

Water System Reliability Study

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City of Portage
Kalamazoo County, Michigan

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Contents

EXECUTIVE SUMMARY	iv
1 INTRODUCTION	1
2 WATER DEMANDS	2
2.1 Population Projections.....	3
2.2 Average Day Demands.....	4
2.3 Maximum Day Demands.....	4
2.4 Peak Hour Demands	4
3 WATER SYSTEM INFRASTRUCTURE.....	5
3.1 Water Supply Source.....	5
3.2 Water Treatment Facilities	5
3.3 Storage Facilities	5
3.4 Water Mains	5
4 WATER SYSTEM ANALYSIS.....	7
4.1 Water Storage Analysis.....	7
4.2 Distribution System Analysis.....	8
4.2.1 Model Development.....	8
4.2.2 Existing System - Steady State	9
4.2.3 Existing System – Age - Extended Period Simulation	10
4.2.4 Future Conditions	11
4.2.5 Distribution System Improvements.....	11
4.2.5.1 Abbot Avenue Dead End.....	12
4.2.5.2 Point O Woods Drive Dead End	12
5 RELIABILITY ISSUES	12
5.1 Redundancy	12
5.1.1 Water Supply	13
5.1.2 Water Transmission	13
5.1.3 Storage.....	13
5.2 System Capacity	13
5.3 Water Quality.....	14
5.3.1 Iron and Hardness.....	14
5.3.2 Lead Service Line Inventory	14
5.3.3 Per- and Polyfluoroalkyl Substances (PFAS)	15

5.3.4	Chlorine Residuals.....	16
5.3.5	Other parameters	16
5.4	Standby Power	16
5.5	Water Loss and Accountability	16
5.6	Deteriorating Mains	17
5.7	General Maintenance	17
5.7.1	Level of Service quantification.....	18
5.7.2	Pumps and Wells.....	18
5.7.3	Flushing Program	18
5.7.4	Valve Exercising Program.....	18
5.7.5	Meter Testing Program.....	18
5.7.6	Cross Connection Program	18
5.7.7	Water Shortage Response Plan	19
6	RECOMMENDATIONS FOR IMPROVEMENTS.....	19
6.1	Recommended Projects.....	19
6.2	General Recommendations	20
6.2.1	Water Accountability Plan	20
6.2.2	Consider Adding Second Iron Removal Treatment Plant	20
6.2.3	Dead End Mains	20
6.2.4	Replace Older Mains.....	20
6.2.5	Tank and Well Inspection Programs	21
6.2.6	General Maintenance Programs.....	21
6.2.7	Reliability Study	21
7	COST OPINIONS	22

Tables

Table 1	Historical and Projected Population
Table 2	Historical Water Use Data
Table 3	Historical and Projected Water Demands
Table 4	Well Data
Table 5	Treatment Plant Element Capacities
Table 6	Storage Tank Data
Table 7	System Wide Storage Analysis
Table 8	Hydrant Test – Static Locations and Results
Table 9	Hydrant Test – Flow Locations and Results
Table 10	Comparison of Calibrated Model to Field Test Pressures
Table 11	Model Results for Existing Conditions
Table 12	Model Results for Year 2029 Demands with Existing Infrastructure
Table 13	Model Results for Year 2044 Demands with Existing Infrastructure
Table 14	Model Results for Year 2029 Demands and Short-Term Recommended Improvements
Table 15	Model Results for Year 2044 Demands and Long-Term Recommended Improvements
Table 16	Standby Power
Table 17	Cost Opinions for Recommended Projects

Figures

Figure 1	Existing System
Figure 2	Population and Water Use Projections
Figure 3	Historical and Projected Water System Demands
Figure 4	Main Age
Figure 5	Main Material with Breaks
Figure 6	Water Age
Figure 7	Chlorine Residual Data
Figure 8	General Plan
Figure 9	Transmission
Figure 10	Historical Water Accountability

Appendices

Appendix A	Annual Pumpage Summary
Appendix B	Comparison of Calibrated Model to Field Test Pressures at Static Hydrant #2
Appendix C	Pressure Contour Maps
Appendix D	Water Quality Report
Appendix E	Water Shortage Response Plan

EXECUTIVE SUMMARY

This report represents the City of Portage (“Portage”) Water System Reliability Study for 2024. After reviewing the primary components of the water system – water supply, water treatment and pumping facilities, water distribution system pipes, and water storage – the following conclusion could be made:

- Portage provides adequate water supply to customers for normal system demand conditions.
- Existing maximum day demands have stabilized at approximately 51% of the rated capacity of the system. Under current demand projections, the maximum day demand could reach 52% of the rated capacity in the next 20 years. So adequate capacity is available in the long term.
- Portage provides fire protection to residential customers of at least 1,000 gpm for 2 hours and to commercial and industrial customers of 3,500 gpm for 3 hours per Asset Management Plan level-of-service goals. Some areas of the system are aging, and continued distribution main replacement is recommended to maintain suggested fire flows and a high level of service.
- Existing storage is sufficient to supply equalization and fire storage (at 3,500 gpm for 3 hours) for existing, five-year, and twenty-year projected demands in the system as a whole.
- The system transmission is adequate, and the system is well looped.
- Portage provides high quality water and has met the regulations for all known contaminants.
- Portage should consider providing a second iron removal treatment plant at the M-1 wells due to the high iron content at this location.

1 INTRODUCTION

Portage is located in Kalamazoo County in the southwestern area of Michigan's lower peninsula. Portage obtains water from wells within the Portage limits. This water is treated and distributed to retail customers in Portage as well as a limited number of customers in neighboring Schoolcraft and Pavilion Townships. Portage's existing water distribution system is shown in Figure 1.

The purpose of this report is to provide a study of the reliability of Portage's water system, which in turn fulfills specific requirements of Part 12 and Part 16 promulgated under Michigan's Safe Drinking Water Act, 1976, P.A. 399, as amended. The Act calls for a 20-year projection of water demands and an evaluation of each of the system components on a five-year interval.

Population projections and historical population data from the United States Department of Commerce, Bureau of Census (through the 2020 census), are included in this report. The water system analysis identifies current and projected water demands and includes a computer assisted network analysis of the water distribution system. Based on the analysis, recommendations for improvements to the water supply system are made and cost estimates are presented for the improvements.

Portage continues to maintain and improve the water system. The following water main projects have been completed since the last reliability study in 2019:

- New residential areas along Osterhout Avenue between Portage Road and Shaver Road, near the intersection of US-131 and I-94, near Bishop Avenue and Romence Road, as well as near Lovers Lane and Centre Avenue.
- Transmission main replacements along Shaver Road, Romence Road, and Milham Avenue.
- Replacement of old cast iron main in residential areas in the north of Portage.
- A 20-inch connection between Mastenbrook Drive and Aviation Drive, across the airport.
- A loop for the new FedEx facility near Portage Road and Romence Road.
- Multiple short extensions and minor loops closed.

2 WATER DEMANDS

The existing service area is shown in Figure 1, with no projected change in service area. Land use within Portage is primarily residential with a concentration of industrial areas in the northeastern as well as commercial areas along Westnedge Avenue and Shaver Road through the center of Portage. As of 2023, Portage had 15,669 service connections.

The average of the most recent five years shows approximately 73% of water use as residential with 22% as commercial. A breakdown of water use by customer type is provided in the table below.

Water Use by Customer Type

Billed Water Use (MG)							
	2018/19	2019/20	2020/21	2021/22	2022/23	5-year Average	Average Percent of Total (%)
Church	6.36	5.53	6.31	6.74	5.31	6.05	<1%
Commercial	328.61	316.68	291.51	338.37	301.18	315.27	22%
Government	11.23	10.48	8.41	13.41	12.28	11.16	<1%
Industrial	49.12	49.40	50.29	62.20	52.85	52.77	4%
Residential	976.82	971.08	1,117.62	1,157.37	1,058.39	1,056.26	73%
Schools	12.24	10.69	5.76	10.91	9.43	9.81	<1%
Other	-	-	-	-	100,000	20,000	<1%
Totals (MG)	1,384.38	1,363.86	1,479.90	1,588.99	1,439.54	1,451.33	

Source: Data provided by Portage.

The eleven largest water customers in Portage have used approximately 8-percent of the total billed water over the past five years. Various Stryker locations together make up the highest usage, followed by the Edward Rose apartments and Zoetis.

Largest Users

Customer	Billed Water Usage [MG]				Avg.	2023 % of Total
	2019/20	2020/21	2021/22	2022/23		
Edward Rose	26.4	43.4	29.1	33.8	33.2	1.9%
Stryker Corporation	5.0	16.2	18.2	21.2	15.1	0.9%
Zoetis Animal Health	26.0	21.2	26.1	16.1	22.3	1.3%
Stryker Medical	11.2	21.0	22.3	14.8	17.3	1.0%
Stryker Instruments	10.2	6.5	6.7	9.2	8.2	0.5%
Greenspire Apartments	7.7	3.1	6.8	6.8	6.1	0.4%
Portage Care 2015 LLC	6.8	8.2	7.4	6.2	7.1	0.4%
Mann & Hummel + Automotive Inc	9.9	17.9	2.6	2.3	8.2	0.5%
Norman/Portage LLC	3.1	11.0	10.6	4.2	7.2	0.4%
FedEx	-	10.0	3.0	1.8	5.0	0.3%
Medilodge of Portage	5.9	5.2	8.4	3.5	5.8	0.3%
Total Large Users	112.1	163.7	141.2	120.0	135.5	7.9%

2.1 Population Projections

Population projections for Portage are shown in Table 1 and are graphically illustrated in Figure 2. Historical population data from 1890 to 2020 was obtained from the U.S. Census Bureau. Population projections for Kalamazoo County through 2045 are based on the 2019 Population Projections by the County. The value of 0.032% growth was used for both the population and demand projections for this study.

Historical water demand data for the service area is provided in Appendix A and summarized in Table 2. From this data and population projection, the following was projected into the future: average day demand, which is the average daily water use for the year; maximum day demand, which is the highest daily use for the year; and peak hour demand, which is the estimated maximum hour of water use during the year.

2.2 Average Day Demands

Historical water demand data for the service area was provided in the form of monthly operating reports (MORs) by Portage for the years 2009-2023. This data is shown in Table 2. From this data, the average day demand was estimated.

The 2024 average day demand is estimated to be approximately 4.91 million gallons per day (mgd). This was determined by using the estimated maximum day demand, as discussed in Section 2.3, and dividing by the maximum day demand factor. By projecting the population growth trend of 0.032% annual growth for average day demands, the 2044 average day demand is projected to be 4.94 mgd. Existing and projected average day water demands for the Portage water system are provided in Table 3.

2.3 Maximum Day Demands

The historical maximum day demands for the water distribution system were obtained from Portage. These are shown in Table 2, while projected maximum day demands are presented in Table 3. The maximum day demands have continued to stabilize since a peak in 2012. Based on the recent historical high maximum day demand, the 2024 maximum day demand was projected to be approximately 10.97 mgd. The projected maximum day demand for 2044 is 11.04 mgd. Figure 3 graphically depicts the projected demands.

The maximum day factor is a ratio comparing the average day demands to the maximum day demands. A maximum day demand factor of 2.23 was assumed to determine projected maximum day demands for the next twenty years.

2.4 Peak Hour Demands

Peak hourly water demands are estimated based on factors from similar communities. Often residential water use has a relatively high peaking factor, both in the morning and the evening, while industrial customers may reduce the overall peaking factor since water use is often steadier during a typical day. A peak hour factor of 2.0 times the maximum day demand was used to estimate peak hour demands based on similar communities. This peaking factor results in a 2024 peak hour demand of 21.9 mgd and a projected 2044 peak hour demand of 22.1 mgd. If the brief morning and evening peak hour demands are above current pumping capability, the demand

would be met by utilizing elevated tank storage. The peak hour projection has been included in Figure 3.

3 WATER SYSTEM INFRASTRUCTURE

There are multiple components to the water system. The water supply source and water treatment facilities produce high quality water and the pumps, water mains, and storage facilities are necessary to distribute the water to customers while maintaining adequate pressure.

3.1 Water Supply Source

Portage pumps water from nineteen wells within the Portage city limits at ten different locations. Table 4 contains details regarding the wells and pumps including diameter, depth, capacity at operating psi, as well as motor horsepower, total dynamic head (TDH), and dates of most recent overhaul and inspection. Also included is the firm supply capacity of the system.

3.2 Water Treatment Facilities

Portage treats the water from wells I-1, I-2, I-3, and I-4 for the removal of iron and arsenic. Four horizontal pressure filters are utilized for removal, and the plant has a firm capacity of 3,000 gpm. There is no bypass for the plant, so if the plant were out of service, the supply from these four wells would be unavailable. Water from all wells is treated with hypochlorite, fluoride, and phosphate (except for the I-Wells) to produce high quality and sufficient quantity of drinking water to customers. Table 5 lists the capacity of each element in the treatment process.

3.3 Storage Facilities

The Portage water distribution system includes two elevated storage tanks. The Pineview Tank, a 1,500,000-gallon elevated storage tank, is located in the southern portion of Portage near Bacon Avenue and Portage Road. The Haverhill Tank, a 750,000 gallon elevated storage tank, is located in the northwestern portion of Portage near Romence Road and Oakland Drive. Table 6 provides more details regarding the storage tanks.

3.4 Water Mains

The Portage water distribution system has a complex network of water mains providing transmission and distribution to residential, commercial, industrial, and other users. The service area covers approximately 35.2 square miles and is supplied through a water distribution network

consisting of approximately 285 miles of water mains ranging from 4 to 20 inches in diameter. An approximate breakdown of the water mains by size is presented in the following table and illustrated in Figure 1.

Water Main Summary by Diameter

Water Main Diameter (inches)	Approximate Length of Water Main (miles)	Percentage of Total (%)
4" or less	1.5	0.5%
6"	41.9	14.7%
8"	140.6	49.4%
10"	6.3	2.2%
12"	60.1	21.1%
14"	0.1	<0.1%
16"	23.9	8.4%
20"	7.6	2.7%
Unknown	2.8	1.0%
Total	284.8	100%

Source: GIS Database.

The system has undergone expansion and water main replacement as needed such that water mains vary in age from less than 10 years old to 70 years old. A summary of water main age is provided in the following table and in Figure 4. Approximately 20-percent of the system is more than 50 years old.

Water Main Summary by Age

Year Installed	Approximate Length of Water Main (miles)	Percentage of Total (%)
1950s	12.4	4.3%
1960s	43.2	15.2%
1970s	51.1	18.0%
1980s	47.9	16.8%
1990s	51.9	18.2%
2000s	49.6	17.4%
2010s	19.3	6.8%
2020s	8.9	3.1%
Unknown	0.5	0.2%
Total	284.8	100%

Source: GIS Database.

An approximate breakdown of water main material is included below and in Figure 5. The majority of the water main is ductile iron (79-percent) whereas 20-percent is cast iron.

Water Main Summary by Material

<i>Material</i>	<i>Approximate Length of Water Main (miles)</i>	<i>Percentage of Total (%)</i>
Cast Iron	56.3	19.8%
Copper	0.0	<0.1%
Ductile Iron	226.6	79.6%
PVC	0.1	<0.1%
Unknown	1.7	0.6%
Total	284.8	100%

Source: GIS Database.

A network of transmission mains, which range from 12 to 20 inches in diameter, extend throughout the system, accounting for 33% of the total distribution main. The transmission mains connect the wells and water treatment plant to the elevated storage tanks and extend throughout the service area, ensuring adequate supply through the system. Looped transmission improves system reliability and redundancy in the event of a main break or other emergency.

4 WATER SYSTEM ANALYSIS

The analysis of the water distribution system entails two main components. The first is that of water storage as it relates to flow available for fire protection. Secondly, and much more extensively, is the hydraulic analysis of the system utilizing a computer model to perform simulations of current and future conditions as well as potential improvements. The model is calibrated with on-site hydrant flow testing.

4.1 Water Storage Analysis

Ten State Standards states in Section 7.1.1: “Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic demands and where fire protection is provided, fire flow demands.”

With Portage’s desire to provide fire protection to customers, a common practice is to determine the storage needs based on maximum daily demands, maximum hourly demands, and fire

demands. An analysis was performed for these demands with consideration for the firm capacity of the water supply.

Table 7 shows the results for the storage analysis of the system. The results indicate that under Year 2024 Demands, the existing system provides 3,500 gpm for a three-hour duration.

The storage analysis was also analyzed for Year 2044 demand projections to determine if additional storage should be considered in the next twenty years. The storage analysis presented in Table 7 shows that the firm capacity of the existing supply and existing storage are sufficient to provide normal demand (equalization) storage plus 3,500 gpm of fire demand for 3 hours.

While no requirements exist for fire protection, the Insurance Services Office (ISO) typically rates residential customers with a fire flow of 1,000 to 1,500 gpm and industrial customers with a fire flow of up to 3,500 gpm, depending on the industry and building. This fire flow calculation is only one portion of the rating. Existing storage for Portage is adequate to provide more than the 3,500 gpm limit for its customers.

4.2 Distribution System Analysis

The water supply system was analyzed using WaterGEMS, a water distribution management and modeling software application. This software combines the ability to perform complex hydraulic computations and the ability to present results in a both a graphical and map format. Model input data consisted of the following: lengths, diameters, and roughness factors (Hazen-Williams coefficients) for pipes, ground elevations and demands for nodes, and storage tank elevations and volumes.

4.2.1 Model Development

The existing model was updated to include recent water system improvements. Demands were entered into the model using the projections based on population growth and water use data.

To calibrate the model, hydrant testing results were used. A hydrant flow test measures the distribution capabilities of a system by measuring and comparing the static pressure at a given location under typical conditions and the residual pressure at that same location for a given hydrant flow. The test data provides information for model calibration; that is, model parameters can be adjusted so that predicted results compare favorably to measured results.

Portage water system personnel performed eighteen fire hydrant flow tests with Prein&Newhof personnel on April 3, 2024. The results of these tests are shown in Tables 8 and 9. The tests were performed using American Water Works Association (AWWA) test procedures at a variety of locations dispersed throughout the system and provide data to adjust roughness coefficients and demands to simulate results.

Using the hydrant test data, the model was calibrated as follows:

- Simulate system conditions using initial assumptions for parameters
- Adjust water main roughness coefficients and system demand distribution
- Perform a sensitivity analysis on adjusted results
- Fine tune results based on previous steps

Table 10 compares the calibrated model results at the nearest model node to the field test results at the test hydrant sites. Tank levels and pump flows recorded during the hydrant tests were also considered for the calibration. Appendix B contains data from the second static hydrant readings taken during hydrant testing.

The model reasonably simulates the hydrant test results. Results are within 10-percent at all locations. Given that hydrant model simulations cannot account for fluctuations in demands, the calibration results are considered reliable.

Based on the calibration results and past observations, it appears that significant tuberculation does not exist in the older pipes. The Hazen-Williams coefficient ranges from 90 to 110 for cast iron main from the 1950s and 1960s to 120 to 140 for newer ductile iron and PVC pipe.

4.2.2 Existing System - Steady State

Using the calibrated model, simulations were performed for various demand conditions. Resulting pressures were reviewed to determine the adequacy of the system under high demand. Pressures during non-emergency conditions should not fall below 35 psi, nor should pressures in the system exceed approximately 90 psi.

The available fire flow is generally the standard by which a system is measured since that is typically the highest demand experienced. The available fire flow represents the flow

available at a given location without creating a low pressure problem anywhere in the system. The minimum system pressure which should be maintained at all times is 20 psi. While recommended fire flows vary based on many factors, the generally suggested fire flows are 1,000 to 1,500 gpm for residential customers, 2,500 gpm for commercial customers and up to 3,500 gpm for industrial customers. At present, the Portage system can provide more than 3,500 gpm for 3 hours for commercial and industrial customers.

Table 11 provides results of simulations for existing conditions. This table shows the results for average day and maximum day pressures and the available fire flow at selected locations. The locations shown represent a cross-section of areas across the water system as well as critical areas and noted areas of concern.

Results indicate that pressures are generally adequate throughout the system. The model results show that the system transmission capacity is adequate. Pressures are greater than the desired 35 psi in all locations for average and maximum day demand scenarios. Older 6-inch diameter mains restrict the flow to a small number of locations in the system.

The available fire flows meet the desired goal of 1,000 gpm in most locations throughout the system. However, in a few areas where 6-inch and smaller main is prevalent and at the end of dead end mains, the desired goal of available residential fire flow is limited to 800 gpm.

Appendix C provides maps that, for each of the 2024 Existing System, 2044 Existing System, and 2044 with Improvements, show pressure contours in the system under peak hour demands as well as fire flow contours under maximum day demands.

4.2.3 Existing System – Age - Extended Period Simulation

An extended period simulation (EPS) using the existing system was performed to analyze the water age over time. Utilizing a typical diurnal curve for water use over the course of a day as well as the average day demands of the system, the water age was simulated using the hydraulic model. Given that the wells are distributed throughout the system, the water is of reasonable age, as demonstrated in Figure 6. The age in the southern area of the system is slightly older than in the rest of the system, which is in agreement with the measured chlorine residuals near the two tanks in Figure 7. The figure illustrates that age near the tank is slightly older than desired, as it is recommended that chlorine residuals be maintained above 0.2

mg/L. An investigation into the impact of well cycling or other measures to improve water age is not in the scope of this project but would be informative.

4.2.4 Future Conditions

Using the model, simulations were performed for both Year 2029 and Year 2044 conditions to determine where improvements to the existing infrastructure may be needed. All water main Hazen-Williams coefficients were reduced by 5 for Year 2029 and an additional 5 for Year 2044 to simulate aging. Resulting pressures and available fire flows were reviewed to determine the adequacy of the existing system under future demands.

Table 12 provides a summary of model results with Year 2029 demands and the existing infrastructure, and Table 13 provides a summary of model results with Year 2044 demands and the existing infrastructure. The results indicate that pressures would still be adequate, but the available fire flows would be lower than existing fire flow capabilities because of additional tuberculation on pipes and additional demands on the system from the projected growth over the twenty-year period.

