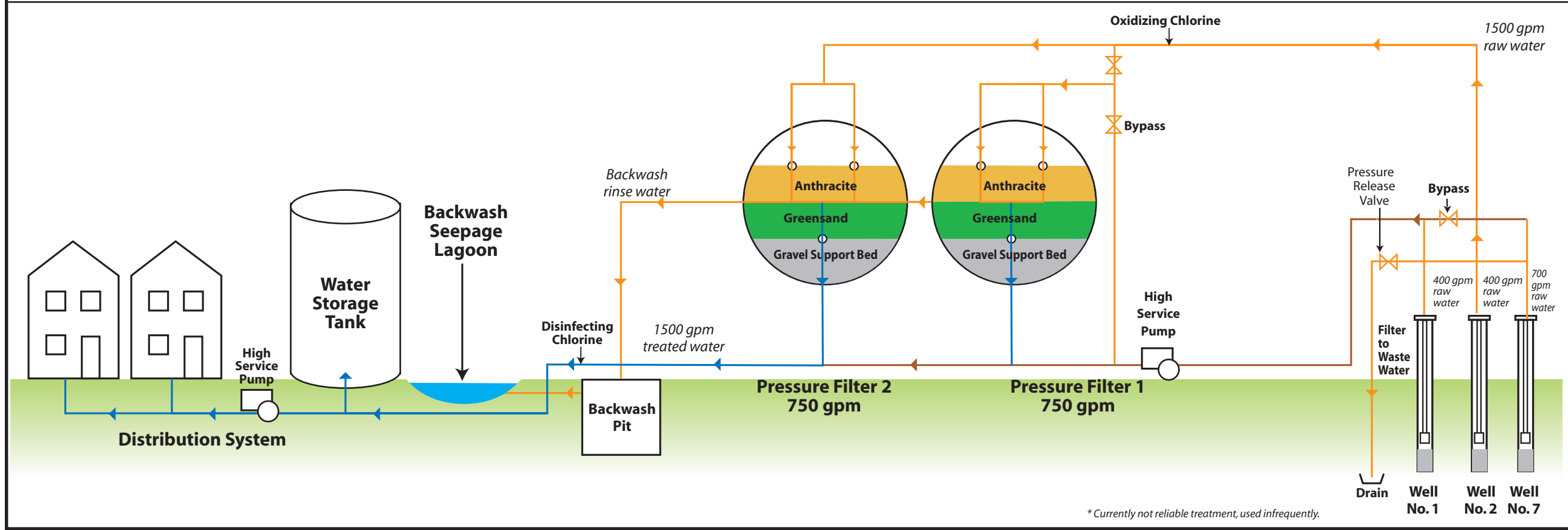
CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