4.2.5 Distribution System Improvements

Based on the results of the existing system analysis with future demand projections as well as the extended period simulations, distribution system improvement alternatives were considered. Several alternatives were considered and then selected and prioritized based on the most cost-effective alternatives to improve fire protection, maintain tank levels during hours of peak use, and enhance overall service.

Given that over 80% of the system is 8-inch main or larger, there are few locations in the system where 4-inch mains and 6-inch mains restrict fire flow to less than 1,000 gpm. In most areas where 6-inch main is prevalent, adequate fire flow is provided due to looping. In some of areas where looping is not feasible or water demand is not high, it is not always desirable to upsize the existing water mains due to the associated increase in stagnation that could degrade water quality.

The following is a summary of deficiencies that were identified and evaluated:

4.2.5.1 Abbot Avenue Dead End

One area with low fire flow is the dead end of Abbott Avenue where fire flow is 720 gpm. Upsizing the water main from Rosewood Avenue and Sherwood Drive to the intersection of Abbott Avenue and Robin Hood Drive would increase the fire flow to 1,000 gpm. Alternatively, this area could be looped with a connection made to Oakland Drive which would increase the fire flow above 3,000 gpm.

4.2.5.2 Point O Woods Drive Dead End

The other area of low fire flow is the dead end of Point O Woods Drive with fire flow of 810 gpm. Upsizing the water main from Westnedge and Point O Woods Drive to the intersection of Point of Woods Drive and Pinewood Circle would increase available fire flow to 1,130 gpm.

Model simulations were performed with potential improvements included. Results for Year 2029 demands with short-term recommended improvements are included in Table 14. Simulation results with all the recommended improvements for Year 2044 demands are summarized in Table 15. The General Plan in Figure 8 shows recommended improvements through 2044.

Results show that the available fire flows throughout the system with the improvements meet the general goals for fire protection.

5 RELIABILITY ISSUES

In order to maintain a reliable water supply, multiple factors must be taken into consideration. In addition to obtaining and producing high quality water, the system of water mains must be monitored along with the associated valves, hydrants, pumps, interconnects, meters, storage tanks, and standby power sources. Built into this system must be adequate redundancy in order to supply water continuously in the case of planned maintenance, water main breaks, or other mechanical failures.

5.1 Redundancy

Redundancy in the water distribution system ensures Portage can maintain a desired level of service even in the event of an emergency, water main break, or planned system maintenance.

Key aspects of system redundancy include a looped water transmission system and backups for critical distribution system components such as pump stations and storage.

5.1.1 Water Supply

Adequate redundancy exists within the well and water treatment plant systems. With nineteen wells distributed throughout Portage in multiple well fields, there is sufficient pumpage available to supply maximum day demands.

5.1.2 Water Transmission

It is important that the transmission system has redundancy via looping from the wells and water treatment plant to the storage tank and throughout the system in case of an emergency such as a water main break.

The system includes over thirty miles of transmission main, sixteen inches or larger, or 11-percent of the system. With the additional sixty miles of twelve inch, or 21-percent of the system functioning as transmission in the perimeter of the system, the looping is adequate, as shown in Figure 9. The three areas that appear to have gaps in transmission (along Centre Avenue east of Westnedge Avenue and along Romence, both east and west of Oakland) are sections of 10-inch main which could be upsized to match the size of surrounding main when they are replaced due to age.

5.1.3 Storage

The Portage distribution system currently has 2,250,000 gallons of storage in two elevated storage tanks. Therefore, adequate redundancy exists to provide storage during an emergency or maintenance work.

5.2 System Capacity

Based on the 2024 projected max day demands, Portage's demands are approximately 51-percent of the current supply capacity of 21.2 MGD. The 2044 projected max day demands are 52-percent of the supply capacity, therefore the current supply is adequate. Alternatives to provide additional supply should be investigated if the demands reach 80% of the supply capacity.

5.3 Water Quality

Operators perform bacteriological, chemical, lead and copper, and radiological monitoring of the finished water and there have been no maximum contaminant level (MCL) exceedances.

Portage provides customers with high-quality drinking water which meets or exceeds all regulations established in the State Safe Drinking Water Standards. Operators test at multiple locations for volatile and total organic carbons as well as contaminants in the drinking water according to Federal and State laws. The 2023 Water Quality report from Portage is included in Appendix D.

5.3.1 Iron and Hardness

Portage obtains water from 19 wells located throughout the system. The groundwater source has elevated iron content and hardness, in general.

Iron is a parameter tested for aesthetic purposes. The EPA aesthetic limit is 0.3 mg/L, and all wells do exceed this limit. This can impact the color and taste. As shown in the 2023 Partial Chemistry Table in Appendix D, one well has had recent samples measuring 1.0 mg/l and M-1 has the highest level at 1.4 mg/l. These could impact the aesthetic quality of the water significantly.

Portage should consider providing a second iron removal treatment plant at the M wells due to this high iron content. The investigation should look at the impact of adding treated water from the M wells and whether more variance in the quality of the water supplied could have adverse impacts. Portage does have an existing iron removal plant and already mixes different quality water with success. A new iron removal plant could allow for the use of the M wells more frequently and significantly improve the water quality.

Hardness is also an aesthetic property. The 2023 chemistry shows elevated levels at the wells. That said, many community systems supply water of the hardness found at the wells without providing treatment. Individual residences can choose to add softeners if they want (though this may cause high sodium/chloride in wastewater).

5.3.2 Lead Service Line Inventory

Portage does not have any lead service lines and is in compliance with the requirements of the Lead and Copper Rule. Copper and Lead levels are provided in Appendix D.

5.3.3 Per- and Polyfluoroalkyl Substances (PFAS)

Per- and Polyfluoroalkyl Substances (PFAS) have been a recent focus in drinking water as well as other environmental sectors as a group of man-made chemicals that are not easily destroyed in the environment and are not easily removed in treatment. Many of the chemicals in the PFAS group have been identified as having increased health risks at relatively low levels in drinking water.

Effective August 2020, Michigan established regulatory MCLs for six PFAS chemicals through amendment to the Michigan Safe Drinking Water Act. Community water supplies are now required to sample finished water for PFAS, and many water supplies also participate in sampling of untreated/raw water for study purposes.

In March 2023, the Environmental Protection Agency (EPA) released the proposed federal regulatory standards for a total of six PFAS compounds. The state and federal proposed standards are summarized below.

PFAS Regulatory Summary

Compound	EPA HAL	Proposed EPA MCLG	Proposed EPA MCL	Michigan MCL
PFOA	0.004 ng/L	Zero	4 ng/L	8 ng/L
PFOS	0.02 ng/L	Zero	4 ng/L	16 ng/L
PFNA	-			6 ng/L
PFHxS	-	1.0 (unitless) Hazard Index*	1.0 (unitless) Hazard Index*	51 ng/L
PFBS	2,000 ng/L			420 ng/L
HFPO-DA (GenX)	10 ng/L			370 ng/L

*H.I. = (GenX / 10) + (PFBS / 2000) + (PFNA / 10) + (PFHxS / 9)

Acronyms: HAL: Health Action Level, MCLG: Maximum Contaminant Level Goal, MCL: Maximum Contaminant Level

Review of Portage's water supply results confirm low levels of select compounds. All detections are below the existing state and proposed federal limits. Portage remains in full compliance with the regulatory limits established in Michigan for PFAS, based on sampling conducted to date. Continued monitoring for PFAS in finished water and study of raw water detections and trends is recommended as we continue to gain understanding of the prevalence and health effects of these chemicals.

5.3.4 Chlorine Residuals

Portage operators obtain Chlorine residual results throughout the system as required. The minimum level of free chlorine is 0.2 mg/L. At the two elevated storage tanks, the level is below that minimum and Portage continues to monitor the water to ensure adequate disinfection is provided to kill bacteria and viruses.

5.3.5 Other parameters

Some additional information on the results of the 2023 well water quality data:

- The recent water quality results show a nitrate presence which could indicate some impact from surface waters.
- Chloride of 80 mg/l and above at some wells is below the aesthetic limit (250 mg/l), but higher than typical.

5.4 Standby Power

The nineteen wells can be powered by eight emergency generators. There are also generators at the two tanks. The generators are of various types and run on either diesel or natural gas. A summary of the existing generators is provided in Table 16.

5.5 Water Loss and Accountability

Unaccounted-for water can be a significant source of lost revenue. Sources of unbilled water that can be accounted for include water used during firefighting, hydrant flushing, main breaks, public usage, and street sweeping, as well as others. The remaining unbilled water that is unaccounted for is described as “lost water”.

Water billing data has been gathered for fiscal years 2015 through 2023 and is presented in the table below and graphically in Figure 10. From 2015 through 2023, the unbilled water ranged from approximately 5 to 24 percent of the total pumped volume with a 9-year average of 16.6 percent and a 5-year average of 12.8 percent. This amount does not consider the known uses of unbilled water described previously. The total unbilled amount is reasonable, but Portage should track unbilled known water use to confirm this. With this additional information, Portage can determine the true water loss.

Water Accountability

Fiscal Year	Total Pumped Volume (MG)	Billed Volume (MG)	Unbilled Volume (MG)	Percent Unbilled
2014/15	1,711	1,399	312	18.2%
2015/16	1,730	1,312	418	24.2%
2016/17	1,710	1,263	447	26.1%
2017/18	1,714	1,361	353	20.6%
2018/19	1,554	1,384	169	10.9%
2019/20	1,596	1,364	232	14.5%
2020/21	1,780	1,480	300	16.9%
2021/22	1,648	1,558	90	5.5%
2022/23	1,713	1,440	274	16.0%
5-year average	1,658	1,445	213	12.8%

Note: All values are in 1,000,000 gallons.
Source: Data provided by Portage.

5.6 Deteriorating Mains

Pipe suppliers indicate that water main is expected to last more than 100 years. However, depending on the material, design parameters, soils, proper construction, water chemistry, and associated breaks that occur etc., a pipe may need to be replaced sooner. Thus, the condition of water main should be observed and tracked. When necessary, water main should be replaced for improved system reliability.

Approximately 20-percent of the water system was constructed prior to the 1970s so the majority of the system is less than 50 years old. Figure 5 includes locations of recent breaks on the water main material map. Operators should continue to document signs of main deterioration and, when possible, deteriorating and older water mains should be replaced in conjunction with other utility projects.

5.7 General Maintenance

The water system and its assets are maintained by Portage. General maintenance of equipment and facilities enhances overall system reliability.

5.7.1 Level of Service quantification

Portage has a formalized Level of Service quantification which includes quality, quantity, reliability, and environmental expectations of the water distribution system equipment, systems, and organization.

5.7.2 Pumps and Wells

Portage has expectations for both pump performance and maintenance. The firm capacity is available at all times, the wells are inspected multiple times per week and more than 7,000 water samples are analyzed annually. All production wells are flow tested annually and preventative maintenance is performed annually on a minimum of two production wells.

5.7.3 Flushing Program

Hydrant flushing is an important maintenance activity to remove sediment and improve water quality. Portage currently flushes and inspects all hydrants twice a year. Hydrant flushing, inspection, and painting are important to ensure all hydrants are operable and in good condition. Portage should also provide good record keeping of maintenance activities performed at each hydrant. Water use during flushing should also be estimated and tracked for the water accountability plan. A minimum of 500 hydrants are painted annually.

5.7.4 Valve Exercising Program

Portage keeps records of valve activities including turning, repairs, etc. Valve exercising better ensures that valves can be operated when needed, especially in an emergency. Portage exercises a minimum of 250 valves annually which is approximately 17 percent of the total valves.

5.7.5 Meter Testing Program

No formal testing/change-out program exists at present, however, meters are replaced as needed. Meter testing/change-out can be to maintain accurate customer billing. Thus, meters should continue to be replaced on a regular basis.

5.7.6 Cross Connection Program

Portage complies with cross-connection control requirements. A cross-connection control program includes distribution of educational materials regarding typical cross-connection

devices such as hose bib vacuum breakers, and air gaps on water softener drain lines. The program also includes testing of devices every 5 years by a certified tester and follow-up to ensure they are being maintained.

5.7.7 Water Shortage Response Plan

A Water Shortage Response Plan is valuable for system reliability as it includes current contact information, critical customers, and water hauler contact information.

6 RECOMMENDATIONS FOR IMPROVEMENTS

Recommendations have been prepared with priority based on ensuring that regulations continue to be met, the high level of service continues to be maintained, and the supply continues to be reliable.

The recommendations have been separated into projects and general improvements based on the above criteria and demand projections. Recommendations developed herein are intended to improve the overall supply and increase available fire flows to customers. These projects should be completed in conjunction with road projects, when possible.

6.1 Recommended Projects

In progress or design

Project 1: Replace 4,800 feet of 6-inch and 8-inch water main with 12-inch main along Lakeview Drive from S Shore Drive to Portage Road.

Project 2: Install 800 feet of 8-inch water main along Portage Road from Helen Avenue to Byrd Drive.

Project 3: Install 3,400 feet of 8-inch water main along Gray Street, Mahoney Street, Lum Street, and Hayes Street from Sprinkle Road to Waruf Avenue.

Recommended

Project 4: Replace 920 feet of 6-inch main along Point O Woods Drive with 8-inch main from Westnedge Avenue to Pinewood Circle.

Project 5: Replace 600 feet of 6-inch main on Sherwood and Abbott with 8-inch main from Rosewood Avenue to Robin Hood Drive.

6.2 General Recommendations

6.2.1 Water Accountability Plan

Over the last five years, the unbilled water in Portage averaged 12.8 percent, with a maximum of 16.9 percent in fiscal year 2021. The unbilled water volume has improved in the past nine years, down from a nine-year average of 16.6 percent with a fiscal year percent of 26.1 in 2017.

We recommend that Portage track unbilled water that can be accounted for such as water that is used for hydrant flushing, firefighting, main breaks, etc. By combining the billed water data with unbilled but accounted for water, Portage is more accurately determining the true ‘lost’ water (unaccounted-for water). Aging meters can impact the documented lost water, and leaks in the system are true lost water and potential lost revenue.

6.2.2 Consider Adding Second Iron Removal Treatment Plant

Portage should consider constructing a second iron removal treatment plant at the Shuman wells due to this high iron content. Portage has an existing iron removal plant and already mixes different quality water with success. A new iron removal plant could also allow for the use of the Shuman wells more frequently and significantly improve the water quality.

6.2.3 Dead End Mains

Water tends to become stagnant in dead end mains, often affecting the quality of water provided to nearby customers. Thus, whenever feasible, dead end mains should be removed by closing loops, thereby improving the circulation of water and adding reliability.

Additionally, removing dead ends will also improve fire protection by providing a second supply route for distribution to the area. Although there are some small dead end mains where looping is not feasible, Portage should continue to eliminate dead ends whenever possible as well as require looped mains in new developments.

6.2.4 Replace Older Mains

As Portage operators observe water mains to be deteriorating, such as experiencing significant main breaks or tuberculation, we suggest continuing to consider main replacement in conjunction with other street and utility projects.

6.2.5 Tank and Well Inspection Programs

EGLE recommends that storage tanks be inspected approximately every five years for preventative maintenance. The structural integrity, tank coatings, and tank components are typically inspected. Portage contracts Veolia Water Technologies to execute the tank and well maintenance programs.

6.2.6 General Maintenance Programs

Portage should continue to implement or update the following general maintenance programs.

- **Hydrants** – continue annual flushing, inspection, painting, record keeping of maintenance activities.
- **Valve Exercising** – continue annual exercising and record keeping.
- **Meter Testing** – implement and formalize meter testing/change-out.
- **Cross Connection Program** – continue meeting regulatory requirements.
- **Water Shortage Response Plan** – update as necessary.

6.2.7 Reliability Study

Portage should continue to update the Water System Reliability Study every five years, as required.

7 COST OPINIONS

An Opinion of Project Costs has been prepared for each element of the project. Costs for projects of similar size and scope that have been constructed in southern Michigan were reviewed for relevant information.

The Cost Opinions have been prepared including an allowance of approximately 35% above the estimated construction cost. This allowance is intended to include the cost of construction contingencies (issues which are presently unknown), legal fees, engineering design and construction services, and administrative expenses related to the project.

No provision has been made in the estimates for cost of land or right-of-way purchase or easements. Cost Opinions for recommended projects are included in Table 17.

Tables

Table 1	Historical and Projected Population
Table 2	Historical Water Use Data
Table 3	Existing and Projected Water Demands
Table 4	Well Data
Table 5	Treatment Plant Element Capacities
Table 6	Storage Tank Data
Table 7	System Wide Storage Analysis
Table 8	Hydrant Test – Static Locations and Results
Table 9	Hydrant Test – Flow Locations and Results
Table 10	Comparison of Calibrated Model to Field Test Pressures
Table 11	Model Results for Existing Conditions
Table 12	Model Results for Year 2029 Demands with Existing Infrastructure
Table 13	Model Results for Year 2044 Demands with Existing Infrastructure
Table 14	Model Results for Year 2029 Demands and Short-Term Recommended Improvements
Table 15	Model Results for Year 2044 Demands and Long-Term Recommended Improvements
Table 16	Standby Power
Table 17	Cost Opinions for Recommended Projects

City of Portage
Water System Reliability Study

Table 1 - Historical and Projected Population

Year	Portage	Kalamazoo County
Historical Population¹		
1840		7,380
1850		13,179
1860		24,646
1870		32,054
1880		34,342
1890	941	39,273
1900	895	44,310
1910	846	60,327
1920	1,123	71,225
1930	2,021	91,368
1940	4,250	100,085
1950	7,946	126,707
1960	20,181 ²	169,712
1970	33,590	201,550
1980	38,157	212,378
1990	41,042	223,411
2000	44,897	238,603
2010	46,292	250,331
2020	48,891	261,670
Projected Population³		
2025	49,422	278,172
2030	50,003	290,091
2035	50,443	300,589
2040	50,742	309,540
2045	50,900	316,423

- Notes:
1. Historical Population from U.S. Census Bureau Data.
 2. Portage was incorporated in 1963 (was a Township).
 3. Kalamazoo county projections based on 2019 population projections by the County through 2045.

City of Portage
Water System Reliability Study

Table 2 - Historical Water Use Data

Year	Average Day Pumpage (mgd)	Maximum Day Pumpage (mgd)	Max/Avg Ratio
2009	5.510	12.630	2.29
2010	4.900	12.460	2.54
2011	4.970	12.530	2.52
2012	5.740	17.030	2.97
2013	5.020	12.670	2.52
2014	4.950	12.650	2.56
2015	4.570	9.160	2.00
2016	4.730	9.680	2.05
2017	4.890	11.520	2.36
2018	4.700	10.120	2.15
2019	4.266	9.290	2.18
2020	4.536	10.300	2.27
2021	4.644	10.335	2.23
2022	4.489	9.893	2.20
2023	4.679	10.966	2.34
10-yr Average	4.65	10.391	2.23
5-yr Average	4.52	10.157	2.24
5-yr Max	4.68	10.966	2.34
5-yr Min	4.27	9.29	2.18

City of Portage
Water System Reliability Study

Table 3 - Existing and Projected Water Demands

Year	Average Day Demand, mgal	Maximum Day Demand, mgal	Peak Hour Demand, mgal	Max Day Multiplier (Max Day / Average Day)	Peak Hour Multiplier (Peak Hour / Max Day)
2024	4.91	10.97	21.9	2.23	4.5
2029	4.92	10.99	22.0	2.23	4.5
2034	4.93	11.01	22.0	2.23	4.5
2039	4.93	11.02	22.0	2.23	4.5
2044	4.94	11.04	22.1	2.23	4.5

Notes: Demand projections based on 0.032% population growth projections for Portage. The 0.032% growth factor was applied to the current maximum day demands to project future growth.