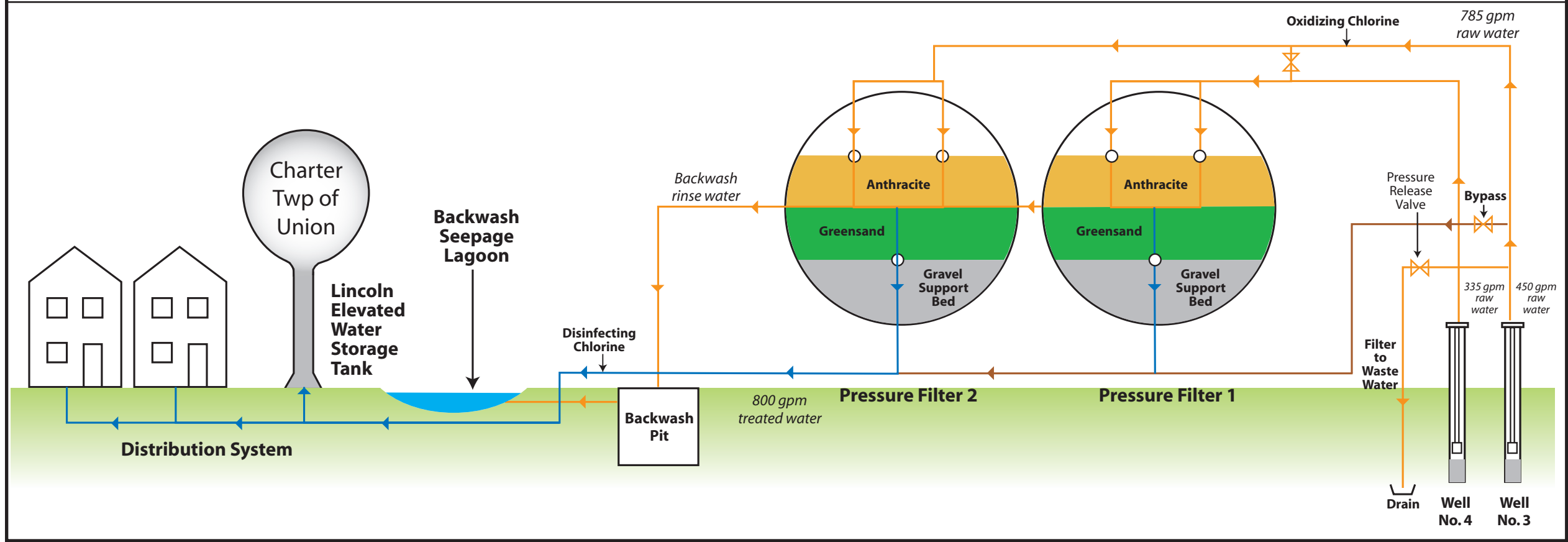
APPENDIX K



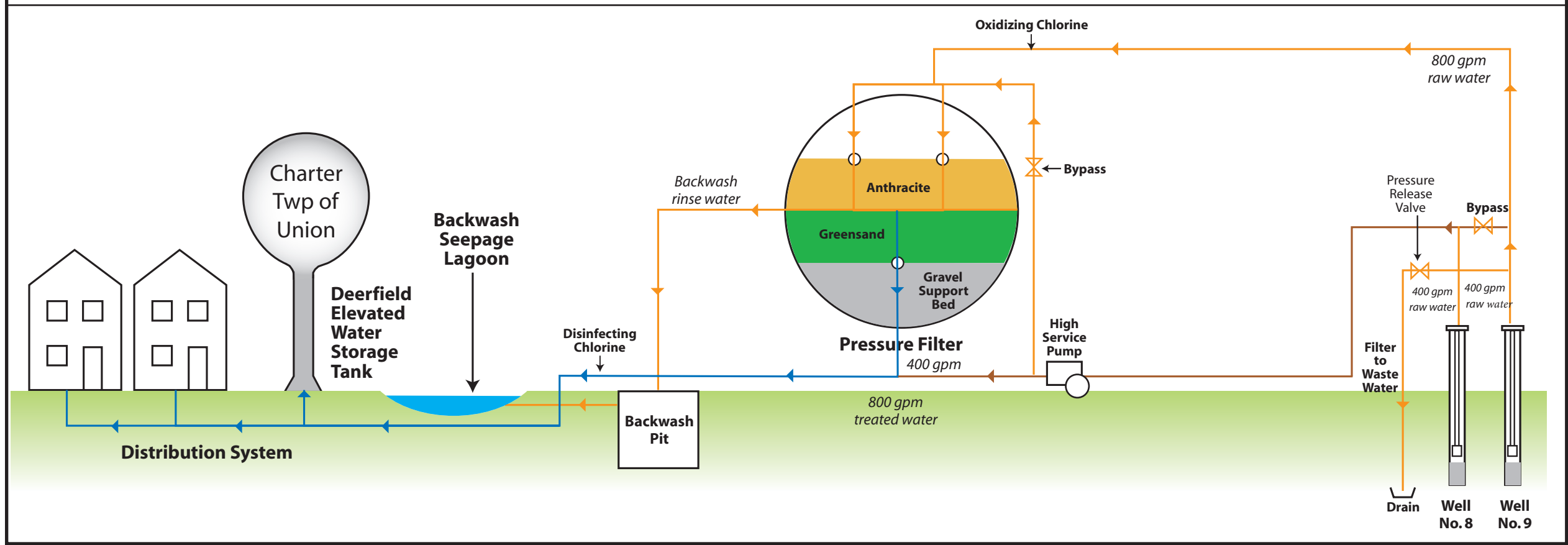
Existing Isabella Road Treatment System



Existing Meridian Road Treatment System



Existing Mission Road Treatment System



*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX L



OPINION OF PROBABLE CONSTRUCTION COST

CHARTER TOWNSHIP OF UNION DRINKING WATER STATE REVOLVING FUND
WATER SYSTEM IMPROVEMENTS : TOTAL COST FOR SELECTED ALTERNATIVE
GFA PROJECT NO. 23045
May 8, 2023

No.	Item	Unit	Estimated Quantity	Unit Price	Item Cost
1	Supply and Treatment Systems Improvements	LS	1	\$4,237,750.00	\$4,237,750.00
2	Distribution System Improvements	LS	1	\$3,035,500.00	\$3,035,500.00
ESTIMATED CONSTRUCTION COST					\$7,273,250.00
25% CONTINGENCY					\$1,818,300.00
LEGAL, ADMINISTRATION, FINANCING					\$436,400.00
ENGINEERING, ADMINISTRATIONS, CONSTRUCTION SERVICES					\$1,454,700.00
TOTAL ESTIMATED CONSTRUCTION COST					\$10,982,650.00

- These costs are based on preliminary information. The actual site conditions may result in variations of unit prices
- Costs for financing, land, right-of-way, easement acquisition, and permit fees are not included in this cost estimate.
- This cost estimate is approximate. Actual construction bids may vary significantly from this statement of probable
- This estimate is based on the drawing included in this report

CHARTER TOWNSHIP OF UNION DRINKING WATER STATE REVOLVING FUND
WATER DISTRIBUTION SYSTEM : ALTERNATIVE 3
GFA PROJECT NO. 23045
May 8, 2023

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
Isabella to Mission Transmission Main Extension					
1	Mobilization, Max 5%	1	LS	\$45,000.00	\$45,000.00
2	Traffic Control	1	LS	\$25,000.00	\$25,000.00
3	Water Main, 12" C900	6500	LF	\$100.00	\$650,000.00
4	Gate Valve and Box, 12"	6	EA	\$10,500.00	\$63,000.00
5	Tapping Sleeve & Valve, Live Tap	2	EA	\$15,000.00	\$30,000.00
6	Patching Asphalt, Roadway and Driveways	180	SY	\$65.00	\$11,700.00
7	Directional Drill, 12" Water Main C900	230	LF	\$250.00	\$57,500.00
8	Site Restoration	1	LS	\$60,000.00	\$60,000.00
Lead Service Line Investigation / Replacement					
1	Lead Service Line Investigation	316	EA	\$1,000.00	\$316,000.00
2	Lead Service Line Replacement	150	EA	\$5,000.00	\$750,000.00
3	Lead Hydrant Head Replacement	40	EA	\$10,000.00	\$400,000.00
Pickard Road Transmission Main Extension					
1	Mobilization, Max 5%	1	LS	\$25,000.00	\$25,000.00
2	Traffic Control	1	LS	\$25,000.00	\$25,000.00
3	Water Main, C900, 12"	2,000	LF	\$100.00	\$200,000.00
4	Water Main, C900, 8"	1,000	LF	\$85.00	\$85,000.00
5	Gate Valve and Box, 12"	2	EA	\$10,500.00	\$21,000.00
6	Gate Valve and Box, 8"	1	EA	\$6,500.00	\$6,500.00
7	Fire Hydrant Assembly	5	EA	\$6,500.00	\$32,500.00
8	Tapping Sleeve & Valve, Live Tap, 12"	2	EA	\$15,000.00	\$30,000.00
9	Live Tap and Valve, 8"	2	EA	\$8,500.00	\$17,000.00
10	Driveway Patch, Concrete	275	SY	\$100.00	\$27,500.00
11	Driveway Patch, Asphalt	45	SY	\$65.00	\$2,925.00
12	Curb & Gutter Removal & Replacement, Concrete	80	LF	\$45.00	\$3,600.00
13	Trees Remove & Replace	12	EA	\$1,500.00	\$18,000.00
14	Sidewalk Remove & Replace, Concrete	3,325	SF	\$10.00	\$33,250.00
15	Site Restoration	1	LS	\$100,000.00	\$100,000.00
ESTIMATED CONSTRUCTION COST					\$3,035,500.00
25% CONTINGENCY					\$758,900.00
LEGAL, ADMINISTRATION, FINANCING					\$182,100.00
ENGINEERING, ADMINISTRATIONS, CONSTRUCTION SERVICES					\$607,100.00
TOTAL ESTIMATED CONSTRUCTION COST					\$4,583,600.00