City of Portage
Water System Reliability Study

Table 4 – Well Data

Well Name	Rated Capacity (mgd)	Diameter (inches)	Depth (ft)	Total Dynamic Head (ft)	Motor (hp)	Last Overhaul (year)	Last Inspection (year)
B-1	1.44	12	142	248	75	2017	2022
B-2	0.65	12	92	220	40	2013	2022
I-1	1.15	12	118	185	75	2009	2023
I-2	1.73	16	177	355	150	2021	2022
I-3	1.44		143	285	100	2019	2022
I-4	1.73	16	175	295	125	2021	2022
I-5	0.92	16	161	295	75	2015	2022
A-1	1.15	12	179	282	100	2016	2022
A-2	1.3	12	148	352	100	2018	2022
A-3	1.3	12	145	208	75	2009	2022
P-1	0.86	12	174.5	255	50	2017	2022
	0.86	12	169	255	50	2022	2022
PC-1	1.58	16	141.5	242	100	2007	2022
H-1	1.3	12	96	208	60	2014	2022
M-1	1.44	16	99	214	75	2014	2023
	5.76						2022
G-1	0.58	12	113	240	40	2018	2022
F-1	0.94	12	183	270	50	2020	2022
F-2	0.79	12	146	260	50	2020	2022
D-1			abandoned				2022
Total Supply Capacity	26.91						
Firm Supply Capacity	21.15						

City of Portage
Water System Reliability Study

**Table 5 – Water Treatment Plant - Arsenic/Iron Removal Plant Elements – M
wells**

Filter Type	Horizontal Pressure Filters
Number of Filters	4
Filter Diameter (ft)	7.0
Filter Length (ft)	13.4
Each Filtration Area (sf)	100
Total Filtration Area (sf)	400
Normal Filtration Rate (gpm/sf)	10
Total Capacity (gpm)	4,000
Filtration Area with one cell out of service (sf)	300
Firm Capacity (gpm)	3,000

City of Portage
Water System Reliability Study

Table 6 - Storage Tank Data

<i>Location</i>	<i>Haverhill Tank</i>	<i>Pineview Tank</i>
Volume (MG)	0.75	1.5
Type	Multi-Column Elevated	Elevated Single Pedestal
Material	Steel	Composite
Overflow Elev. (ft)	1,035	1,035
Date Constructed	1962	1991
Total Head Range (feet)	30	40
Last Warranty Inspection	2024	2021
Last Maintenance Inspection	2018	2010
Last Painted	2023	2020

City of Portage
Water System Reliability Study

Table 7 – System Wide Storage Analysis

Year	Firm Pump Capacity (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)	Fire-Flow Required (gpm)	Duration (hours)	Water Supplied (gallons)	Customer Demand (gallons)	Needed Fire Storage (gallons)	Needed Storage Vol. (gallons)	Storage Volume Provided (gallons)	Recommended Storage Volume (gallons)
2024	14,694	7,618	15,235	1,000	2	1,763,333	1,371,000	120,000	0	2,250,000	0
2024	14,694	7,618	15,235	2,250	2	1,763,333	1,371,000	270,000	0	2,250,000	0
2024	14,694	7,618	15,235	3,000	3	2,645,000	1,828,000	540,000	0	2,250,000	0
2024	14,694	7,618	15,235	3,500	3	2,645,000	1,828,000	630,000	0	2,250,000	0
2029	14,694	7,630	15,260	1,000	2	1,763,333	1,373,000	120,000	0	2,250,000	0
2029	14,694	7,630	15,260	2,250	2	1,763,333	1,373,000	270,000	0	2,250,000	0
2029	14,694	7,630	15,260	3,000	3	2,645,000	1,831,000	540,000	0	2,250,000	0
2029	14,694	7,630	15,260	3,500	3	2,645,000	1,831,000	630,000	0	2,250,000	0
2044	14,694	7,667	15,334	1,000	2	1,763,333	1,380,000	120,000	0	2,250,000	0
2044	14,694	7,667	15,334	2,250	2	1,763,333	1,380,000	270,000	0	2,250,000	0
2044	14,694	7,667	15,334	3,000	3	2,645,000	1,840,000	540,000	0	2,250,000	0
2044	14,694	7,667	15,334	3,500	3	2,645,000	1,840,000	630,000	0	2,250,000	0

- Notes:
1. Storage Methodology based on maximum day demand with 1 hour of peak hour demand for the duration, and fire flow for the entire duration.
 2. Fire demand and duration based on Table 1-1 of AWWA M-31 Manual.
 3. Firm Supply Capacity based on the firm capacity of 18 of the 19 wells in service.
 4. Recommended Storage Volume calculation is zero due to adequate supply from multiple wells. Current storage provided is adequate for 11 hours of ADD.
 5. Customer Demand Volume based on 1 hour of peak demand and maximum day demands for the remaining duration.
 6. Emergency Storage based on Fire Flow Demand over the duration.
 7. Example Calculation (Year 2044; 3,500 gpm for 3 hours):
 Water Supplied = 14,694 gpm x (60 min x 3 hours) = 2,645,000 gallons
 Customer Demand = Max Day Demand x 2 hrs x 60 min + Peak Hour Demand x 1 hr x 60 min = 7,618 gpm x 2 hrs x 60 min + 15,334 gpm x 1 hr x 60 min = 1,840,000 gal.
 Needed Fire Storage = Fire-Flow Required x Duration = 3,500 gpm x 3 hrs x 60 min = 630,000 gallons
 Needed Storage Volume = Customer Demand + Needed Fire Storage – Water Supplied = 1,840,000 gal. + 630,000 gal. – 2,645,000 gal. = -175,000 gal.
 Recommended Storage Volume = Needed Storage Volume – Storage Volume Provided = -175,000-2,250,000=0

City of Portage
Water System Reliability Study

Table 8 - Hydrant Test - Static Locations and Results

Hyd. Test #	Static Hydrant #1 Location	Static Pressure (psi)	Residual Pressure (psi)	Static Hydrant #2 Location	Static Pressure (psi)	Residual Pressure (psi)	Pinevie w Tank Level (ft)	Haverhil I Tank Level (ft)
1	Timbercreek dead end	66	44	Whispering Brook	62	49	27.45	29.11
2	Curtis & Pickering	56	42	Quincy W of Curtis	62	50	26.72	28.81
3	NE corner of Ascen. Borgess campus	62	42	Angling W of Ascen. Borgess campus	56	43	24.7	27.61
4	Coulter & Buckhorn	52	43	Manhattan & Coulter	56	45	23.79	26.09
5	Westfield between Alten & Claremount	45	32	Cedarcrest & Claremount	50	40	23.15	27.64
6	Fleetwood & Angling*	58	40	Greenhill & Fleetwood	52	42	24.72	27.72
7	Deerfield between Kirkwood & Quaker	58	48	Milham & Roanoke	55	49	26.19	27.65
8	Outer between Connecticut & New Hampshire	68	56	Idaho & Outer	69	60	26.92	28.88
9	Gertrude & Kromdyk	74	58	Ramona & Gertrude	73	68	29.48	28.82
10	Eckener & Bennett	71	34	Helen & Portage	74	53	30.34	29.92
11	Chatham dead end	78	44	Meredith & Lexington	80	71	30.51	30.77
12	Capri between Bermuda & Pebble	72	52	Tiffany & Capri	73	66	31.63	30.8
13	Sailor dead end	70	56	Bayside & Spinnaker	73	64	32.41	32.27
14	Panama dead end	76	40	Canal & Balboa	76	56	33.57	32.35
15	Brahms between Mozart & Shuman	70	58	Liszt & Beethoven	69	60	34.4	32.52
16	Oakview dead end	72	36	Cherryview & Orangeview	74	66	35.2	33.43
17	Newhouse, N of Crocket	70	58	Newhouse & Melody	72	66	35.69	33.2
18	Forest dead end	73	43	Barberry & Tumbleweed	74	68	36.66	34.2

Notes: 1. Hydrant Flow tests performed on April 3, 2024 between 8:00 a.m. and 3:00 p.m. by P&N and Portage personnel.
2. Wellfield G & Wellfield I #3 operating all day, Wellfield A #2&3, Wellfield F #2 & 3, Wellfield P 1&2 on from 10:14 to 14:53.

City of Portage
Water System Reliability Study

Table 9 - Hydrant Tests - Flow Locations and Results

Hydrant Test #	Flow Hydrant #1 Location	Pitot Reading (psi)	Flow (gpm)	Flow Hydrant #2 Location	Pitot Reading (psi)	Flow (gpm)
1	Timber Creek 1st hyd N of dead end	22	787	Whispering Brook	30	919
2	Chippewa, 1st hyd S of Curtis	35	993	Curtis & Walcot	24	822
3	1st hyd W of static #1	34	979	SE corner of Ascension Borgess campus	42	1,088
4	Buckhorn & Fescue	32	950	Marlow St between Clouter and Greenview	16	671
5	Alten St between Beechmount & Westfield	27	872	Westfield 1st hyd W of Claremount St	26	856
6	Hillan Brook & Angling	31	935	Hill and Brook & Merryview	28	888
7	Roanoke & Kirkwood	29	904	Roanoke between Kirkwood & Quaker	32	950
8	Connecticut & New Hampshire	34	979	New Hampshire E of Outer	45	1,126
9	1st hyd N of static #1	39	1,048	Gertrude & Lansing	41	1,075
10	1st hyd W of static #1	35	993	1st hyd E of Static #1	26	856
11	Hanover between Meredith & Chatham	25	839	Bedford & Hanover	36	1,007
12	Capri S of Bermuda	49	1,175	Capri N of Pebble	21	769
13	Bayside between Spinnaker & Sailor	24	822	Sailor & Bayside	45	1,126
14	Panama & Canal	36	1,007	Canal E of Panama	34	979
15	Shuman & Brahms	47	1,151	Bach & Mozart	30	919
16	Roseview dead end	26	856	Oakview Dr 1st hyd S of Cherryview	34	979
17	Crocket & Newhouse	45	1,126	1st hyd N of Static #1	38	1,035
18	Barberry dead end	39	1,048	Forest 1st hyd E of Static #1	33	964

Notes: 1. Hydrant Flow tests performed on April 3, 2024 between 8:00 a.m. and 3:00 p.m. by P&N and Portage personnel.
2. Wellfield G & Wellfield I #3 operating all day, Wellfield A #2&3, Wellfield F #2 & 3, Wellfield P 1&2 on from 10:14 to 14:53.

City of Portage
Water System Reliability Study

Table 10 - Comparison of Calibrated Model to Field Test Pressures at Static Hydrant #1

Hydrant Test No.	Static Hydrant Location	Total Hydrant Test Flow (gpm)	Field Tests			Model Results			Available Fire Flow Percent Difference
			Static Pressure, psi	Residual Pressure, psi	Calculated Available Fire Flow at 20 psi (gpm)	Static Pressure, psi	Residual Pressure, psi	Available Fire Flow at 20 psi (gpm)	
1	Timbercreek dead end	1,707	66	44	2,542	65.9	44.3	2,564	1%
2	Curtis & Pickering	1,815	56	42	3,023	55.6	42.5	3,115	3%
3	NE corner of Ascen. Borgess campus	2,067	62	42	3,085	62.4	45.6	3,407	10%
4	Coulter & Buckhorn	1,621	52	43	3,215	52.7	42.3	3,009	-6%
5	Westfield between Alten & Claremount	1,728	45	32	2,460	48.3	35.1	2,609	6%
6	Fleetwood & Angling*	1,823	48	40	3,585	48.4	41.5	3,913	9%
7	Deerfield between Kirkwood & Quaker	1,853	58	48	3,811	58.6	49.8	4,118	8%
8	Outer between Connecticut & New Hampshire	2,105	68	56	4,449	69.4	57.6	4,560	2%
9	Gertrude & Kromdyk	2,123	74	58	4,095	73.6	59.5	4,366	7%
10	Eckener & Bennett	1,760	71	34	2,093	71.2	28.1	1,931	-8%
11	Chatham dead end	1,846	78	44	2,464	78.2	37.6	2,243	-9%
12	Capri between Bermuda & Pebble	1,944	72	52	3,257	72.6	51.4	3,176	-2%
13	Sailor dead end	1,948	70	56	3,874	69.5	57.7	4,226	9%
14	Panama dead end	1,986	76	40	2,521	74.9	32.8	2,292	-9%
15	Brahms between Mozart & Shuman	2,070	70	58	4,474	70.0	57.8	4,434	-1%
16	Oakview dead end	1,835	72	36	2,238	72.0	28.0	2,008	-10%
17	Newhouse, N of Crocket	2,161	70	58	4,670	70.4	58.9	4,799	3%
18	Forest dead end	2,012	73	43	2,736	70.5	38.4	2,570	-6%

- Notes:
1. Hydrant Flow tests performed on April 4, 2024 between 8:00 a.m. and 3:00 p.m. by P&N and Portage Personnel.
 2. Wellfield G & Wellfield I #3 operating all day, Wellfield A #2&3, Wellfield F #2 & 3, Wellfield P 1&2 on from 10:14 to 14:53.
 3. Known closed valve during hydrant testing on Quincy Avenue just west of Oakland Drive, confirmed in calibration.
 4. Closed valve suspected during calibration, verified by Portage, north of Coulter on the connection between Manhattan Street and Marlow Street.

City of Portage
Water System Reliability Study

Table 11 - Model Results for Existing Conditions

Model Node Number	Description / Location	Description	Pressure, psi		Available Fire Flow (gpm)
			Average Day Demands	Maximum Day Demands	
WF-11-03-024	Stryker Corporation	Industrial	63	63	5,000+
WJ-14-03-008	Zoetis Animal Health	Industrial	72	72	5,000+
WF-24-04-046	Stryker Medical	Industrial	69	69	5,000+
J-7	Stryker Instruments	Industrial	74	74	5,000+
J-3535	Mann & Hummel + Automotive Inc	Industrial	72	72	5,000+
WF-12-01-057	Hospital Network Ventures	Medical	75	75	3,830
WJ-18-03-017	Ascension Borgess Hospital	Medical	66	67	3,230
WF-11-02-010	Norman/Portage LLC	Medical	67	67	5,000+
J-1345	Hudson's Country Manor	Retirement Community	64	64	5,000+
J-2880	Medilodge of Portage	Retirement Community	63	63	5,000+
WF-07-04-091	Bickford of Portage	Retirement Community	43	48	2,660
WF-07-01-050	StoryPoint Portage	Retirement Community	61	64	3,960
J-4203	Haverhill Elementary School	School	55	55	5,000+
J-3298	Amberly Elementary School	School	54	55	3,880
WJ-17-04-005	West Middle School	School	55	55	5,000+
WF-22-04-037	Portage Central High school	School	67	67	5,000+
WJ-17-01-045	St. Michael Lutheran School	School	63	64	5,000+
WJ-04-03-035	Portage Northern High School	School	60	61	5,000+
WJ-05-02-024	Abbott dead end	Residential	50	51	720
J-1340	Point O Woods	Residential	64	63	810
J-2754	Lakeview	Residential	69	69	1,610
WJ-02-04-029	Helen Dead end	Residential	72	71	1,110
WJ-24-02-010	Lum and Waruf	Residential	71	71	3,460
WF-06-02-056	Copperleaf and Ta Unton	Residential	59	61	4,740
WJ-07-02-047	Oleander dead end	Residential	57	58	3,030

- Notes:
1. Average Day Demand Pressures are based on elevated tank elevation at 5 feet below full and one high service pump operating.
 2. Maximum Day Demand Pressures and Available Fire Flows are based on maximum day demands, elevated tank elevation at 5 feet below full, and ten high service pumps operating.
 3. ISO typically suggests an available fire flow of 2,000 to 5,000 gpm for commercial and industrial areas and 1,000-1,500 gpm for Residential Areas. The recommended available fire flows represent that necessary for full credit toward insurance rating but is not required.
 4. Locations represent critical locations within the system and system extremities.

City of Portage
Water System Reliability Study

Table 12 - Model Results for Year 2029 Demands with Existing Infrastructure

Model Node Number	Location	Description	Pressure, psi		Available Fire Flow (gpm)
			Average Day Demands	Maximum Day Demands	
WF-11-03-024	Stryker Corporation	Industrial	63	63	5,000+
WJ-14-03-008	Zoetis Animal Health	Industrial	72	71	5,000+
J-7	Stryker Medical	Industrial	74	74	5,000+
J-3535	Stryker Instruments	Industrial	72	72	5,000+
WF-12-01-057	Mann & Hummel + Automotive Inc	Industrial	75	75	3,670
WJ-18-03-017	Hospital Network Ventures	Medical	66	67	3,090
WF-11-02-010	Ascension Borgess Hospital	Medical	67	67	5,000+
J-1345	Norman/Portage LLC	Medical	64	64	5,000+
J-2880	Hudson's Country Manor	Retirement	63	63	5,000+
WF-07-04-091	Medilodge of Portage	Retirement	43	49	2,560
WF-07-01-050	Bickford of Portage	Retirement	61	65	3,820
J-4203	StoryPoint Portage	Retirement	55	55	5,000+
J-3298	Haverhill Elementary School	School	54	55	3,700
WJ-17-04-005	Amberly Elementary School	School	55	55	5,000+
WF-22-04-037	West Middle School	School	67	67	4,800
WJ-17-01-045	Portage Central High school	School	63	64	5,000+
WJ-04-03-035	St. Michael Lutheran School	School	60	61	5,000+
WJ-05-02-024	Portage Northern High School	School	50	51	880
J-1340	Abbott dead end	Residential	64	63	780
J-2754	Point O Woods	Residential	69	69	1,530
WJ-02-04-029	Lakeview	Residential	72	71	1,060
WJ-24-02-010	Helen Dead end	Residential	71	71	3,320
WF-06-02-056	Lum and Waruf	Residential	59	61	4,560
WJ-07-02-047	Copperleaf and Ta Unton	Residential	57	58	2,910

- Notes:
1. Average Day Demand Pressures are based on elevated tank elevation at 5 feet below full and one high service pump operating.
 2. Maximum Day Demand Pressures and Available Fire Flows are based on maximum day demands, elevated tank elevation at 5 feet below full, and ten high service pumps operating.
 3. ISO typically suggests an available fire flow of 2,000 to 5,000 gpm for commercial and industrial areas and 1,000-1,500 gpm for Residential Areas. The recommended available fire flows represent that necessary for full credit toward insurance rating but is not required.
 4. Locations represent critical locations within the system and system extremities.

City of Portage
Water System Reliability Study

Table 13 - Model Results for Year 2044 Demands with Existing Infrastructure

Model Node Number	Location	Description	Pressure, psi		Available Fire Flow (gpm)
			Average Day Demands	Maximum Day Demands	
WF-11-03-024	Stryker Corporation	Industrial	63	63	5,000+
WJ-14-03-008	Zoetis Animal Health	Industrial	72	71	5,000+
WF-24-04-046	Stryker Medical	Industrial	69	69	4,730
J-7	Stryker Instruments	Industrial	74	74	5,000+
J-3535	Mann & Hummel + Automotive Inc	Industrial	72	72	5,000+
WF-12-01-057	Hospital Network Ventures	Medical	75	75	3,510
WJ-18-03-017	Ascension Borgess Hospital	Medical	66	67	2,950
WF-11-02-010	Norman/Portage LLC	Medical	67	67	5,000+
J-1345	Hudson's Country Manor	Retirement Community	64	64	5,000+
J-2880	Medilodge of Portage	Retirement Community	63	63	4,780
WF-07-04-091	Bickford of Portage	Retirement Community	44	49	2,460
WF-07-01-050	StoryPoint Portage	Retirement Community	61	65	3,670
J-4203	Haverhill Elementary School	School	55	55	4,820
J-3298	Amberly Elementary School	School	54	55	3,520
WJ-17-04-005	West Middle School	School	55	55	5,000+
WJ-04-03-035	Portage Central High school	School	60	61	5,000+
WJ-05-02-024	St. Michael Lutheran School	School	50	52	850
J-1340	Portage Northern High School	School	64	63	740
J-2754	Abbott dead end	Residential	69	69	1,450
WJ-02-04-029	Point O Woods	Residential	72	71	1,000
WJ-24-02-010	Lakeview	Residential	71	71	3,170
WF-06-02-056	Helen Dead end	Residential	59	62	4,380
WJ-07-02-047	Lum and Waruf	Residential	57	58	2,790

- Notes:
1. Average Day Demand Pressures are based on elevated tank elevation at 5 feet below full and one high service pump operating.
 2. Maximum Day Demand Pressures and Available Fire Flows are based on maximum day demands, elevated tank elevation at 5 feet below full, and ten high service pumps operating.
 3. ISO typically suggests an available fire flow of 2,000 to 5,000 gpm for commercial and industrial areas and 1,000-1,500 gpm for Residential Areas. The recommended available fire flows represent that necessary for full credit toward insurance rating but is not required.
 4. Locations represent critical locations within the system and system extremities.

City of Portage
Water System Reliability Study

Table 14 - Model Results for Year 2029 Demands with Recommended Improvements

Model Node Number	Location	Description	Pressure, psi		Available Fire Flow (gpm)
			Average Day Demands	Maximum Day Demands	
WF-11-03-024	Stryker Corporation	Industrial	63	63	5,000+
WJ-14-03-008	Zoetis Animal Health	Industrial	72	71	5,000+
WF-24-04-046	Stryker Medical	Industrial	69	69	4,940
J-7	Stryker Instruments	Industrial	74	74	5,000+
WF-12-01-057	Mann & Hummel + Automotive Inc	Industrial	75	75	3,670
WJ-18-03-017	Hospital Network Ventures	Medical	66	67	3,100
WF-11-02-010	Ascension Borgess Hospital	Medical	67	67	5,000+
J-1345	Norman/Portage LLC	Medical	64	64	5,000+
J-2880	Hudson's Country Manor	Retirement	63	63	5,000+
WF-07-04-091	Medilodge of Portage	Retirement	43	49	2,560
WF-07-01-050	Bickford of Portage	Retirement	61	65	3,820
J-4203	StoryPoint Portage	Retirement	55	55	5,000+
J-3298	Haverhill Elementary School	School	54	55	3,700
WJ-17-04-005	Amberly Elementary School	School	55	55	5,000+
WF-22-04-037	West Middle School	School	67	67	4,810
WJ-17-01-045	Portage Central High school	School	63	64	5,000+
WJ-04-03-035	St. Michael Lutheran School	School	60	61	5,000+
WJ-05-02-024	Portage Northern High School	School	50	51	1,010
J-1340	Abbott dead end	Residential	64	63	1,140
J-2754	Point O Woods	Residential	69	69	3,710
WJ-02-04-029	Lakeview	Residential	72	71	2,490
WJ-24-02-010	Helen Dead end	Residential	71	71	5,000+
WF-06-02-056	Lum and Waruf	Residential	59	61	4,560
WJ-07-02-047	Stryker Corporation	Residential	57	58	2,910

- Notes:
1. Average Day Demand Pressures are based on elevated tank elevation at 5 feet below full and one high service pump operating.
 2. Maximum Day Demand Pressures and Available Fire Flows are based on maximum day demands, elevated tank elevation at 5 feet below full, and ten high service pumps operating.
 3. ISO typically suggests an available fire flow of 2,000 to 5,000 gpm for commercial and industrial areas and 1,000-1,500 gpm for Residential Areas. The recommended available fire flows represent that necessary for full credit toward insurance rating but is not required.
 4. Locations represent critical locations within the system and system extremities.