CHARTER TOWNSHIP OF UNION DRINKING WATER STATE REVOLVING FUND
WATER SUPPLY AND TREATMENT : ALTERNATIVE 3, OPTION 1
ISABELLA TREATMENT FACILITY EXPANSION
GFA PROJECT NO. 23045
May 8, 2023

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
Well Site Access					
1	Mobilization, Max 5%	1	LS	\$ 12,000.00	\$ 12,000.00
2	Grubbing / Clear Cutting	0.50	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	2000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase (500' Away)	1	LS	\$ 15,000.00	\$ 15,000.00
Production Well					
1	Mobilization	1	LS	\$ 5,000.00	\$ 5,000.00
2	12" Well including development	1	LS	\$ 125,000.00	\$ 125,000.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 20,000.00	\$ 20,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
6	Pumping Equipment (pump, motor, drop pipe and v	1	LS	\$ 25,000.00	\$ 25,000.00
7	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
8	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
Transmission Line					
1	Water Main, C900, 12"	2,500	LF	\$ 100.00	\$ 250,000.00
2	Gate Valve & Box, 12"	2	EA	\$ 8,500.00	\$ 17,000.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 7,500.00	\$ 7,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 15,000.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 25,000.00	\$ 45,000.00
Isabella Treatment Site					
1	Mobilization, Max 5%	1	LS	\$60,000.00	\$60,000.00
2	12' Diameter Horizontal Pressure Filters (800 GPM Rated) including installation	1	LS	\$650,000.00	\$650,000.00
3	Piping, Valves, Fittings	1	LS	\$150,000.00	\$150,000.00
4	Flow Meter and Chemical Treatment Equipment	1	LS	\$75,000.00	\$75,000.00
5	Electrical and Instrumentation	1	LS	\$50,000.00	\$50,000.00
6	Backwash Lagoon Expansion	1	LS	\$115,000.00	\$115,000.00
7	Filter Room Expansion, Including HVAC, Plumbing & Lighting	2700	SF	\$600.00	\$1,620,000.00
8	Storage Building, 20'x30' Steel Structure	1	LS	\$50,000.00	\$50,000.00
Isabella Treatment Facility High Service Pump Addition					
1	High Service Pumps rated at 400 GPM / 290' TDH (Each) including installation	2	EA	\$80,000.00	\$160,000.00
2	Piping, Valves, Fittings	1	LS	\$125,000.00	\$125,000.00
3	Electrical / Instrumentation	1	LS	\$75,000.00	\$75,000.00
4	Pump Room Expansion (20 x 26') including HVAC, Plumbing & Lighting	550	SQFT	\$600.00	\$330,000.00
5	Variable Frequency Drives (100 Hp)	3	EA	\$25,000.00	\$75,000.00
6	SCADA Programming	1	LS	\$22,000.00	\$22,000.00
7	Restoration	1	LS	\$50,000.00	\$50,000.00
ESTIMATED CONSTRUCTION COST					\$4,237,750.00
25% CONTINGENCY					\$1,059,400.00
LEGAL, ADMINISTRATION, FINANCING					\$254,300.00
ENGINEERING, ADMINISTRATIONS, CONSTRUCTION SERVICES					\$847,600.00
TOTAL ESTIMATED CONSTRUCTION COST					\$6,399,050.00

CHARTER TOWNSHIP OF UNION DRINKING WATER STATE REVOLVING FUND
WATER SUPPLY AND TREATMENT : ALTERNATIVE 3, OPTION 2
MERIDIAN TREATMENT FACILITY UPGRADES
GFA PROJECT NO. 23045
May 8, 2023

No.	Item	Estimated Quantity	Unit	Unit Price	Item Cost
Well Site Access					
1	Mobilization, Max 5%	1	LS	\$ 20,000.00	\$ 20,000.00
2	Grubbing / Clear Cutting	0.50	ACRE	\$ 2,500.00	\$ 1,250.00
3	Site Grading	2000	SYD	\$ 5.00	\$ 10,000.00
4	Driveway, Gravel	833	SYD	\$ 15.00	\$ 12,500.00
5	Site Electrical & Communication , (2) 1-1/2" Conduit, 480V / 3 Phase (500' Away)	1	LS	\$ 15,000.00	\$ 15,000.00
Production Well					
1	Mobilization, Max 5%	1	LS	\$ 15,000.00	\$ 15,000.00
2	12" Well including development	1	LS	\$ 125,000.00	\$ 125,000.00
3	One (5") Monitoring Wells	1	LS	\$ 25,000.00	\$ 25,000.00
4	Well Testing	1	LS	\$ 20,000.00	\$ 20,000.00
5	Aquifer Analysis	1	LS	\$ 10,500.00	\$ 10,500.00
6	Pumping Equipment (pump, motor, drop pipe and valves)	1	LS	\$ 25,000.00	\$ 25,000.00
7	Variable Frequency Drive, 25 Hp	1	LS	\$ 25,200.00	\$ 25,200.00
8	SCADA & Programming	1	LS	\$ 10,500.00	\$ 10,500.00
Transmission Line					
1	Water Main, C900, 12"	3,500	LF	\$ 100.00	\$ 350,000.00
2	Gate Valve & Box, 12"	4	EA	\$ 8,500.00	\$ 29,750.00
3	BlowOff Yard Hydrant	1	EA	\$ 5,800.00	\$ 5,800.00
4	Connect to Existing, Wellhead	1	EA	\$ 7,500.00	\$ 7,500.00
5	Live Tap and Valve, 12"	1	EA	\$ 15,000.00	\$ 8,500.00
6	Site Restoration	1	LS	\$ 25,000.00	\$ 45,000.00
Meridian Treatment Facility Upgrades					
1	Mobilization, Max 5%	1	LS	\$200,000.00	\$200,000.00
1	12' Diameter Horizontal Pressure Filters (800 GPM Rated)	1	EA	\$650,000.00	\$650,000.00
2	Piping, Valves, Fittings	1	LS	\$300,000.00	\$300,000.00
3	Flow Meters and Chemical Treatment Equipment	1	LS	\$150,000.00	\$150,000.00
4	Instrumentation including installation (VFDs, Filter, Wells, Configuration, etc.)	1	LS	\$125,000.00	\$125,000.00
5	New Building, Including HVAC, Plumbing, & Lighting	3500	SF	\$750.00	\$2,625,000.00
6	Backwash Lagoon Expansion & Site Improvements	1	LS	\$225,000.00	\$225,000.00
7	Building & Site Piping	1	LS	\$150,000.00	\$150,000.00
8	Building & Site Electrical	1	LS	\$75,000.00	\$75,000.00
9	Access Drive	1	LS	\$50,000.00	\$50,000.00
10	Restoration	1	LS	\$50,000.00	\$50,000.00
ESTIMATED CONSTRUCTION COST					\$5,361,500.00
25% CONTINGENCY					\$1,340,400.00
LEGAL, ADMINISTRATION, FINANCING					\$321,700.00
ENGINEERING, ADMINISTRATIONS, CONSTRUCTION SERVICES					\$1,206,300.00
TOTAL ESTIMATED CONSTRUCTION COST					\$8,229,900.00

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX M



Present Worth Analysis & Short Lived Depreciation

Community Name: Charter Township of Union
Project: Union DWSRF Water System Improvements
Prepared By: Gourdie Fraser, Inc.