City of Portage
Water System Reliability Study

Table 15 - Model Results for Year 2044 Demands with Recommended Improvements

Model Node Number	Location	Description	Pressure, psi		Available Fire Flow (gpm)
			Average Day Demands	Maximum Day Demands	
WF-11-03-024	Stryker Corporation	Industrial	63	63	5,000+
WJ-14-03-008	Zoetis Animal Health	Industrial	72	71	5,000+
WF-24-04-046	Stryker Medical	Industrial	69	69	4,730
J-7	Stryker Instruments	Industrial	74	74	5,000+
J-3535	Mann & Hummel + Automotive Inc	Industrial	72	72	5,000+
WF-12-01-057	Hospital Network Ventures	Medical	75	75	3,510
WJ-18-03-017	Ascension Borgess Hospital	Medical	66	67	2,950
WF-11-02-010	Norman/Portage LLC	Medical	67	67	5,000+
J-1345	Hudson's Country Manor	Retirement Community	64	64	5,000+
J-2880	Medilodge of Portage	Retirement Community	63	63	4,790
WF-07-04-091	Bickford of Portage	Retirement Community	44	49	2,460
WF-07-01-050	StoryPoint Portage	Retirement Community	61	65	3,670
J-4203	Haverhill Elementary School	School	55	55	4,820
J-3298	Amberly Elementary School	School	54	55	3,520
WJ-17-04-005	West Middle School	School	55	55	5,000+
WF-22-04-037	Portage Central High school	School	67	67	4,610
WJ-17-01-045	St. Michael Lutheran School	School	63	64	5,000+
WJ-04-03-035	Portage Northern High School	School	60	61	5,000+
WJ-05-02-024	Abbott dead end	Residential	50	52	1,120
J-1340	Point O Woods	Residential	64	63	1,170
J-2754	Lakeview	Residential	69	68	3,670
WJ-02-04-029	Helen Dead end	Residential	72	71	2,360
WJ-24-02-010	Lum and Waruf	Residential	71	71	5,000+
WF-06-02-056	Stryker Corporation	Residential	59	62	4,380
WJ-07-02-047	Zoetis Animal Health	Residential	57	58	2,790

- Notes:
1. Average Day Demand Pressures are based on elevated tank elevation at 5 feet below full and four high service pump operating.
 2. Maximum Day Demand Pressures and Available Fire Flows are based on maximum day demands, elevated tank elevation at 5 feet below full, and ten high service pumps operating.
 3. ISO typically suggests an available fire flow of 2,000 to 5,000 gpm for commercial and industrial areas and 1,000-1,500 gpm for Residential Areas. The recommended available fire flows represent that necessary for full credit toward insurance rating but is not required.
 4. Locations represent critical locations within the system and system extremities.

City of Portage
Water System Reliability Study

Table 16 - Standby Power

Location - Well	Generator Make	KW-KVA	Volts-Phase	Engine Make	Fuel Type	Run time (hours) ¹
A-wells	Onan-Cummings	300 kw - 375 kva	480 V - 3 Ph	Cummins	Diesel	52
M-wells	Onan-Cummings	200 kw - 250 kva	480 V - 3 Ph	Cummins	Diesel	78
I-2	Onan-Cummings	300 kw - 350 kva	480 V - 3 Ph	Cummins	Natural Gas	
I-3	Onan-Cummings	200 kw - 250 kva	480 V - 3 Ph	Cummins	Diesel	78
I-4	Generac	150 kw - 188 kva	480 V - 3 Ph	Generac	Diesel	
I-5	Onan-Cummings	250 kw - 312 kva	480 V - 3 Ph	Cummins	Diesel	65
PC-1	Onan-Cummings	300 kw - 337 kva	480 V - 3 Ph	Cummins	Diesel	48
F-wells	Generac	150 kw - 188kva	480 V - 3 Ph	Generac	Natural Gas	
Haverhill Tank	Generac	35 kw - 44 kva	120/240 V - 1 Ph	Generac	Natural Gas	
Pineview Tank	Generac	35 kw - 44 kva	120/240 V - 1 Ph	Generac	Natural Gas	

Note: 1. Run time is with a full load. Natural gas provided by Consumers Energy.

City of Portage
Water System Reliability Study

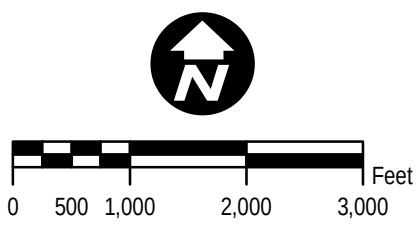
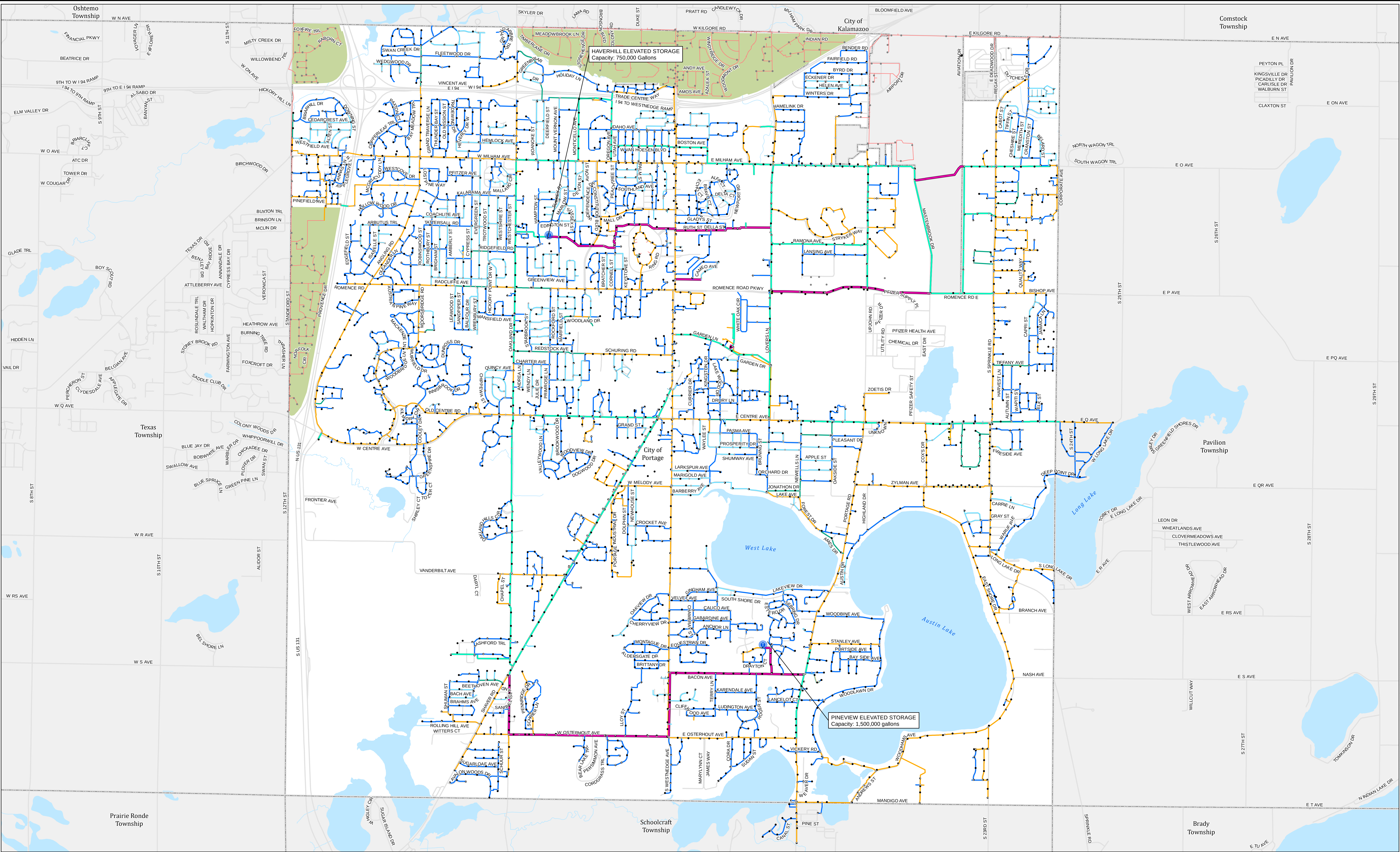
Table 17 – Cost Opinions for Recommended Projects

Improvement Project	Opinion of Probable Project Cost	Est. Year of CIP Implementation
1. Replace water main along Lakeview Drive from S Shore Drive to Portage Road.	In Design	In Design
2. Install water main along Portage Road from Helen Avenue to Byrd Drive.	In CIP	In CIP
3. Install 8" water main along Gray Street, Mahoney Street, Lum Street, and Hayes Street from Sprinkle Road to Waruf Avenue.	In Progress	In Progress
4. Replace 920' of 6" main on Point O Woods Drive with 8" main from Westnedge Avenue to Pinewood Circle.	\$210,000	2027
5. Replace 600' of 6" main on Sherwood and Abbott with 8" from Rosewood Avenue to Robin Hood Drive.	\$140,000	2028
Total	\$ 350,000	

Note: Cost Opinions do not include land or right-of-way purchase or easements. Estimates include 35% for the cost of construction contingencies (issues which are presently unknown), legal fees, engineering design and construction services, and administrative expenses related to the project.

Figures

Figure 1	Existing System
Figure 2	Population and Water Use Data Projections
Figure 3	Historical and Projected Water System Demands
Figure 4	Main Age
Figure 5	Main Material with Breaks
Figure 6	Water Age
Figure 7	Chlorine Residual Data
Figure 8	General Plan
Figure 9	Transmission
Figure 10	Historical Water Accountability



Water Main Diameter

Unknown

4" and Smaller

6"

8"

10"

12"

14" - 16"

20"

Water Main Owned by Others

System Valve

Hydrant (City of Portage)

Hydrant (Owned by Others)

Franchise Area (City of Kalamazoo Water)

Tank

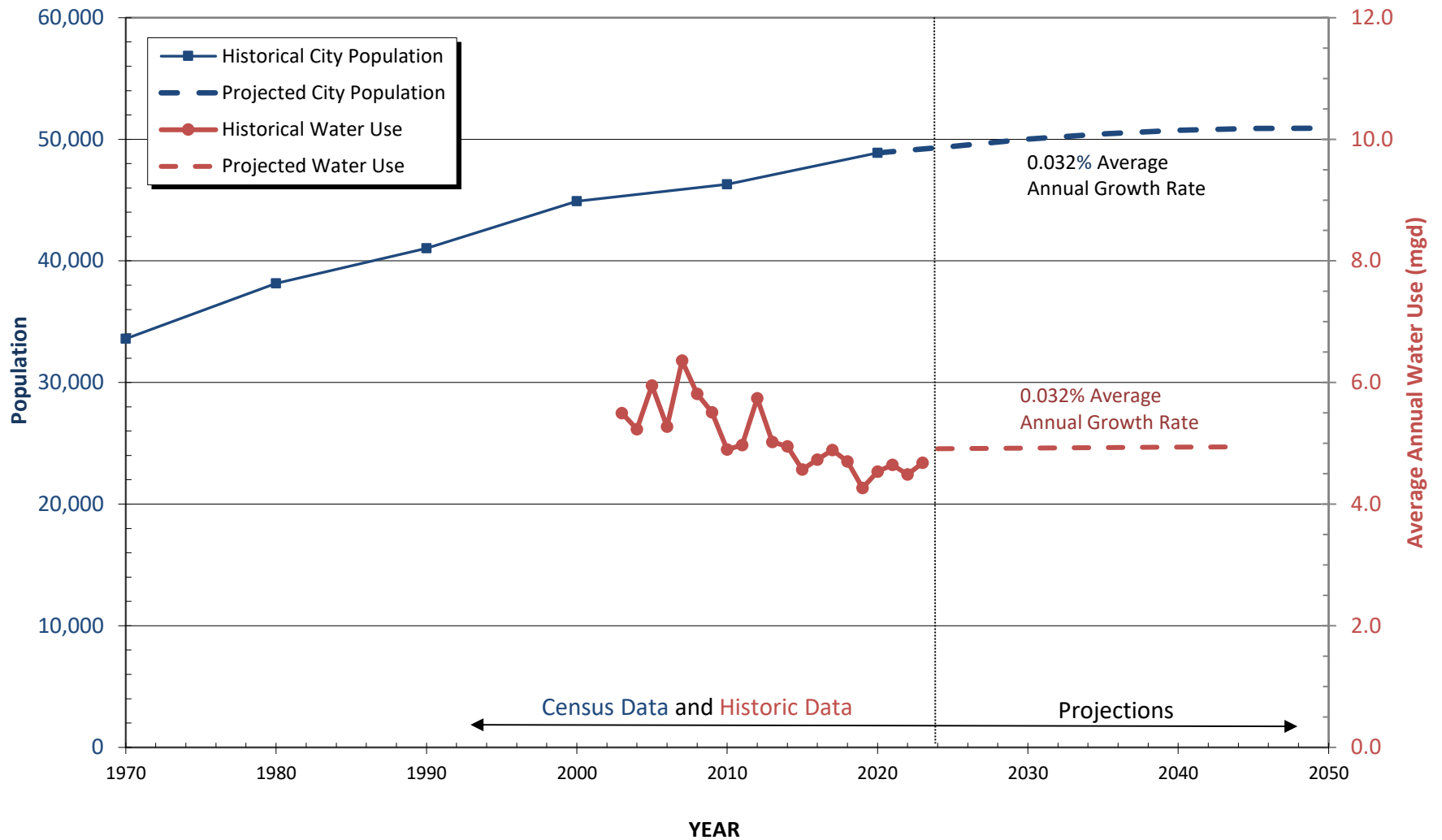
CITY OF PORTAGE
KALAMAZOO COUNTY, MI
FIGURE 1: EXISTING SYSTEM

2240301

City of Portage Water System Reliability Study

Population and Water Use Data Projections

Figure 2

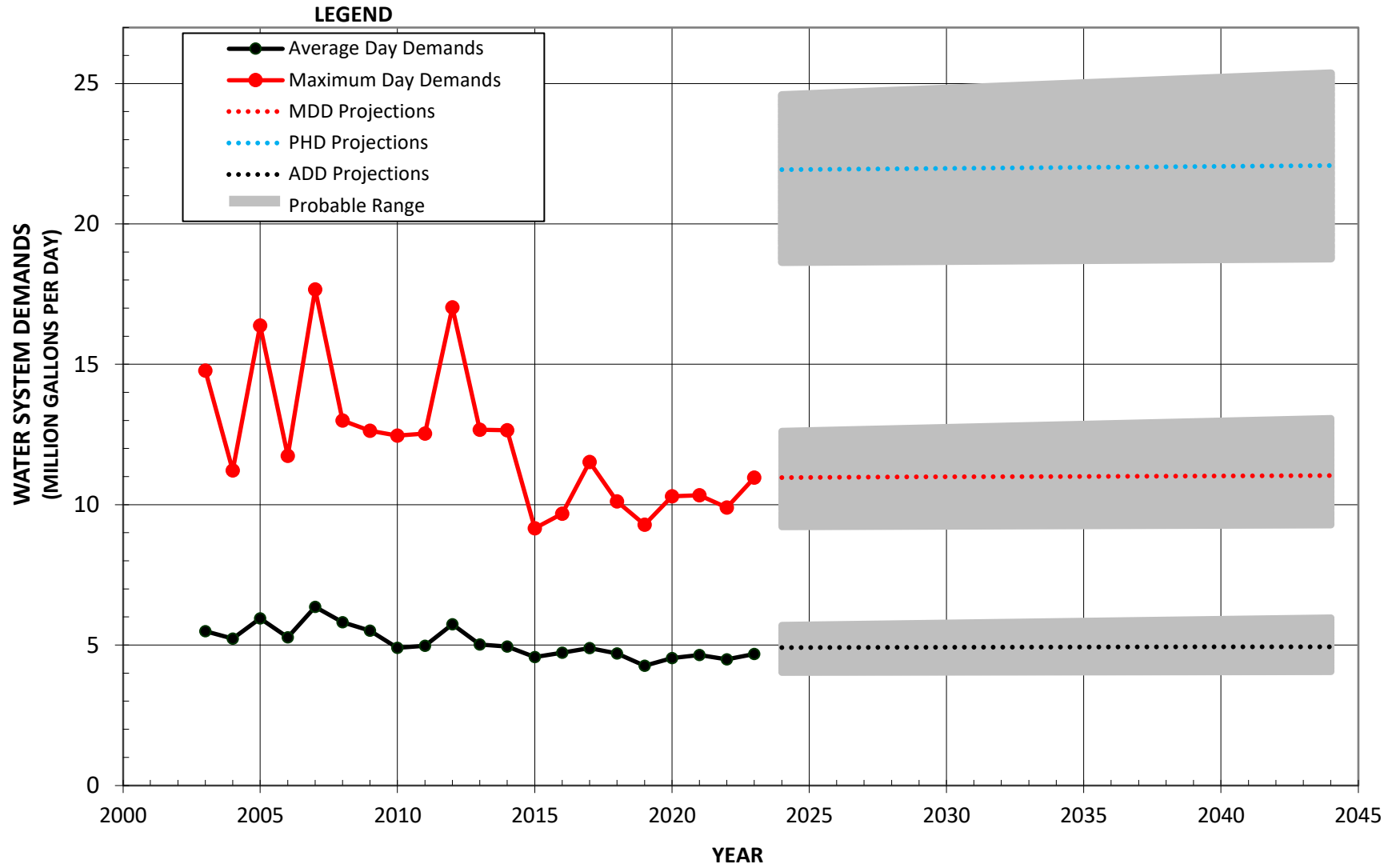


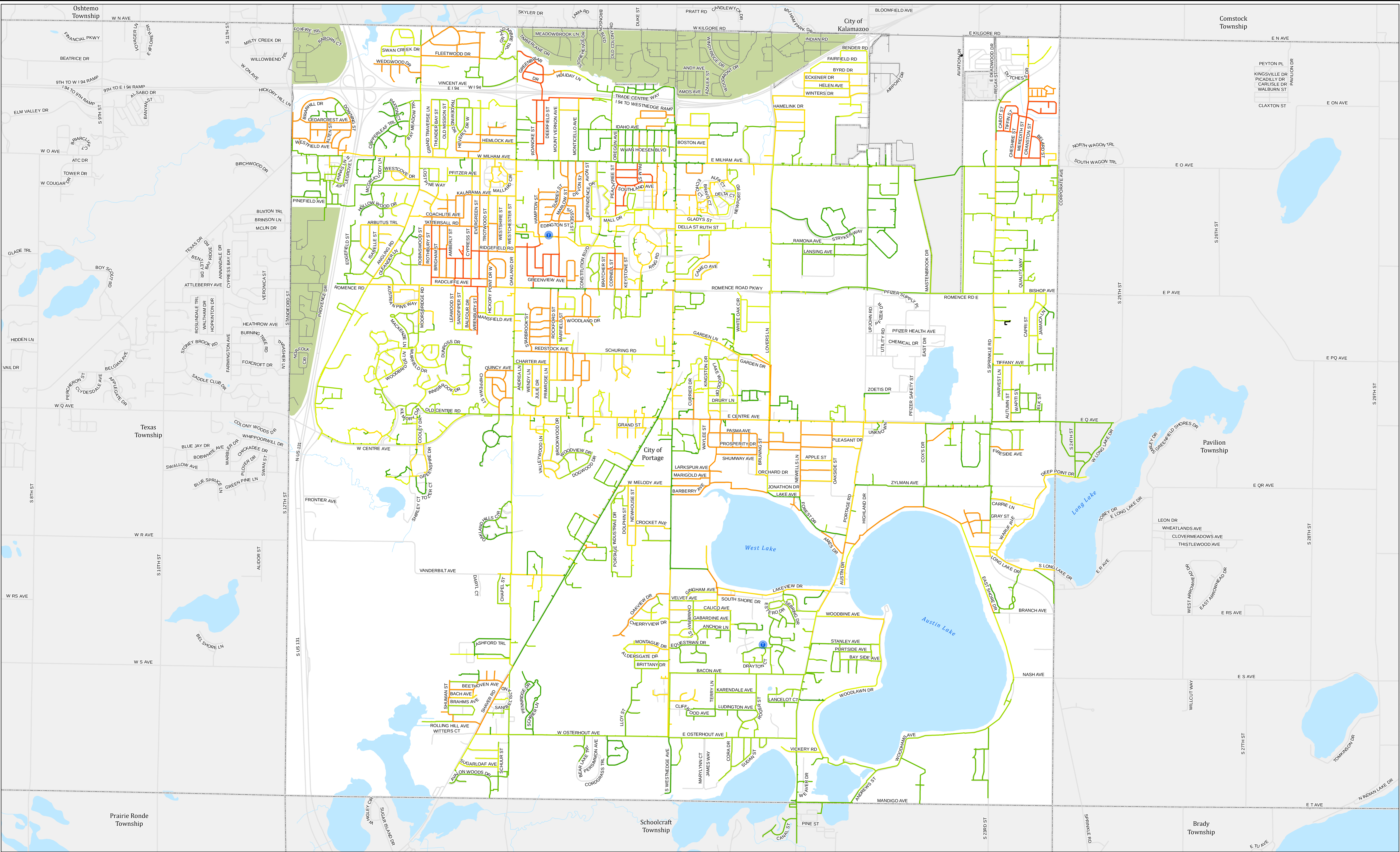
Note: Projected population based on historic growth trend.

City of Portage Water System Reliability Study

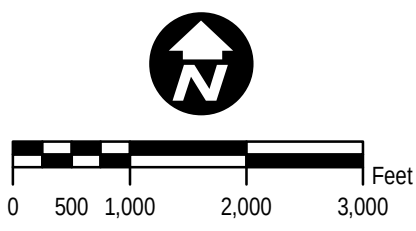
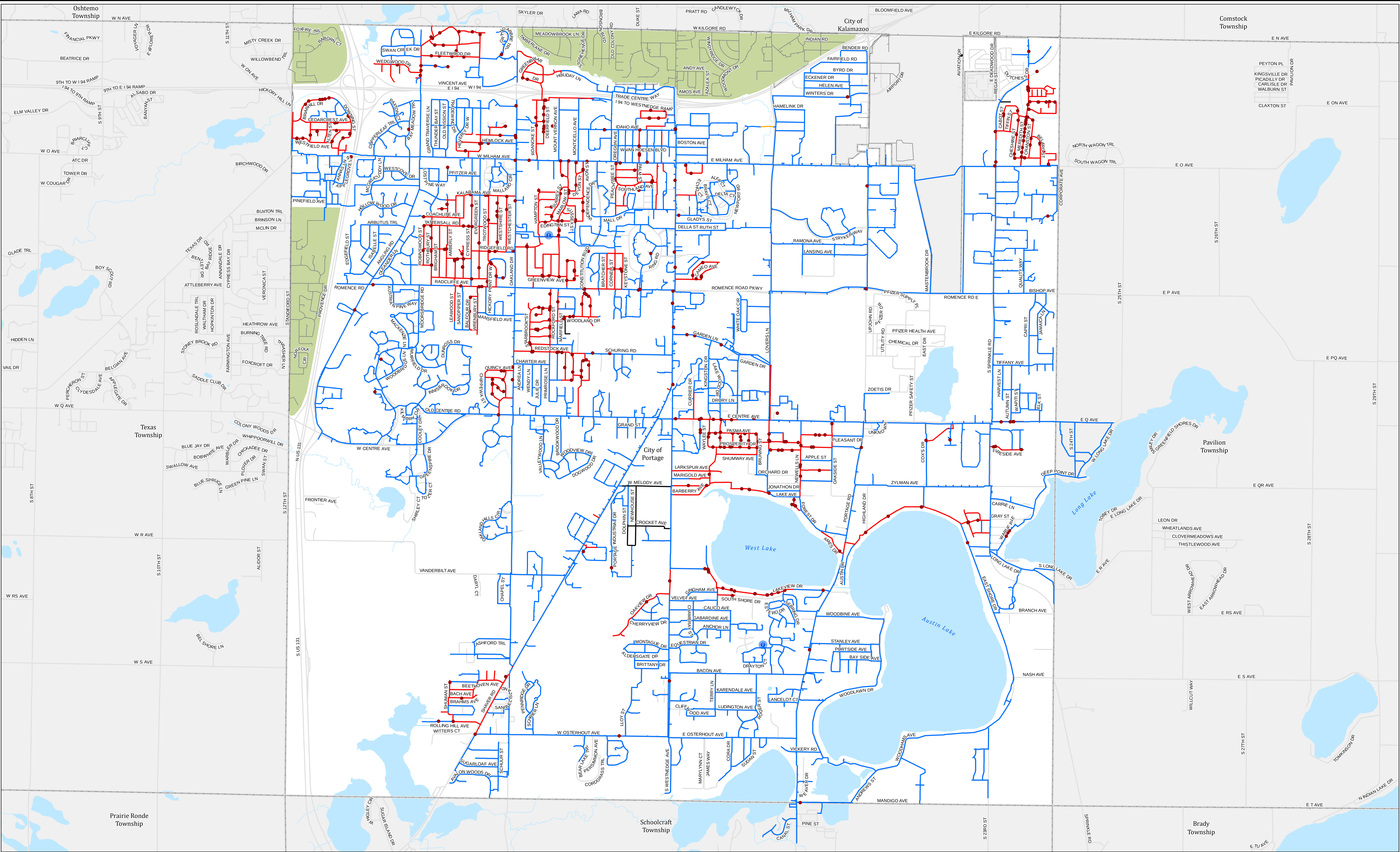
Historical and Projected Water System Demands

Figure 3





CITY OF PORTAGE
KALAMAZOO COUNTY, MI
FIGURE 4: MAIN AGE

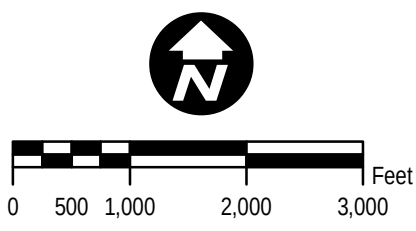
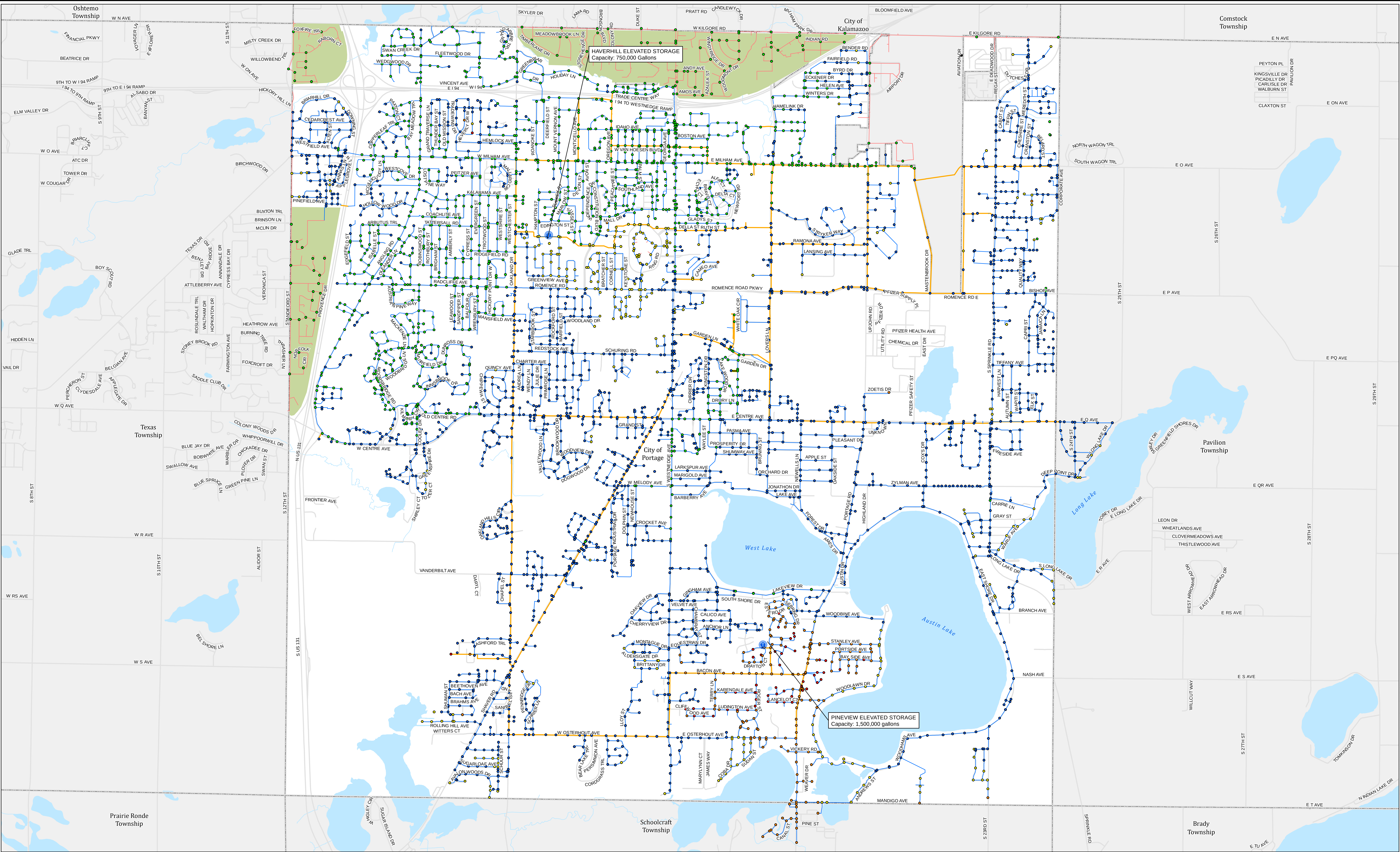


- LEGEND**
- | | | | |
|---------------------|--------------------|----------------------------|--|
| Water Main Material | Copper | Water Main Owned by Others | Franchise Area (City of Kalamazoo Water) |
| Unknown | Ductile Iron | Water Tower | Water Main Break (2000-present) |
| Cast Iron | Polyvinyl Chloride | | |

CITY OF PORTAGE
KALAMAZOO COUNTY, MI

FIGURE 5: MAIN MATERIAL WITH BREAKS

2240301



Maximum Water Age

- less than 24 hours
- 25 - 96 hours
- 97 - 182 hours
- 183 - 296 hours
- 297 - 384 hours

Water Main Diameter

- Unknown
- Water Main Owned by Others

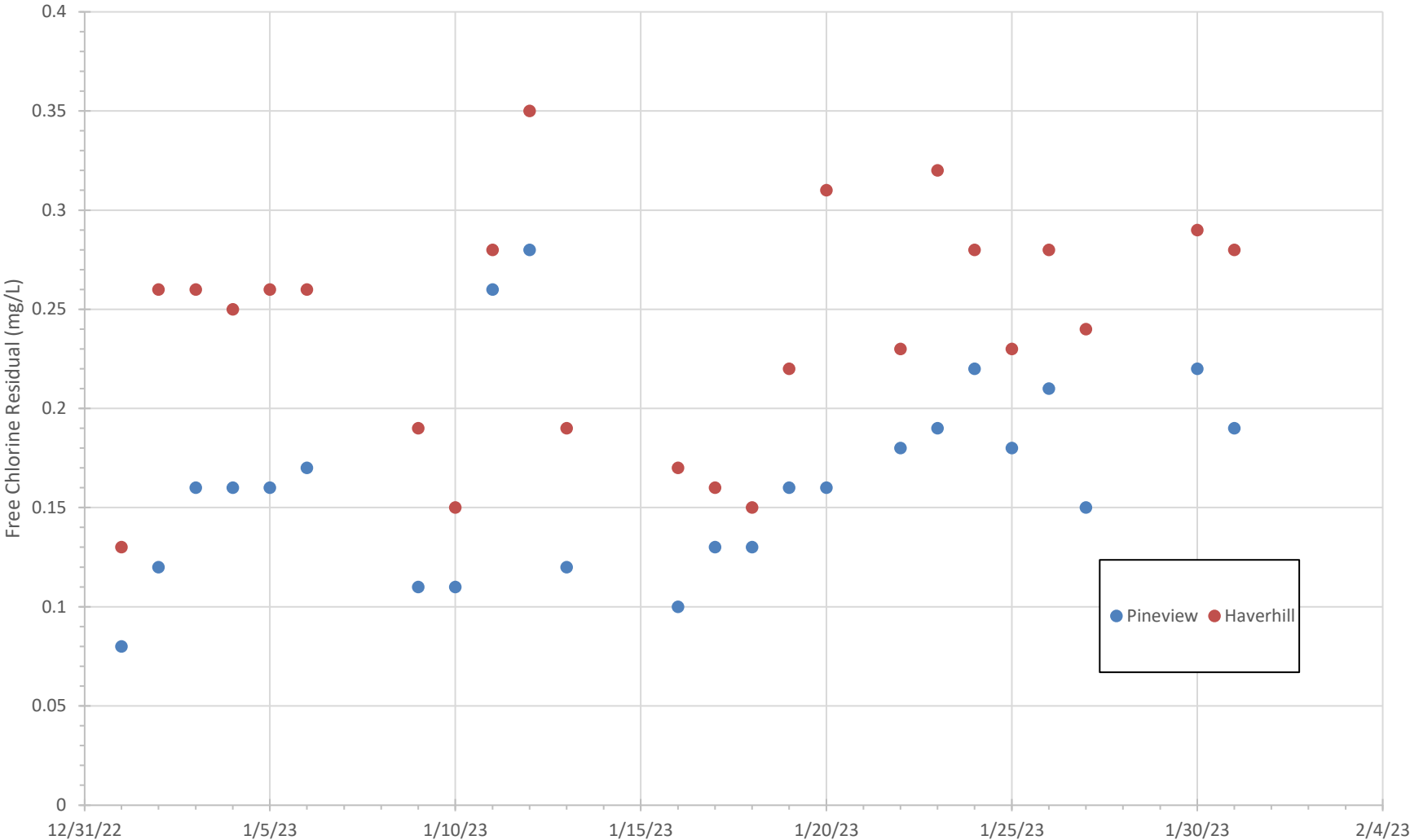
LEGEND

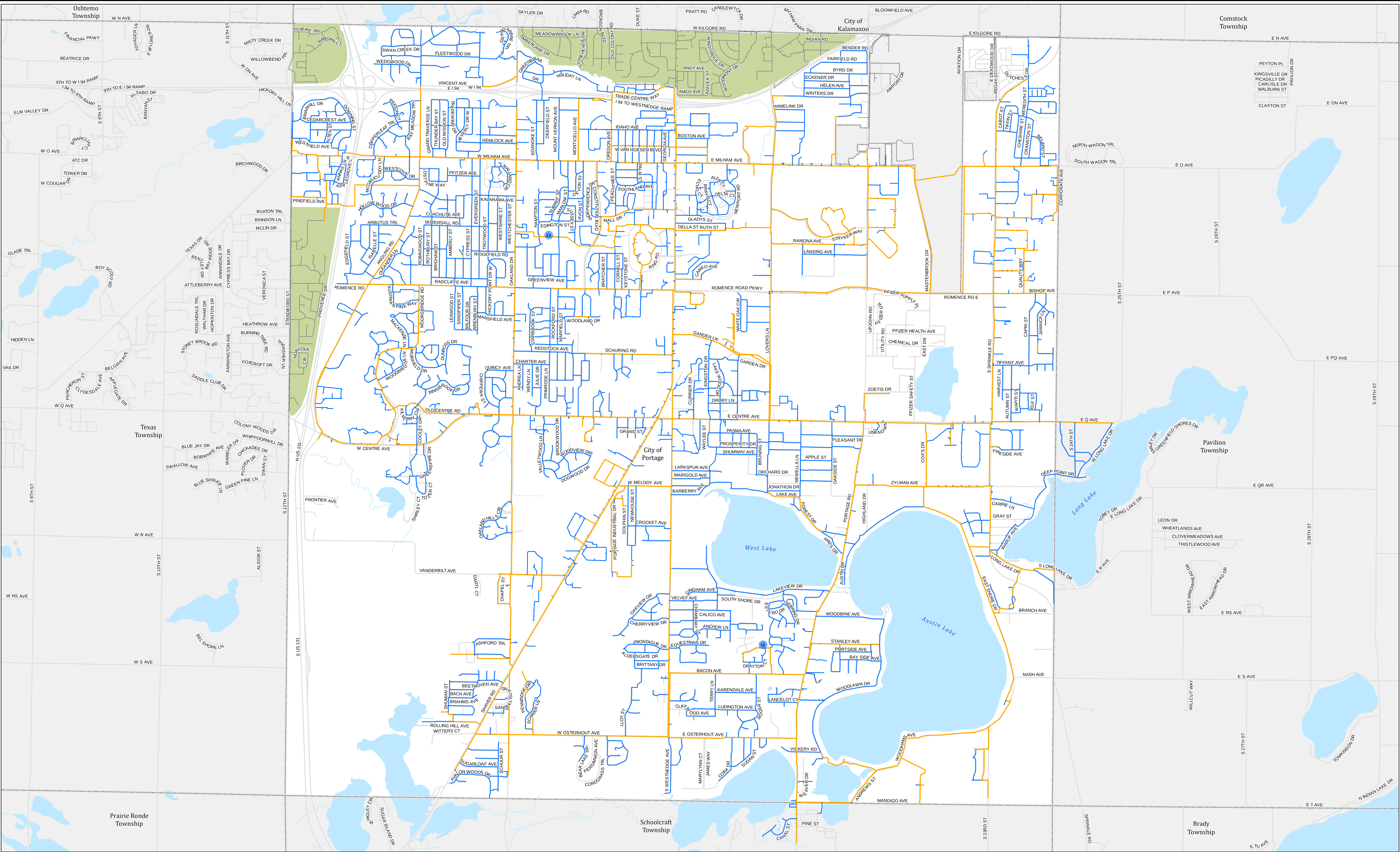
- Distribution (12" and smaller)
- Transmission
- Tank
- Franchise Area (City of Kalamazoo Water)

CITY OF PORTAGE
KALAMAZOO COUNTY, MI
FIGURE 6. WATER AGE
2240301

City of Portage Water System Reliability Study

Chlorine Residual Data
Figure 7





LEGEND

Water Main	Water Tower
Distribution (less than 12")	Franchise Area (City of Kalamazoo Water)
Transmission (12" or greater)	
Water Main Owned by Others	

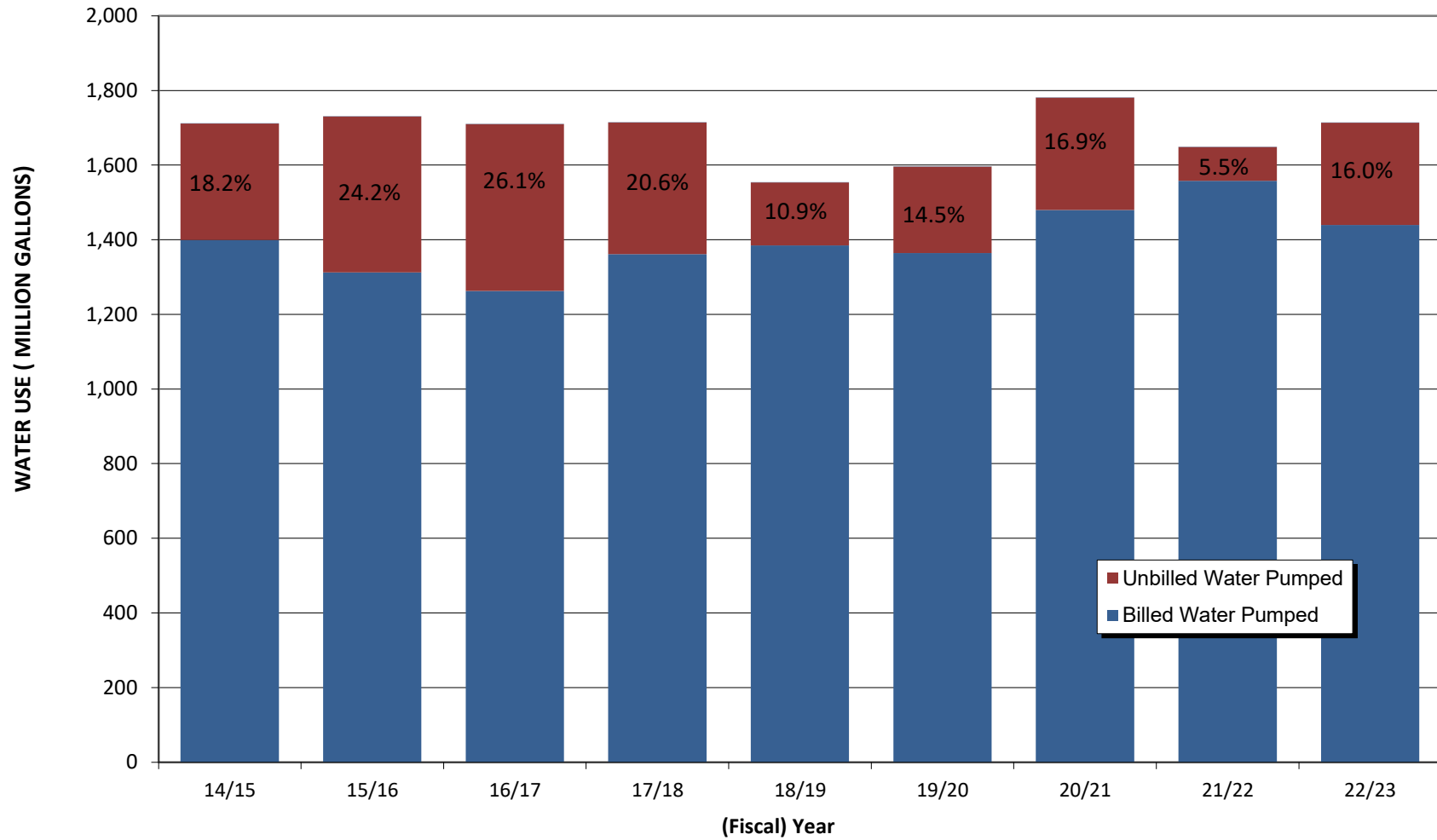
CITY OF PORTAGE
KALAMAZOO COUNTY, MI

FIGURE 9: TRANSMISSION

2240301

City of Portage Water System Reliability Study

Historical Water Accountability
Figure 10



Appendix A

Annual Pumping Summary

Appendix A
Pumpage Data

Annual Pumpage 2023 (Millions of Gallons)

	Wellfield B			Wellfield I			Wellfield A			Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield		Wellfield F		Wellfield				
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals		
January	9.24	3.55			25.71		26.611		5.13	11.54	7.07	5.83	5.71					13.49	6.6	5.82		100.591		
February	8.200	3.140			21.320		22.143		4.880	10.930	6.720	5.330	5.180					10.650	6.960	6.130		90.263		
March	10.670	4.090	1.530	0.160	19.960		23.030		4.570	9.950	6.106	5.900	5.650					13.120	7.670	6.740		97.496		
April	12.260	4.640			24.980		25.734		2.930	12.330	7.590	7.590	7.380					12.740	8.190	7.180		108.564		
May	18.750	6.790	5.030		27.270	2.610	34.800		20.410	12.770	11.980	11.630			1.410	1.490		13.120	13.450	11.760		158.360		
June	35.130	13.670	36.960		22.460	31.500	88.570		23.560	14.800	10.190	10.082			13.190	10.720		16.000	15.480	13.630		265.022		
July	34.600	13.520	39.530		25.590	0.880	64.302		17.850	11.150	10.650	10.130			7.010	9.840		16.650	11.320	9.900		216.922		
August	18.165	7.240	37.980		24.630		61.084		20.490	12.800	12.270	11.880				7.410		16.690	13.150	11.630		192.809		
September	15.420	6.100	38.400		20.620		57.692		12.910	9.880	9.950	8.620				3.680		16.044	11.290	10.030		161.616		
October	9.820	3.850	35.480		20.820		55.108		8.810	5.410	5.780	5.770						16.630	5.960	5.220		122.358		
November	9.090	3.610			25.990		26.850		10.530	6.060	5.910	5.680						16.050	6.930	6.140		96.850		
December	5.910	4.010			26.880		27.666		10.010	6.670	5.720	5.920						19.280	8.260	8.160		101.606		
*Portage Creek and Winterforest Wells not listed due to no pumpage data.																					Total Yearly Volume (mg)		1712.46	
																					Average Daily Pumpage (mgd)		4.68	
																					Maximum Daily Pumpage (mgd)		10.966	

Annual Pumpage 2022 (Millions of Gallons)

	Wellfield B			Wellfield I			Wellfield A			Wellfield P		Wellfield	Wellfield	Wellfield M		Wellfield	Wellfield F		Wellfield					
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals		
January	10.780	3.780	0.950		16.500		17.688		5.290	11.740	7.170	5.950	3.710					21.650	8.680	7.990		104.428		
February	12.850	4.760							5.670	11.916	7.410	7.880	4.900					19.460	8.820	8.080		91.746		
March	13.150	4.840	0.680		5.030		5.776		5.790	13.092	8.030	8.250	2.080					21.320	9.180	8.410		99.918		
April	11.330	4.200			25.260		25.879		4.910	10.950	7.020	7.180						20.010	8.610	7.820		107.909		
May	9.870	3.570	20.810		13.470		40.489		6.780	15.020	9.330	5.340						21.250	12.060	11.050		134.759		
June	22.400	8.470	6.610	0.250	19.260	27.156	54.038		10.180	22.420	14.000	14.160	10.910		4.150			20.270	15.740	14.380		211.118		
July	26.510	10.130	34.630	0.120	26.500	6.010	65.300		9.930	22.020	13.710	11.900	11.680		6.180			21.030	12.450	11.210		222.050		
August	17.530	6.650	34.720		26.450	2.030	63.145		8.454	18.980	11.720	10.600	10.400		2.790			18.500	11.310	10.330		190.409		
September	13.560	5.140	35.600		25.830		62.064		6.320	14.310	8.760	8.420	8.260					19.750	9.280	8.150		164.014		
October	10.400	3.960	21.940		27.430		50.238		3.860	8.730	5.310	5.070	5.000					19.000	5.510	4.670		121.748		
November	7.950	3.040			27.660		28.310		4.030	9.070	5.580	4.600	4.560					14.340	5.930	5.270		92.680		
December	10.030	3.830			27.500		28.131		4.820	10.820	6.580	6.580	6.420					10.060	7.900	6.980		102.151		
*Portage Creek and Winterforest Wells not listed due to no pumpage data.																					Total Yearly Volume (mg)		1642.93	
																					Average Daily Pumpage (mgd)		4.49	
																					Maximum Daily Pumpage (mgd)		9.893	

Annual Pumpage 2021 (Millions of Gallons)

	Wellfield B			Wellfield I			Wellfield A			Wellfield P		Wellfield	Wellfield	Wellfield M		Wellfield	Wellfield F		Wellfield				
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals	
January	11.980	4.420			27.380		29.475		3.280	7.320	4.440	8.130	6.200					19.550	3.980	3.700		102.475	
February	12.240	4.550			24.860		26.680		2.950	6.720	3.960	7.420	5.600					18.450	3.740	3.490		95.800	
March	12.930	4.810			27.430		28.437		3.530	7.720	4.780	8.490	6.360					15.120	4.340	3.980		100.497	
April	16.110	5.950			16.810		17.314		4.880	10.660	6.510	10.270	7.730					21.630	6.630	6.130		113.814	
May	22.010	8.130	7.710		13.470		20.445		10.380	22.600	13.870	12.050	8.800			5.180		22.110	14.180	13.110		172.865	
June	19.010	7.150	34.690		25.900	13.880	70.665		9.190	20.790	12.810	9.990	7.280			9.380		17.500	16.630	15.410		215.805	
July	16.470	6.090			24.950	52.607	76.200		5.520	11.890	7.280	7.070	5.070		6.260	0.038		21.570	10.974	10.230		184.662	
August	18.310	6.780			26.040	44.454	69.626		7.550	16.400	10.150	10.730	7.570		12.630			21.820	12.320	11.420		205.306	
September	20.180	7.490			27.540	15.770	43.350		7.500	16.570	10.220	10.490	7.240		13.510			20.660	11.890	10.990		180.090	
October	14.060	5.220			29.370		29.901		5.580	12.410	7.510	7.850	5.290		2.570			21.880	9.400	8.760		130.431	
November	10.590	3.900			13.070		13.383		5.100	11.340	6.860	6.250	4.060					20.400	7.150	6.820		95.853	
December	9.560	3.520			27.220		27.804		4.160	9.310	5.630	5.040	3.180					21.860	5.860	6.140		102.064	
*Portage Creek and Winterforest Wells not listed due to no pumpage data.																					Total Yearly Volume (mg)		1699.66
																					Average Daily Pumpage (mgd)		4.64
																					Maximum Daily Pumpage (mgd)		10.335

Appendix A
Pumpage Data

Annual Pumpage 2020 (Millions of Gallons)

	Wellfield B				Wellfield I				Wellfield A		Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield			
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals	
January	15.440	5.580							6.070	13.370	7.990	9.810	8.440					21.090	4.390	4.160		96.340	
February	12.880	4.670							6.200	13.780	8.260	8.380	7.180					19.150	9.340			89.840	
March	13.940	5.070							6.560	14.750	8.730	9.490	8.090					20.920	3.010			90.560	
April	19.210	7.000			12.180		13.076		4.680	10.580	6.300	7.900	6.730					17.730	0.080	5.560		98.846	
May	40.200	14.640							3.510	7.810	4.730	5.930	5.320					12.630	4.600	6.040		105.410	
June	33.870	12.250			22.300	12.400	35.755		9.940	21.860	13.400	13.960	11.710					20.560	13.780	13.010		200.095	
July	33.520	12.490			27.040	55.550	82.921		10.560	23.370	14.640	13.480	11.240			5.060		21.200	15.020	14.060		257.561	
August	30.200	11.020			26.770	54.410	83.193		9.120	20.340	12.500	12.010	9.840			10.520		20.390	12.920	12.020		244.073	
September	20.750	7.520			26.760	28.160	57.465		7.750	17.390	10.550	9.630	7.800			0.350		17.750	9.680	9.060		175.695	
October	11.630	4.250			21.190		22.451		3.940	8.730	5.350	13.080	10.510					16.510	7.030	6.630		110.111	
November	18.330	6.750							3.340	7.380	4.570	12.640	9.840					16.270	6.110	5.730		90.960	
December	12.230	4.500			28.050		30.019		2.370	5.200	3.210	7.700	6.030					21.000	4.370	4.090		100.719	
*Portage Creek and Winterforest Wells not listed due to no pumpage data.																					Total Yearly Volume (mg)		1660.21
																					Average Daily Pumpage (mgd)		4.54
																					Maximum Daily Pumpage (mgd)		10.3

Annual Pumpage 2019 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A				Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield				
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals		
January	14.300	5.060							7.900	16.050	9.230	9.140	7.550					22.81	5.51	7.110		104.660		
February	12.780	4.510						0.720	6.240	13.760	7.790	8.170	7.700					20.260	7.660	7.140		96.730		
March	12.600	4.450						0.500	5.920	13.190	7.510	8.510	7.320					22.560	8.060	7.240		97.860		
April	18.780	6.700			4.230	8.500	13.331	0.410	5.040	11.210	6.460	6.940	6.030					17.070	6.820	6.210		105.001		
May	11.640	4.130			28.340		31.804		4.250	9.530	5.450	6.110	5.300					21.670	5.890	5.350		111.124		
June	12.390	4.370			27.020		29.561		6.360	13.810	8.130	8.040	7.060					22.000	7.920	7.270		126.911		
July	26.920	9.700			24.630	52.750	79.879		9.780	21.190	12.440	12.890	11.330					21.210	12.240	10.970		228.549		
August	23.170	8.320			24.170	55.240	80.054		9.010	19.870	11.840	13.410	11.780					22.600	11.360	10.200		221.614		
September	13.650	4.860			23.350	46.040	71.914		5.650	12.630	7.350	7.620	6.580					22.110	7.430	6.710		166.504		
October	9.130	3.280			26.580		28.557		4.260	9.660	5.490	5.880	5.100					22.040	6.000	5.400		104.797		
November	8.440	2.990			26.260		28.242		2.900	6.530	3.790	6.180	5.300					21.990	5.270	5.120		96.752		
December	7.600	2.710			7.040	39.800	48.894		2.430	5.590	3.290	5.010	4.270					7.560	4.620	4.450		96.424		
*Portage Creek and Winterforest Wells not listed due to no pumpage data.																					Total Yearly Volume (mg)			1556.93
																					Average Daily Pumpage (mgd)			4.27
																					Maximum Daily Pumpage (mgd)			9.29

Annual Pumpage 2018 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A			Wellfield P		Wellfield	Wellfield	Wellfield M		Wellfield	Wellfield F		Wellfield			
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals
January	13.190	5.280						2.270		13.470	9.300	9.010	7.870					6.690				67.080
February	10.680	4.290						2.730	0.040	10.630	7.030	7.230	6.330					6.780				55.740
March	10.260	4.090						4.010	0.200	8.270	3.060	7.340	6.440					6.380				50.050
April	15.520	6.200						2.780	7.410	11.680	6.720	9.810	8.580					7.000	9.310	8.810		93.820
May	17.290	6.940						7.030	6.820	10.600	6.630	7.100	6.230					13.570	8.310	7.800		98.320
June	33.820	13.650						6.770	5.760	8.220	5.640	8.400	7.390					4.450	8.040	7.540		109.680
July	24.300	9.830					100.667	10.780	11.120	4.170	10.180	11.090	9.820					20.670	13.160	12.360		238.147
August							97.160		8.650	14.530	6.530	11.590	10.060					22.130	10.790	10.040		191.480
September							91.148		5.420	9.090	5.180	6.030	5.260					20.030	6.080	5.640		153.878
October							40.505		8.730	14.660	8.450	8.630	7.550					20.650	9.590	9.070		127.835
November									10.130	17.110	9.740	10.530	9.250					21.870	9.460	9.340		97.430
December	9.490	3.320							8.660	14.630	8.310	9.350	8.140					22.560	8.730	9.410		102.600
Total Yearly Volume (mg)																					1386.06	
Average Daily Pumpage (mgd)																					3.79	
Maximum Daily Pumpage (mgd)																					10.119	

Appendix A
Pumpage Data

Annual Pumpage 2017 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A			Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield		Wellfield F		Wellfield		Totals
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	
January							3.407		10.180	22.180	12.570	10.610	10.440					17.690	7.780	7.390		102.247
February							47.068		8.180	11.590	6.550	4.480	4.590					4.696	3.350	3.420	3.250	97.174
March	6.190	2.470					51.625	3.530	6.080	8.540	4.820	5.210	8.320					5.974	4.720	2.480	2.350	112.309
April	0.510	0.200					50.407	4.720	8.220	11.260	6.520	7.550	7.930					5.871	5.980	6.880	6.520	122.568
May	11.870	4.540					24.945	7.020	16.610	19.690	13.260							7.160	15.190	11.490	10.770	142.545
June	31.210	12.480					35.332	12.870	21.580	25.230	17.450	16.240	14.470					9.697	16.530	16.650	15.710	245.449
July	38.240	15.210						11.320	23.950	27.940	19.200	19.930	17.320					11.232	17.040	18.150	17.500	237.032
August	38.260	15.120					45.730	6.440	17.760	21.600	14.760	15.410	13.350					10.764	16.910	14.550	27.480	258.134
September	30.740	12.150					44.130	8.420	13.510	15.860	5.190	11.080	9.600					8.158	16.430	10.170	9.200	194.638
October	28.280	11.130					23.800	3.540	9.200	10.770	7.150	6.010	5.190					6.772	12.760	6.830	6.200	137.632
November	23.260	9.220						2.670	1.940	13.230	9.080	8.550	7.510					5.894	2.950	2.380		86.684
December	9.230	3.630					43.817	1.760		9.140	6.310	6.060	5.300					6.186	13.940	4.838		110.211
Total Yearly Volume (mgd)																					1846.62	
Average Daily Pumpage (mgd)																					5.06	
Maximum Daily Pumpage (mgd)																					11.524	

Annual Pumpage 2016 (Millions of Gallons)

	Wellfield B		Wellfield I		Wellfield A			Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield	Totals				
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3		G	Well #1	Well #2	D
January	8.920	3.810						0.110	5.670	11.120	6.350	12.050	12.370		5.610	7.360	4.865	6.800	12.460	13.870		111.365
February	12.820	5.580					1.366	3.530	3.790	7.710	4.390	11.330	12.020		1.370	1.340	4.696	7.830	11.030	11.970		100.772
March	16.390	7.200					6.279	7.400	10.680	21.710	12.540	1.740	1.790		4.200	4.780	5.974	7.320	0.810	0.880		109.693
April	18.278	8.040					10.492	10.310	9.760	19.520	11.090	8.170	8.460		5.570	6.380	5.871	7.890	7.060	7.680		144.571
May	22.350	9.670					10.224	12.050				15.850	16.450			7.610	7.160	9.540	15.770	16.760		143.434
June	21.400	9.250					56.066	12.550	20.260	23.380	13.380	15.770	16.210			2.940	9.697	10.480	12.970	13.600		237.953
July	37.390	16.140					57.334	7.900	16.080	20.530	11.323	10.010	10.210			3.540	11.232	10.750	10.499	20.630		243.568
August	15.500	6.690					53.854	9.840	16.580	22.340	11.480	8.070	8.310			5.720	10.764	13.750	11.000	10.610		204.508
September	12.490	5.390					55.651	5.720	12.410	16.640	8.640						8.158	17.820	8.770	8.480		160.169
October	11.820	5.080					46.009	6.030	12.310	15.330	8.630						6.772	19.280	8.240	7.720		147.221
November	12.890	5.570						8.970	13.940	17.160	9.720						5.894	18.880	6.840	6.180		106.044
December							2.285	5.770	10.610	23.700	13.480	1.040	1.070				6.186	19.370	13.980	13.180		110.671
Total Yearly Volume (mg)																					1819.97	
Average Daily Pumpage (mgd)																					4.99	
Maximum Daily Pumpage (mgd)																					9.682	

Annual Pumpage 2015 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A				Wellfield P		Wellfield	Wellfield	Wellfield M		Wellfield	Wellfield F		Wellfield	Totals	
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2		D
January								7.310	10.170	25.760	9.390	9.730	10.620		9.970			0.620	6.210	6.400		96.180
February								7.250	8.950	21.890	11.070	6.190	5.950		3.020	15.990		4.150	14.280	9.570		108.310
March	3.270	1.420					1.060	1.270		26.450	13.000				10.110	18.570		7.170	15.120	12.530		109.970
April	8.010	3.540					5.379		9.720	20.580	11.460	7.200	7.550		14.980	14.410		6.710	10.200	10.850		130.589
May									12.120	25.050	9.210	13.440	14.170		19.790	2.710		8.550	13.030	14.240		132.310
June	11.410	4.710					0.640		11.870	24.620	8.170	13.460	14.160		19.760	0.210		8.520	13.520	14.700		145.750
July	19.710	8.670						5.840	13.300	27.590	11.940	14.450	15.170		21.160	3.640		8.970	16.640	18.250		185.330
August	22.470	9.910						12.260	10.930	22.850	13.060	21.610	22.680		17.090	18.500		17.560	13.520	15.270		217.710
September	21.540	9.460						4.110	7.680	16.150	9.160	16.750	17.380		11.250	12.050		14.570	11.880	13.970		165.950
October	18.480	7.990					8.505	9.220	8.120	17.060	9.670	14.570	15.050		13.220	5.870		6.700	8.880	9.730		153.065
November								5.260	7.710	16.020	9.140	8.420	8.710		10.040	4.130		14.080	8.360	9.370		101.240
December	3.200	1.340						2.820	8.080	16.770	9.600	9.750	10.120		7.980	11.300		8.330	6.210	7.050		102.550
Total Yearly Volume (mgd)																					1648.95	
Average Daily Pumpage (mgd)																					4.52	
Maximum Daily Pumpage (mgd)																					9.16	

Annual Pumpage 2014 (Millions of Gallons)

Appendix A
Pumpage Data

	Wellfield B		Wellfield I				Wellfield A				Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield		
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals
January								9.880	7.550	15.210	7.700	9.210	9.890		14.650	14.290		6.630	11.770	12.330		119.110
February								11.250	3.670	7.460	3.870	10.560	11.390		15.610	14.530		7.400	12.950	13.880		112.570
March								0.190	4.530	9.310	4.780	12.250	13.260		16.250	15.340		8.590	13.220	14.350		112.070
April								11.250	5.110	10.260	5.080	8.980	9.680		16.680	6.950		6.200	13.010	14.040		107.240
May							15.380	17.830	11.010	22.590	11.610	14.060	15.390		14.240	24.760		10.210	13.850	14.700		185.630
June	0.440	0.190					0.414	16.130	13.540	28.470	14.820	14.330	15.800		13.930	22.120		9.930	15.450	16.660		182.224
July	6.350	2.980						16.790	13.380	28.280	14.970	13.860	14.950		21.620	25.230		13.350	15.110	16.900		203.770
August	18.570	8.350						17.470	14.120	29.980	15.710	14.370	15.370		19.680	24.580		10.630	27.500	32.100		248.430
September								14.980	11.570	24.440	12.650	11.800	12.480		10.540	16.180		15.260	12.110	13.680		155.690
October	12.710	5.650					25.600	12.380	2.860	6.020	3.450	13.310	10.290		13.570	15.400		5.620	10.540	11.900		149.300
November	9.910	4.220						8.390	8.200	18.440	9.960	7.150	7.440		12.260	2.110		3.080	8.260	9.030		108.450
December								6.760	9.560	22.710	10.300	9.790	10.350		7.660	10.400		0.630	7.590	8.640		104.390
Total Yearly Volume (mg)																					1788.87	
Average Daily Pumpage (mgd)																					4.90	
Maximum Daily Pumpage (mgd)																					12.65	

Annual Pumpage 2013 (Millions of Gallons)

	Wellfield B				Wellfield I					Wellfield A			Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield		Wellfield F		Wellfield	
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals		
January	9.200	3.690						9.350	8.420	18.230	5.010	8.080	8.300		8.160	9.800		4.860	6.660	7.090		106.850		
February	9.470	3.800					1.900	7.810	6.930	15.640	7.440	6.790	7.010		8.170	10.000		2.540	5.340	5.670		98.510		
March	12.420	4.840					1.460	9.100	7.980	18.350	8.920	8.470	8.670		6.730	8.680		6.740	5.750	6.700		114.810		
April	11.650	4.510					14.820	8.190	10.500	23.230	12.000	7.750	7.680		7.840	10.180		5.590	5.860	6.260		136.060		
May	17.570	6.940					4.880	10.860	13.700	31.170	15.130	7.740	7.830		11.990	12.350		6.640	7.790	8.280		162.870		
June	15.000	5.940					6.470	10.980	12.630	28.030	13.540	12.950	13.100		17.690	20.680		4.920	13.080	13.940		188.950		
July	19.750	5.400					26.340	12.810	13.810	29.590	13.550	13.950	13.960		21.620	25.820		7.210	13.850	14.490		232.150		
August	15.340						24.080	10.910	13.480	29.040	13.000	12.060	11.930		25.130	11.940		7.250	16.910	16.960		208.030		
September	17.500						16.570	12.580	14.880	31.270	13.960	12.370	13.060		17.670	15.170		7.680	14.760	15.470		202.940		
October	18.820						21.680	12.910	10.790	23.300	10.200	8.080	8.600		13.180	16.360		5.250	8.350	8.610		166.130		
November	1.300						2.280	6.320	9.450	19.150	8.900	7.090	7.500		12.330	10.640		2.550	8.390	8.190		104.090		
December							1.410	9.510	10.260	20.670	10.110	8.370	8.940		12.840	13.910		5.350	6.350	6.410		114.130		
Total Yearly Volume (mg)																						1835.52		
Average Daily Pumpage (mgd)																						5.03		
Maximum Daily Pumpage (mgd)																						12.67		

Annual Pumpage 2012 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A			Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield			
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2	D	Totals
January	15.490	5.670					2.870	2.520	10.030	17.990	12.760	6.850	6.830		9.520	11.400		7.370				109.300
February	15.610	5.800					0.690	1.290	10.770	18.570	13.200	6.260	6.270		5.030	10.040		7.260				100.790
March	14.890	6.070					1.860	1.350	10.110	17.980	12.830	7.280	7.280		8.880	11.030		6.740				106.300
April	18.340	6.920					11.970	3.590	9.550	16.570	11.690	8.640	8.690		11.070	13.390		6.900	7.050	7.800		142.170
May	24.020	11.560					6.760	8.780	12.470	21.900	15.570	16.710	17.000		20.730	13.890		10.730	6.510	7.040		193.670
June	23.780	16.820					25.920	12.470	19.150	29.560	24.520	27.870	28.540		32.830	26.370		15.510	15.190	16.910		315.440
July	23.520	13.750					59.600	13.980	15.900	29.060	19.980	26.810	27.480		35.340	24.470		16.990	17.500	19.140		343.520
August	23.570	9.590					7.020	8.170	16.020	28.700	19.240	27.910	28.520		23.900	23.540		12.100	13.960	14.540		256.780
September	20.390	8.240						2.810	13.410	0.430	17.480	26.820	27.540		12.760	13.180		7.540	10.020	11.040		171.660
October	13.160	5.270					11.490	2.240	9.520		12.590	25.260	26.460		11.720	12.750		6.580	8.430	9.000		154.470
November	11.050	4.440					0.660	7.790	9.740	1.860	12.540	6.680	6.900		7.950	10.000		6.290	6.640	7.120		99.660
December	9.440	3.790					1.930	7.660	7.110	15.390	7.750	6.810	6.960		8.840	10.190		4.720	6.770	7.220		104.580
Total Yearly Volume (mg)																					2098.34	
Average Daily Pumpage (mgd)																					5.75	
Maximum Daily Pumpage (mgd)																					17.03	

Annual Pumpage 2011 (Millions of Gallons)

Appendix A

Pumpage Data

	Wellfield B		Wellfield I				Wellfield A			Wellfield P		Wellfield		Wellfield M		Wellfield		Wellfield F		Wellfield	Totals	
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2		D
January	5.170	2.010					1.060		13.290	23.270	16.460	6.270	6.330		14.820	0.350		7.150	5.890	6.630		108.700
February	0.640	0.260							11.260	19.200	13.250	8.050	8.120		12.350	4.390		5.260	8.540	9.810		101.130
March	8.380	3.270					3.260		9.780	16.790	11.220	6.710	6.680		12.360	10.410		4.130	6.690	7.410		107.090
April	15.090	5.870							10.070	18.340	13.020	9.390	9.490		12.240	11.080		6.190	10.210	11.460		132.450
May	15.160	5.590					4.190		9.720	17.800	12.510	9.200	9.420		11.980	14.630		6.620	8.230	9.930		134.980
June	25.110	9.330					13.120	0.790	15.510	28.450	20.320	12.420	12.730		16.040	18.960		10.740	12.730	14.850		211.100
July	24.800	9.460					22.310	13.040	16.520	30.500	21.740	23.430	24.120		20.420	23.780		6.830	16.760	19.300		273.010
August	22.820	8.920					1.540	12.930	14.900	27.420	18.950	16.450	16.570		16.340	18.580		7.690	15.340	17.510		215.960
September	19.120	7.020					1.270	0.190	11.920	22.080	15.220	11.390	11.480		15.360	19.000		6.940	12.310	13.990		167.290
October	17.000	6.180					7.140	2.970	10.730	19.970	13.790	11.410	11.440		13.140	15.210		7.430	9.400	10.600		156.410
November	14.530	5.300						0.780	8.070	13.540	10.220	6.300	6.280		8.960	10.220		0.700	7.810	8.870		101.580
December	14.460	5.280					3.060	1.450	8.610	15.310	10.880	7.500	7.480		9.770	12.060		5.130	1.110	1.320		103.420
Total Yearly Volume (mg)																					1813.12	
Average Daily Pumpage (mgd)																					4.95	
Maximum Daily Pumpage (mgd)																					12.53	

Annual Pumpage 2010 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A			Wellfield P		Wellfield	Wellfield	Wellfield M		Wellfield	Wellfield F		Wellfield	Totals		
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1		Well #2	D
January	15.070	6.340							10.540	17.190	9.150	13.870	11.990		4.790	0.540		4.280			29.130	122.890
February	19.830	8.220							9.310	15.830	8.930	2.300	6.120	4.250	5.980	4.290		8.060			11.480	104.600
March	13.960	6.000							9.230	15.620	8.790	8.410		4.710	3.960	5.630		5.040			28.850	110.200
April	20.070	8.590							13.450	23.180	13.440	12.520	11.000		4.040	4.160		9.300			26.930	146.680
May	22.870	9.800							9.900	16.760	9.530	25.440	27.050		6.720	1.380		11.160			27.750	168.360
June	19.290	8.100					21.490		12.580	21.720	12.930	13.970	14.760		7.200				9.370		27.130	168.540
July	24.020	9.940					47.260	13.510	17.180	30.240	8.470	22.350	23.530	16.110	17.970			2.610	22.320	6.020	27.610	289.140
August	14.510	5.930					32.270	10.230	10.920	19.010		16.090	16.780	15.120	12.820	6.520		20.740	30.700	34.330	27.340	273.310
September	11.540	4.600					12.050	7.040	11.410	19.800	7.380	8.680	8.840	11.670	6.320	8.010		19.910	11.100	12.290	15.710	176.350
October	12.320	5.120					15.690	1.540	11.830	21.010	15.000	8.800	8.480	2.650	8.270	8.750		10.850	12.720	13.890		156.920
November	8.170	3.510					4.470		10.980	19.500	13.890	5.000	5.080		5.840	3.930		2.880	11.380	12.680		107.310
December	7.910	3.210					0.500		11.420	19.440	13.350	5.450	5.500		6.520	6.630		3.570	11.840	13.110		108.450
Total Yearly Volume (mgd)																					1932.75	
Average Daily Pumpage (mgd)																					5.30	
Maximum Daily Pumpage (mgd)																					12.46	

Annual Pumpage 2009 (Millions of Gallons)

	Wellfield B		Wellfield I				Wellfield A				Wellfield P		Wellfield Wellfield		Wellfield M		Wellfield	Wellfield F		Wellfield	Totals	
	Well #1	Well #2	Well #1	Well #2	Well #3	Well #4	Dist Sys	Well #5	Well #1	Well #2	Well #3	Well #1	Well #2	PC	H	Well #1	Well #2/3	G	Well #1	Well #2		D
January	26.620	12.460			0.140							22.230	28.890	4.060				18.830	5.360	8.740		127.330
February	21.240	9.120						0.520				21.620	21.320	2.830	0.180			16.870	4.120	6.460	9.720	114.000
March																						
April	19.270	8.070			0.600			0.330	3.550	5.960		18.360	18.170	1.030				18.850	2.340	3.500	27.660	127.690
May	16.600	7.000			5.170				5.910	9.680		27.170	26.840	8.570				19.780	4.870	7.320	28.090	167.000
June	18.060	7.500			5.900			3.050	10.540	17.720	6.150	30.240	29.820	10.820	0.240	1.870		18.390				160.300
July	27.950	11.730			17.520			11.680	17.260	29.130	17.890	31.140	30.710	20.040	0.560	14.030		19.480	12.920	20.610	27.990	310.640
August	21.520	9.020			12.520			6.440	11.810	19.710	10.780	27.380	27.710	11.000			6.640	18.520	14.190	23.970	27.560	248.770
September	25.280	10.790						4.040	12.370	20.730	9.230	22.760	23.410	6.510				16.880	9.880	19.889	23.840	205.609
October	11.640	4.840						3.460	7.280	12.650	6.510	29.900	30.720	5.470	4.800			19.400	4.500	6.410		147.580
November	13.490	5.730						0.130	6.200	10.400	5.560	10.660	11.020	0.200	0.170	0.160		6.640	5.270	7.400	26.630	109.660
December	13.660	5.740							9.320	15.600	8.090	10.770	11.180		1.760	1.130		6.610	0.310	0.460	28.860	113.490
Total Yearly Volume (mgd)																					1832.07	
Average Daily Pumpage (mgd)																					5.02	
Maximum Daily Pumpage (mgd)																					12.63	

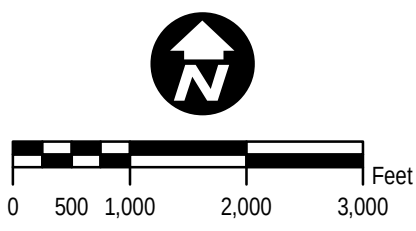
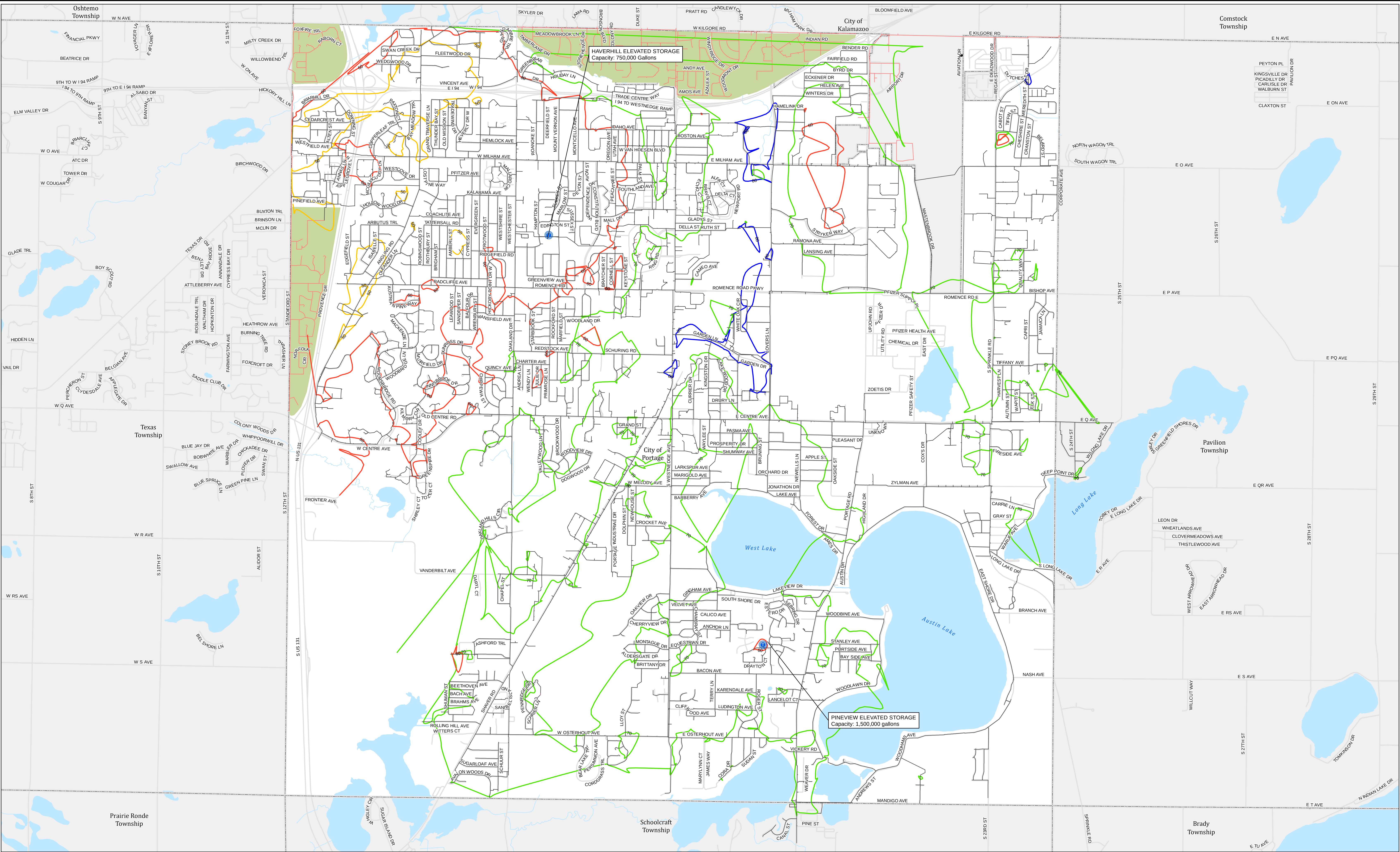
Appendix B

Comparison of Calibrated Model to Field Test Pressures at Static Hydrant #2

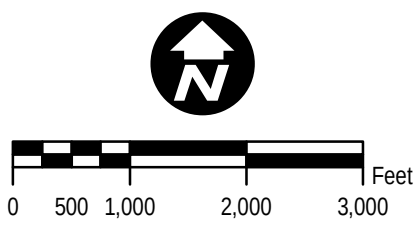
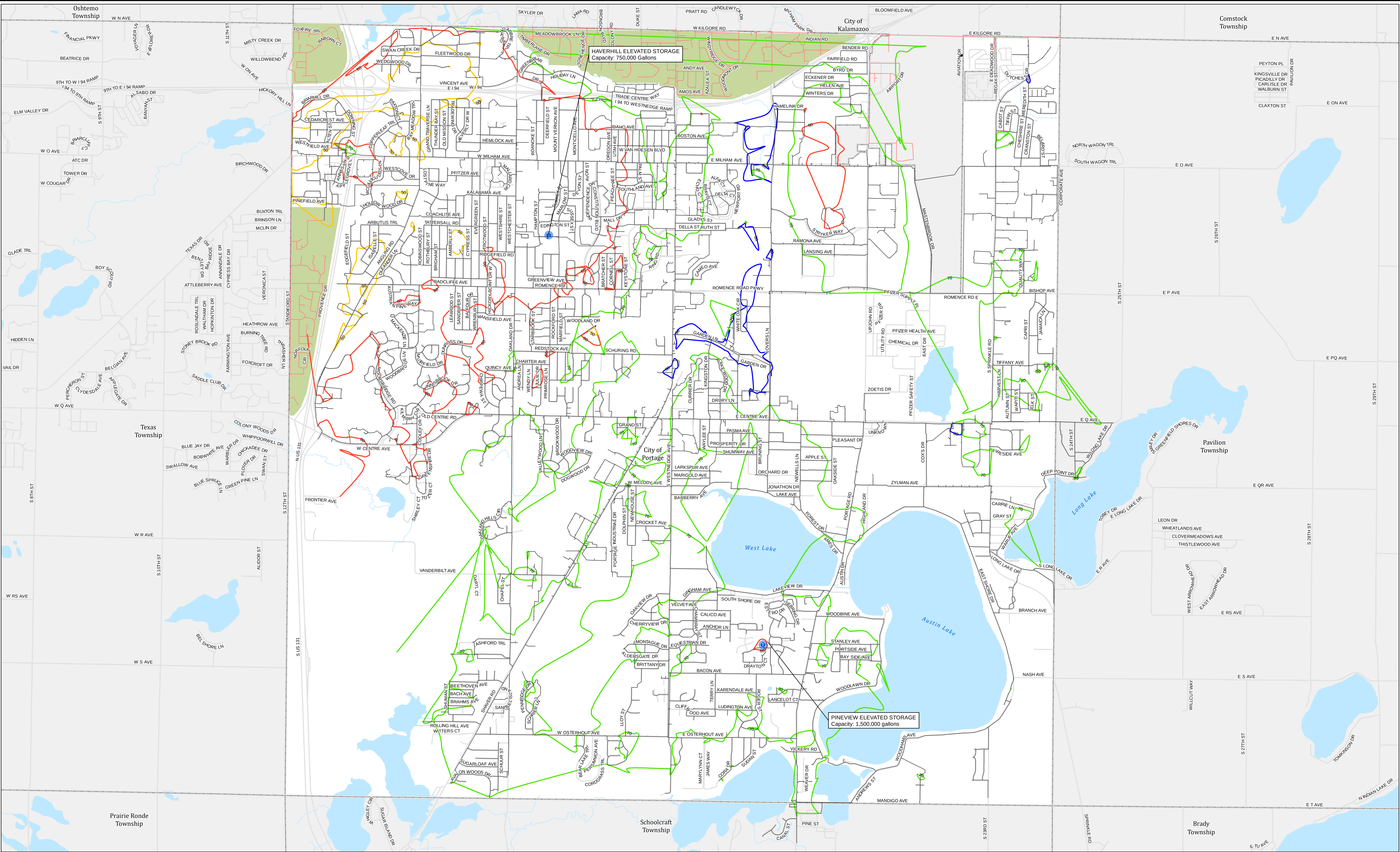
Hydrant Test No.	Static Hydrant #2 Location	Total Hydrant Test Flow (gpm)	Field Tests			Model Results		
			Static Pressure, psi	Residual Pressure, psi	Calculated Available Fire Flow at 20 psi (gpm)	Static Pressure, psi	Residual Pressure, psi	Available Fire Flow at 20 psi (gpm)
1	Whispering Brook Dr	1,853	62	49	3,215	61.1	49.7	3,411
2	Quincy St W of Curtis Ave	2,105	62	50	3,571	58.2	43.8	3,074
3	Angling Rd W of Ascen. Borgess campus	2,123	56	43	3,582	54.3	45.6	4,335
4	Manhattan St & Coulter Ave	1,760	56	45	3,075	53.9	44.9	3,317
5	Cedarcrest & Claremount	1,944	50	40	3,128	49.2	38.4	2,957
6	Greenhill & Fleetwood	1,986	52	42	3,416	50.5	41.1	3,442
7	Milham & Roanoke	1,948	55	49	4,804	53.1	51.4	9,209
8	Idaho Ave & Outer	1,986	69	60	5,255	65.8	63.8	11,416
9	Ramona Ave & Gertrude Dr	2,070	73	68	7,596	68.8	66.8	11,916
10	Helen Ave & Portage	1,835	74	53	2,931	68.3	52.0	3,164
11	Meredith & Lexington	2,161	80	71	5,143	79.2	67.7	4,473
12	Tiffany Ave & Capri St	2,012	73	66	5,801	72.3	64.9	5,589
13	Bayside Ave & Spinnaker St	2,105	73	64	5,075	70.9	63.7	5,602
14	Canal St & Balboa St	2,123	76	56	3,463	74.6	54.1	3,370
15	Liszt & Beethoven	1,760	69	60	5,169	64.9	59.1	6,251
16	Cherryview & Orangeview	1,846	74	66	5,145	72.6	63.1	4,623
17	Newhouse St & Melody Ave	1,944	72	66	6,935	69.5	67.6	12,565
18	Barberry & Tumbleweed	1,986	74	68	6,592	72.7	68.7	8,098

Appendix C

Pressure Contour Maps



- LEGEND**
- Pressure (psi)
 - 70
 - 50
 - 60
 - Portage Water Main
 - Water Main Owned by Others
 - Tank
 - Franchise Area (City of Kalamazoo Water)



LEGEND

Pressure (psi)

70

50

60

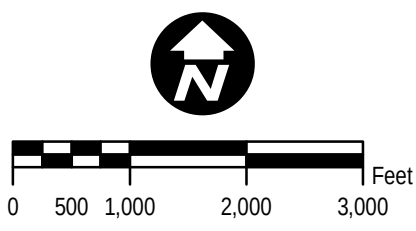
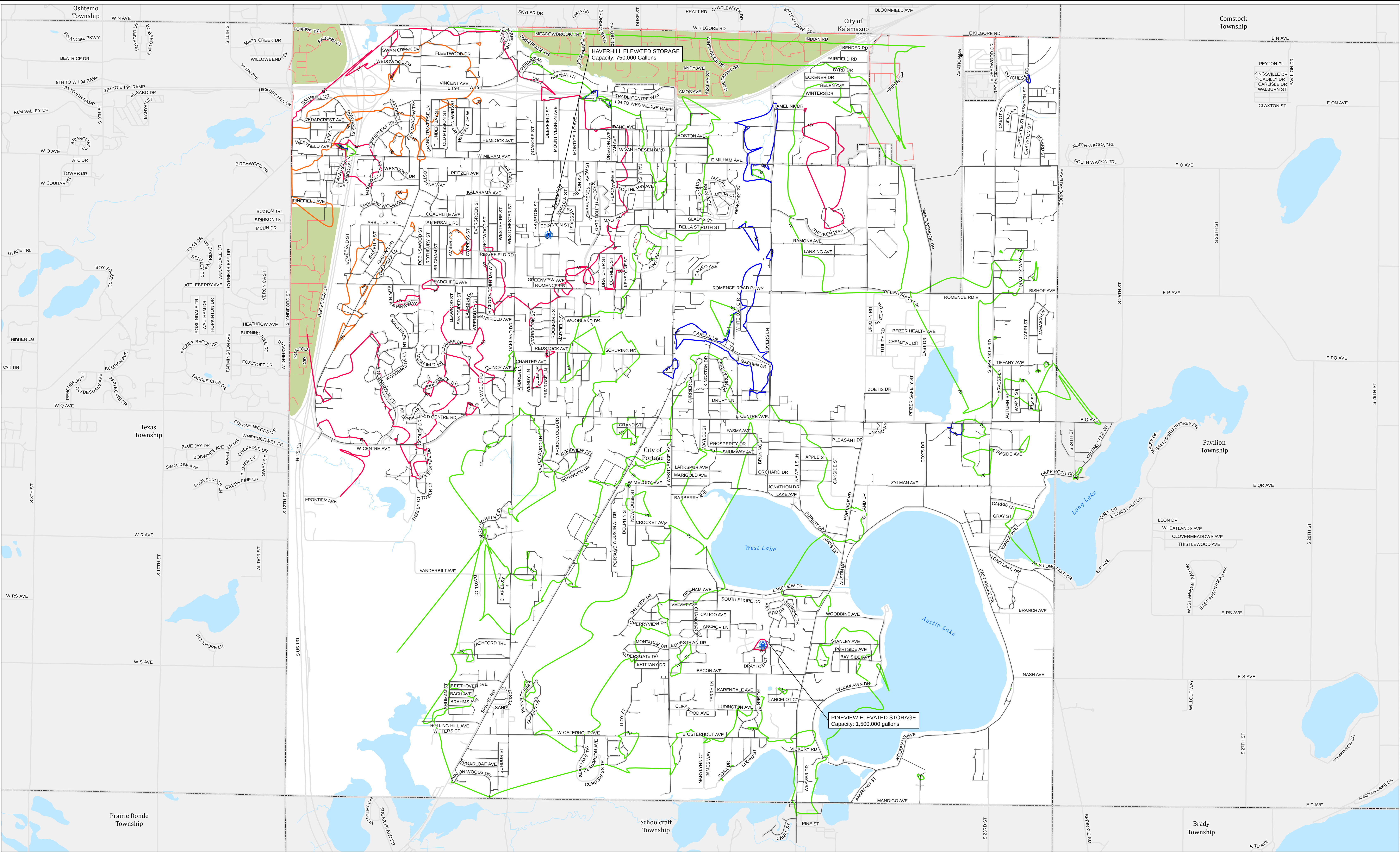
80

Portage Water Main

Water Main Owned by Others

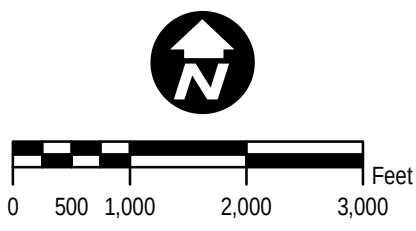
Franchise Area (City of Kalamazoo Water)

Tank

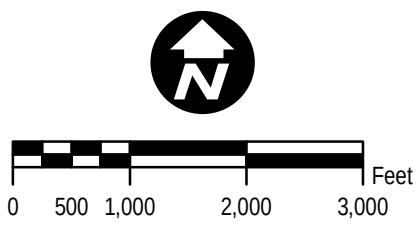
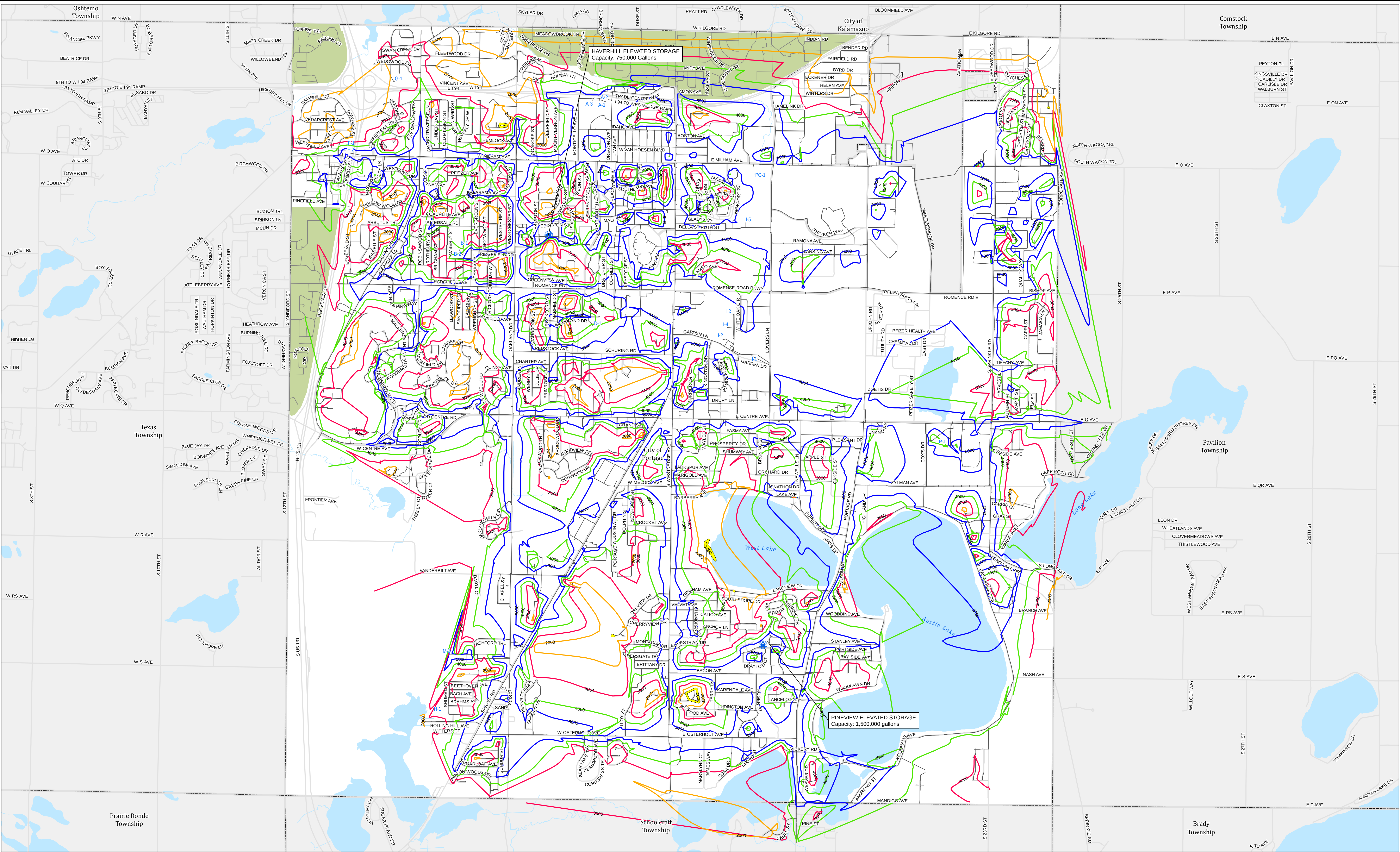


LEGEND

Pressure (psi)	70	Portage Water Main	Tank
50	80	Water Main Owned by Others	Franchise Area (City of Kalamazoo Water)
60			



- LEGEND**
- | | | | |
|-----------------|------|--|------|
| Fire Flow (gpm) | 3000 | Portage Water Main | Tank |
| 1000 | 4000 | Water Main Owned by Others | |
| 2000 | 5000 | Franchise Area (City of Kalamazoo Water) | |



LEGEND

Fire Flow (gpm)

1000

2000

3000

4000

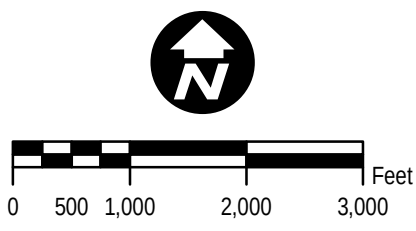
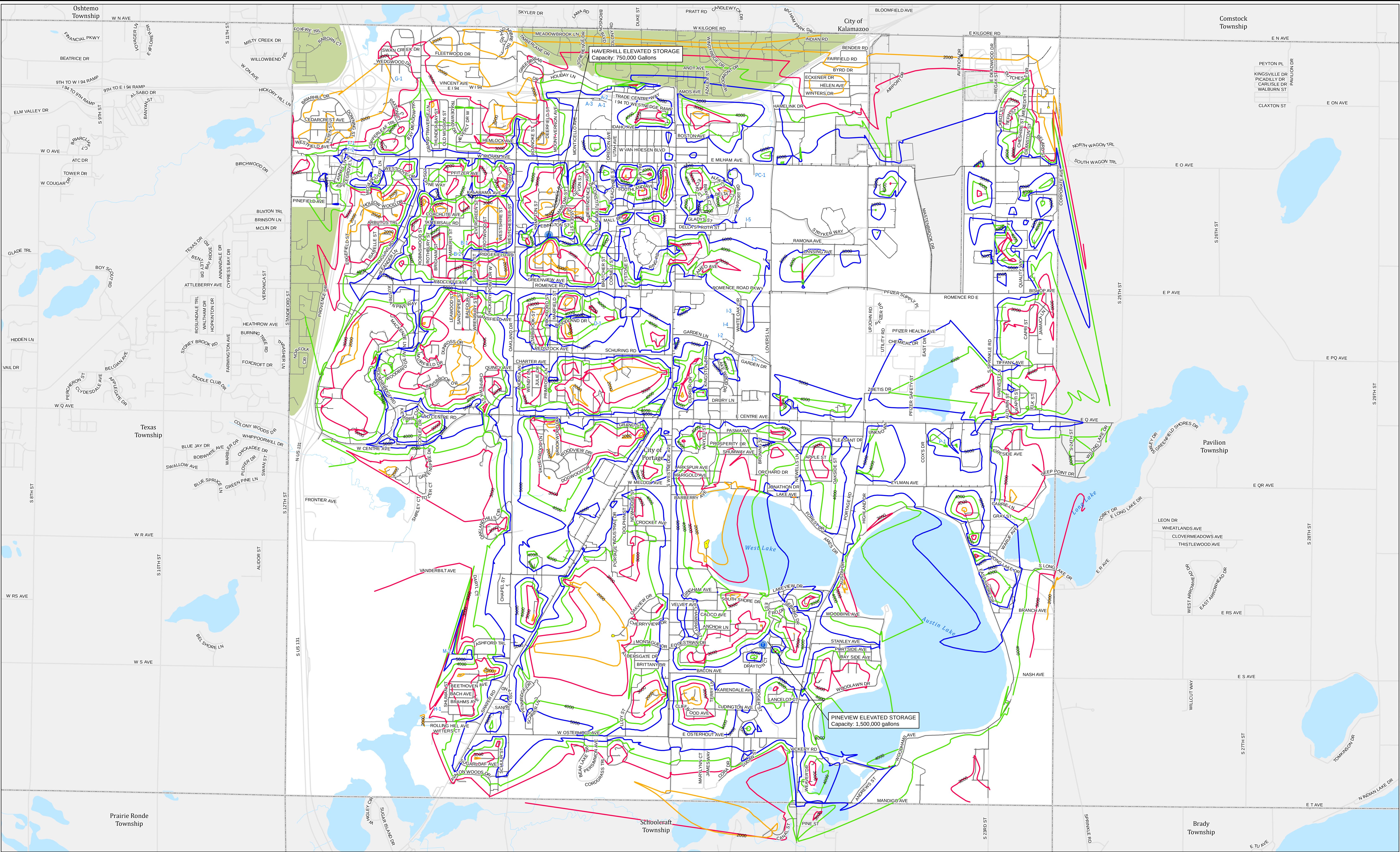
5000

Portage Water Main

Water Main Owned by Others

Tank

Franchise Area (City of Kalamazoo Water)



LEGEND

Fire Flow (gpm)	3000	Portage Water Main	Tank
1000	4000	Water Main Owned by Others	Franchise Area (City of Kalamazoo Water)
2000	5000		

Appendix D

Water Quality

The City of Portage provides this Annual Drinking Water Quality Report for review by Portage Water System customers, pursuant to requirements of the Federal "Safe Drinking Water Act." The City of Portage welcomes the opportunity to demonstrate the excellent level of water quality delivered to Portage residents and utility customers.

Portage Water Meets or Exceeds all Federal and State Quality Requirements

The water source for the Portage utility is groundwater from the Kalamazoo-Portage and Schoolcraft aquifers. Aquifers are water bearing formations beneath the surface of the earth that consist of sand and gravel deposited by glacial activity. The city water system uses 19 groundwater wells with pumping capacities ranging from 330 to 3,700 gallons per minute. The water is treated with chlorine, fluoride and phosphate. The city closely monitors the source water and the treated drinking water to ensure that a high level of quality and safety is maintained.

To ensure that tap water is safe to drink, the Environmental Protection Agency (EPA) prescribes regulations that limit the amount of certain contaminants in water provided by public water supplies. Food & Drug Administration regulations establish limits for contaminants in bottled water that provide the same protection for public health.

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 water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the United States

Environmental Protection Agency Safe Drinking Water Hotline (800-426-4791) or at <http://www.epa.gov/safewater>.

Veolia, operator of the city sewer and water utilities, routinely monitors for constituents/substances in the drinking water according to federal and state laws. The results of monitoring efforts for the period of January 1 to December 31, 2023 are provided in the table at the end of this report.

All drinking water sources contain naturally occurring levels of dissolved minerals and, in some cases, radioactive material. However, the presence of these minerals in small amounts is not a concern to the health and well-being of Portage utility customers.

Substances that may be present in source water include:

- » Microbial substances, such as viruses and bacteria, which may come from septic systems, sewage treatment plants, agricultural livestock operations and wildlife.
- » Inorganic substances, such as salts and metals, can be naturally-occurring or may result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming
- » Pesticides and herbicides may come from a variety of sources such as agriculture, urban stormwater runoff and residential uses.
- » Organic chemical substances, including synthetic and volatile organic chemicals, are by-products of industrial processes, petroleum production, gas stations, urban stormwater runoff and septic systems.
- » Radioactive substances can occur naturally or be the result of oil and gas production or mining activities.

QUESTIONS CONCERNING WATER QUALITY AND OTHER UTILITY SERVICES MAY BE DIRECTED TO THE FOLLOWING PERSONNEL:

Kendra Gwin, P.E.
 Director of Transportation & Utilities
 City of Portage
 7719 South Westnedge Avenue
 Portage, MI 49002
 (269) 329-4422

Judy Graham
 Utility Contract Administrator
 City of Portage
 7719 South Westnedge Avenue
 Portage, MI 49002
 (269) 329-4424

John Rydbeck
 Project Manager
 Veolia
 7701 South Westnedge Avenue
 Portage, MI 49002
 (269) 324-9235

The Portage City Council meets twice monthly on Tuesdays at 6 PM in Council Chambers at Portage City Hall (7900 South Westnedge Avenue).

As indicated in the water monitoring results on the following pages, the city water system had no Maximum Contaminant Level (MCL) violations during 2023. Through monitoring and testing, some substances have been detected; however, the concentrations found are well below the regulatory standards and not harmful to customers.

The MCL established for each substance is set by the EPA at a very stringent level. To understand the possible health effects described for many regulated substances, a person would have to drink two liters of water containing the substance at the MCL every day for a lifetime to have a one-in-a-million chance of having the described health effect.

While Portage drinking water meets EPA standards for arsenic, it does contain low levels of arsenic. EPA standards balance the current understanding of possible health effects of arsenic against the cost of removing arsenic from drinking water. The EPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

The City of Portage, to address water sources with higher arsenic levels, constructed a 5.7 million-gallon-a-day water treatment facility at the Garden Lane Well Field in 2010. The Garden Lane Water Treatment Facility removes arsenic, iron and manganese from the water and provides a dependable supply of water, meeting all EPA regulations. There are no detectable levels of lead in the City of Portage water system. If present, elevated levels of lead can cause serious health

problems, especially for pregnant women and young children.

The City of Portage water system has no known lead water service lines and is currently completing an inventory of the 15,000 water service lines. The material of approximately 4,400 water services have yet to be verified, however, they are not anticipated to contain lead. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City of Portage is responsible for providing high-quality drinking water but cannot control the variety of materials used in plumbing components. When water has been sitting (not running) for several hours, the potential for lead exposure can be minimized by flushing the tap for 30 seconds to 2 minutes before using the water for drinking or cooking. Water users concerned about lead in drinking water may wish to have the water tested. Additional information on lead in drinking water, testing methods and steps to minimize exposure is available from the Safe Drinking Water Hotline at (800) 426-4791 or at <http://water.epa.gov/drink/info/lead>.

Some people may be more vulnerable to substances 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 and some elderly and infants, can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. The Center for Disease Control (CDC) may be contacted at (800) 342-2437. Guidelines on appropriate means to lessen the risk of infection by microbiological substances are also available from the EPA Safe Drinking Water Hotline at (800) 426-4791.

Protecting Our Groundwater Source

The Michigan Department of Environment, Great Lakes and Energy (EGLE) performed source water assessments of all public water supplies to assess their susceptibility to contamination in 2003. The susceptibility rating, primarily based on geologic sensitivity and sources of contamination, uses a six-tiered scale from very low to very high. Based on the evaluation criteria, the assessment performed by EGLE rated the susceptibility of the ten City of Portage well sites as high. Questions regarding the Source Water Assessment may be directed to staff listed on the front page of this report.

The city has taken proactive steps to protect the groundwater, including the city's Wellhead Protection Program, Risk & Resilience Assessment, Stormwater Management Plan, Mandatory Sanitary Sewer Connection Program, Consolidated Drain Regional Stormwater Facility, and South Westnedge Avenue Stormwater Treatment Enhancement Project.

The 2021 updated **Wellhead Protection Program** helps identify sources of pollution that could potentially impact the groundwater supply. The program delineates measures that protect the groundwater from contamination. The **Risk & Resilience Assessment** also completed in 2021 evaluates the threats, vulnerabilities, and consequences of potential hazards. Strategies, plans, procedures, and resources to improve resilience were implemented.

The **Stormwater Management Plan** is a proactive plan developed to protect city groundwater resources. The plan defines the method of stormwater disposal in relation to the proximity of well sites or groundwater use. While it may impose additional cost to developments and businesses in Portage, the plan is a valuable tool used to protect the groundwater source from surface water runoff in commercial and industrial areas.

The **Mandatory Sewer Connection Program** eliminates the use of septic tanks and drain fields for wastewater disposal, as sanitary sewer service is made available. This helps eliminate the potential for groundwater contamination due to substances in the wastewater. As a result of this important program, more than 90 percent of all Portage residents utilize the city sanitary sewer system.

The **Consolidated Drain Regional Stormwater Facility** treats stormwater runoff from nearby commercial properties by removing sediment, grit, fertilizer, and other pollutants resulting in much cleaner water being discharged to Portage Creek.

The **South Westnedge Stormwater Treatment Enhancement Project** treats stormwater runoff from South Westnedge Avenue between West Centre Avenue and Garden Lane. The project eliminated direct stormwater discharges into Portage Creek resulting in much cleaner water discharged into Portage Creek.

Water Monitoring Terms

The Water Monitoring Results shown in the tables may contain terms and abbreviations you might not be familiar with. To help you better understand these terms, the following definitions are provided:

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

Detect (D) - laboratory analysis indicates the substance is present.

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

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

Maximum Residual Disinfection Level (MRDL) - the highest

level of a disinfectant allowed in drinking water. There is convincing evidence that the addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfection Level Goal (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.

Non-Detect (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 (ug/L) - one part per billion corresponds to one minute in 2,000 years, or a single penny in \$10,000,000.

Picocuries per liter (pCi/L) - picocuries per liter is a measure of the radioactivity in water.

Likely source of substance - if detected, where a substance may come from.

Per- and Polyfluoroalkyl Substances

Per- and polyfluoroalkyl substances, commonly known as PFAS, are contaminants of emerging concern. In 2020, EGLE established maximum contaminant levels (MCLs) and sampling requirements for seven PFAS compounds. PFAS are a large group of human-made chemicals that are fire resistant and

repel oil, stains, grease, and water. They have been widely used fire-fighting foams, stain repellents, nonstick cookware, waterproof clothing and shoes, fast food wrappers, personal care products and many other consumer goods. PFAS chemicals are very persistent, meaning that they do not easily break down in the environment. The sampling and test results for Portage are shown in the table below.

Per- and Polyfluoroalkyl Substances (PFAS)

Substance	Violation Yes/No	Highest Detected Level	Range Detected	Unit of Measurement	Year Sampled	Maximum Contaminant Level Goal	Maximum Contaminant Level	Likely Source of Substance
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	No	Non-Detect	Non-Detect	Parts per trillion	2023	N/A	370 ppt	Discharge and waste from industrial facilities utilizing the Gen X Chemical process
Perfluorobutane Sulfonic Acid (PFBS)	No	8.5 ppt	Non-Detect to 8.5 ppt	Parts per trillion	2023	N/A	420 ppt	Discharges and waste from industrial facilities; stain-resistant treatments
Perfluorohexane Sulfonic Acid (PFHxS)	No	5.4 ppt	Non-Detect to 5.4 ppt	Parts per trillion	2023	N/A	51 ppt	Firefighting foam; discharges and waste from industrial facilities
Perfluorohexanoic Acid (PFHxA)	No	2.4 ppt	Non-Detect to 2.4 ppt	Parts per trillion	2023	N/A	400,000 ppt	Firefighting foam; discharges and waste from industrial facilities
Perfluorononanoic Acid (PFNA)	No	Non-Detect	Non-Detect	Parts per trillion	2023	N/A	6 ppt	Firefighting foam; discharges and waste from industrial facilities
Perfluorooctane Sulfonic Acid (PFOS)	No	2.2 ppt	Non-Detect to 2.2 ppt	Parts per trillion	2023	N/A	16 ppt	Firefighting foam; discharges and waste from industrial facilities
Perfluorooctanoic Acid (PFOA)	No	Non-Detect	Non-Detect	Parts per trillion	2023	N/A	8 ppt	Discharge and waste from industrial facilities, stain-resistant treatments

Unregulated Contaminants

Substance	Highest Level Detected	Range Detected	Unit of Measurement	Year Sampled	Likely Source of Substance	Health Effects
Sodium	79 ppm	5 ppm to 79 ppm	Parts per million	2023	Erosion of natural deposits present in the environment	N/A

Annual Water Monitoring Results

Inorganic Substances

Substance	Violation Yes/No	Highest Level Detected	Range Detected	Unit of Measurement	Year Sampled	Maximum Contaminant Level Goal	Maximum Contaminant Level	Likely Source of Substance
Fluoride	No	0.75 ppm	Non-Detect to 0.75 ppm	Parts per million	2023	4 ppm	4 ppm	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
Nitrate (As Nitrogen)	No	2.3 ppm	Non-Detect to 2.3 ppm	Parts per million	2023	10 ppm	10 ppm	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Arsenic	No	3 ppb	Non-Detect to 3 ppb	Parts per billion	2023	0 ppb	10 ppb	Naturally present in the environment

Radioactive Substances

Substance	Violation Yes/No	Highest Level Detected	Range Detected	Unit of Measurement	Year Sampled	Maximum Contaminant Level Goal	Maximum Contaminant Level	Likely Source of Substance
Alpha Emitters	No	2.51 pCi/L	Non-Detect to 2.51 pCi/L	Picocuries per liter	2023	0 pCi/L	15 pCi/L	Erosion of natural deposits
Radium 226 & 228	No	1.189 pCi/L	0.407 pCi/L to 1.189 pCi/L	Picocuries per liter	2023	0 pCi/L	5 pCi/L	Erosion of natural deposits

Disinfection Byproduct Monitoring

Substance	Violation Yes/No	Range Detected	Annual Average	Unit of Measurement	Year Sampled	Maximum Contaminant Level Goal	Maximum Contaminant Level	Likely Source of Substance
Total Trihalomethane (TTHM)	No	26.0 ppb to 34.3ppb	30.2 ppb	Parts per billion	2023	N/A	80 ppb	Byproduct of drinking water disinfection
Haloacetic Acids (HAA5s)	No	8 ppb to 11 ppb	9.5 ppb	Parts per billion	2023	N/A	60 ppb	Byproduct of drinking water disinfection
Substance	Violation Yes/No	Range Detected	Running Annual Average	Unit of Measurement	Year Sampled	Maximum Disinfection Residual Level Goal	Maximum Disinfection Residual Level	Likely Source of Substance
Chlorine Residual	No	0.32 ppm to 0.36 ppm	0.36 ppm	Parts per million	2023	4 ppm	4 ppm	Water additive used to control microbes

Lead and Copper Monitoring

Substance	Violation Yes/No	Level Detected at 90th Percentile	Range Detected	Unit of Measurement	Year Sampled	Number of Samples Above Action Level	Maximum Contaminant Level Goal	Action Level	Likely Source of Substance
Lead	No	2 ppb	0 ppb to 18 ppb	