Federal Discount Rate for Water Resources Planning (Interest Rate) $i =$ 2.13%
 Number of Years, $n =$ 30 years

Water Supply / Treatment Alternatives

Alternative 1 & 2	
Initial Capital Costs =	\$0
Annual Operations & Maintenance Costs =	\$904,333
Future Salvage Value =	\$0
Present Worth of 30 years of O & M =	\$19,910,028
PW =	$\text{Annual OM} \frac{(1+i)^n - 1}{i(1+i)^n}$
Present Worth of 20 yr Salvage Value =	\$0
PW =	$\text{FSV} \frac{1}{(1+i)^n}$
Alternate 1 Total Present Worth =	\$19,910,028

Alternative 3: Option 1	
Initial Capital Costs =	\$6,399,050
Annual Operations & Maintenance Costs =	\$904,333
Future Salvage Value =	\$0
Present Worth of 30 years of O & M =	\$19,910,028
PW =	$\text{Annual OM} \frac{(1+i)^n - 1}{i(1+i)^n}$
Present Worth of 20 yr Salvage Value =	\$0
PW =	$\text{FSV} \frac{1}{(1+i)^n}$
Alternate 1 Total Present Worth =	\$26,309,078

Alternative 3: Option 2	
Initial Capital Costs =	\$8,229,900
Annual Operations & Maintenance Costs =	\$904,333
Future Salvage Value =	\$0
Present Worth of 30 years of O & M =	\$19,910,028
PW =	$\text{Annual OM} \frac{(1+i)^n - 1}{i(1+i)^n}$
Present Worth of 20 yr Salvage Value =	\$0
PW =	$\text{FSV} \frac{1}{(1+i)^n}$
Alternate 1 Total Present Worth =	\$28,139,928

Water Distribution Alternatives

Alternative 1: No Action	
Initial Capital Costs =	\$0
Annual Operations & Maintenance Costs =	\$0
Future Salvage Value =	\$0
Present Worth of 30 years of O & M =	\$0
PW =	$\text{Annual OM} \frac{(1+i)^n - 1}{i(1+i)^n}$
Present Worth of 20 yr Salvage Value =	\$0
PW =	$\text{FSV} \frac{1}{(1+i)^n}$
Alternate 1 Total Present Worth =	\$0

Alternative 2: Transmission Main & Loop	
Initial Capital Costs =	\$4,583,600
Annual Operations & Maintenance Costs =	\$0
Future Salvage Value =	\$0
Present Worth of 30 years of O & M =	\$0
PW =	$\text{Annual OM} \frac{(1+i)^n - 1}{i(1+i)^n}$
Present Worth of 20 yr Salvage Value =	\$0
PW =	$\text{FSV} \frac{1}{(1+i)^n}$
Alternate 1 Total Present Worth =	\$4,583,600

Present Worth Analysis & Short Lived Depreciation

Community Name: Charter Township of Union
Project: Union DWSRF Sanitary Sewer System Improvements
Prepared By: Gourdie Fraser, Inc.

Short Lived Depreciated Assets

Water Supply

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
Well Pumps	15	9	\$315,000	\$21,000

Water Treatment

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
Pressure Filter Media	15	6	\$450,000	\$30,000
Flow Meters	10	10	\$120,000	\$12,000
Chemical Feed Pumps	15	6	\$90,000	\$6,000
High Service Pumps	15	3	\$225,000	\$15,000
Sodium Hypochlorite Electrolyzers	15	4	\$6,000	\$400

Water Storage

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
Isabella Ground Tank - Cathodic Protection	10	1	\$20,000	\$2,000

Water Distribution

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
River Road Pumps	15	1	\$75,000	\$5,000
			TOTAL	\$91,400

**Operating Budget
For First Full Year After Construction**

Community Name: Charter Township of Union **County:** Isabella

Address: 5228 S Isabella Rd
Mt Pleasant, MI 48858

A. Applicant Fiscal Year: **From:** 2024 **To:** 2025

B. Operating Income:	From Water Rates & Charges :	\$1,616,018
	Connection, Benefit Fees :	\$100,000
	Water Tower Rental :	\$56,000
	Inspection Fees, Fines, Interest Etc. :	\$42,000
	Total Operating Income:	<u>\$1,814,018</u>

C. Operating Expenses:

Utilities, Supplies, Operations & Maintenance Expenses :	\$275,000
Operations / Employee Wages :	\$437,333
Professional Services :	\$87,000
Insurances, Misc. Expenses :	<u>\$105,000</u>

Total Operating Expenses: \$904,333

D. **Net Operating Income:** \$909,685

E. Non Operating Expenses:

Interest Expense:
Interest Income:

Other (Property Taxes):

Total Non Operating Income: \$0

F. **Net Income** \$909,685

G. Expenditures/Transfers

Repair, Replacement & Improvement Fund	\$91,400
Debt Service Payment	\$159,505
Bond Reserve	\$49,884
Payment to SRF Loan	<u>\$498,843</u>

Total Expenditures/Transfers: \$799,632

Excess/Deficit over net income: \$110,052

*CHARTER TOWNSHIP OF UNION,
ISABELLA COUNTY*

DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX N



Charter Township of Union

Bond Schedule

Date: 05/08/23

Interest Rate: 2.125%

Type of Bond: DWSRF
Low Interest

Yrs Deferred Principle 0

Principal: \$10,982,650

Amort. Factor 0.0454

Amortized Payment: \$498,843

bond reserve 10%: \$49,884

Year	1st Interest	2nd Interest	Principal Paid	Total Year Payment	Loan Balance
					10,982,650
1	116,691	116,691	265,000	498,381	10,717,650
2	113,875	113,875	271,000	498,750	10,446,650
3	110,996	110,996	277,000	498,991	10,169,650
4	108,053	108,053	283,000	499,105	9,886,650
5	105,046	105,046	289,000	499,091	9,597,650
6	101,975	101,975	295,000	498,950	9,302,650
7	98,841	98,841	301,000	498,681	9,001,650
8	95,643	95,643	308,000	499,285	8,693,650
9	92,370	92,370	314,000	498,740	8,379,650
10	89,034	89,034	321,000	499,068	8,058,650
11	85,623	85,623	328,000	499,246	7,730,650
12	82,138	82,138	335,000	499,276	7,395,650
13	78,579	78,579	342,000	499,158	7,053,650
14	74,945	74,945	349,000	498,890	6,704,650
15	71,237	71,237	356,000	498,474	6,348,650
16	67,454	67,454	364,000	498,909	5,984,650
17	63,587	63,587	372,000	499,174	5,612,650
18	59,634	59,634	380,000	499,269	5,232,650
19	55,597	55,597	388,000	499,194	4,844,650
20	51,474	51,474	396,000	498,949	4,448,650
21	47,267	47,267	404,000	498,534	4,044,650
22	42,974	42,974	413,000	498,949	3,631,650
23	38,586	38,586	422,000	499,173	3,209,650
24	34,103	34,103	431,000	499,205	2,778,650
25	29,523	29,523	440,000	499,046	2,338,650
26	24,848	24,848	449,000	498,696	1,889,650
27	20,078	20,078	459,000	499,155	1,430,650
28	15,201	15,201	468,000	498,401	962,650
29	10,228	10,228	478,000	498,456	484,650
30	5,149	5,149	489,000	499,299	-4,350

Charter Township of Union

Capitalized Interest

Date: 05/08/23

Interest Rate: 2.125%
Yrs Deferred Principle 0
Principal: \$10,982,650
Amort. Factor 0.0454
Amortized Payment: \$498,843

Type of Bond: DWSRF
Low Interest

	Value of Project	Interest Rate	Capitalized Interest
Year Completed			
October 2024	\$ 1,000,000	2.13%	\$21,250.00
April 2025	\$ 3,000,000	2.13%	\$63,750.00
October 2025	\$10,982,650	2.13%	\$116,690.66
Total Capitalized Interest			\$201,690.66

CHARTER TOWNSHIP OF UNION, ISABELLA COUNTY

DRINKING WATER REVOLVING FUNDS (SRF) PROJECT PLAN

APPENDIX O



Environmental Contamination

Community Name:

Charter Township of Union

Project:

Union CWSRF Sanitary Sewer System Improvements

Prepared By:

Gourdie Fraser, Inc.

Part 213 Open

Facility ID	Facility Name	Facility Address		Restrictions
173	Isabella County Rd Commission	2261 E Remus Rd	Mt Pleasant	48858 NO
38030	Next Door Store #70	2025 E Remus Rd	Mt Pleasant	48858 YES
39002	United Investments Inc	5370 E PICKARD	MT PLEASANT	48858 NO
18983	Mobil #3	5636 E PICKARD	MT PLEASANT	48858 NO
19246	Heritage Chrysler	4650 E Pickard St	Mt Pleasant	48858 NO
2783	Blodgett Oil Co Inc #16	5612 E Pickard St	Mt Pleasant	48858 NO

Env Contamination

Facility ID	Facility Name	Facility Address		POLLUTANTS
37000003	Fussman Race Track	North Mission	Mt Pleasant	48858 Cl
37000137	Dowell Schlumberger	1220 South Mission Road	Mt Pleasant	48858 Ethylbenzene; PCE
37000142	Pickard St. 5636 E., Mt. Pleasant	5636 E. Pickard St.	Mt Pleasant	48858 Acenaphthene; Xylenes
37000147	Corporate Drive 4525, Mt. Pleasant	4525 Corporate Drive	Mt Pleasant	48858 Cd; Pb
37000151	Remus Rd. 2120 E., Mt. Pleasant	2120 E. Remus Rd.	Mt Pleasant	48858 Ba; Pb; Zn

Part 211 Active

Facility ID	Facility Name	Facility Address		Restrictions
38030	Next Door Store #70	2025 E Remus Rd	Mt Pleasant	48858 YES
19532	Robert Brady	285 E Remus Rd	Mt Pleasant	48858 NO
2783	Blodgett Oil Co Inc #16	5612 E Pickard St	Mt Pleasant	48858 NO
19981	Next Door Store #39	5025 E Pickard St	Mt Pleasant	48858 NO

Part 211 Closed

Facility ID	Facility Name	Facility Address		Restrictions
36458	Anna Cockrell	5982 S Mission Rd	Mt Pleasant	48858 YES
173	Isabella County Rd Commission	2261 E Remus Rd	Mt Pleasant	48858 NO
1059	Beard Oil Pipeline Supply Inc	616 Industrial Ave	Mt Pleasant	48858 YES
16864	Dowell Schlumberger Inc	1220 S Mission	Mt Pleasant	48858 YES
17125	M&m Chevrolet Inc	4580 E Pickard St	Mt Pleasant	48858 NO
17160	Indril, Inc	2113 Enterprise Dr	Mt Pleasant	48858 NO
38430	Pro Comm Inc	5788 E AIRPORT RD	MT PLEASANT	48858 NO
9560	The Delfield Co	980 S Isabella Rd	Mt Pleasant	48858 NO
39002	United Investments Inc	5370 E PICKARD	MT PLEASANT	48858 NO
10845	Erb Lumber Co Inc	4851 PACKARD ST	MT PLEASANT	48858 NO
11224	2140045a	1430 S Isabella Rd	Mt Pleasant	48858 YES
18983	Mobil #3	5636 E PICKARD	MT PLEASANT	48858 NO
19246	Heritage Chrysler	4650 E Pickard St	Mt Pleasant	48858 NO
40363	Ada Smith	1023 E River Rd	Mt Pleasant	48858 NO
12691	Alwood Nursery	2945 S Meridian Rd	Mt Pleasant	48858 NO
12695	Dolphin Coin Inc	4353 S ISABELLA RD	MT PLEASANT	48858 YES
13785	Former Marathon Unit #3028	5353 E PICKARD ST	MT PLEASANT	48858 YES
21778	Unit 22-923	5655 E Pickard St	Mt Pleasant	48858 YES
41074	Beard Oil Inc	5654 PICKARD ST	Mt Pleasant	48858 NO
41780	Bob Sission Motor	5152 E Pickard	Mt Pleasant	48858 NO
5580	Mt Pleasant Municipal Airport	5580 E AIRPORT	MT PLEASANT	48858 YES
50001342	Pro Comm	5788 E AIRPORT	MT PLEASANT	48858 NO
34860	Imperial Oil Co	5115 E Pickard St	Mt Pleasant	48858 NO
36016	Rhynos Carwash	425 S Mission St	Mt Pleasant	48858 NO

*CHARTER TOWNSHIP OF UNION,
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DRINKING WATER REVOLVING FUNDS
(SRF) PROJECT PLAN

APPENDIX P

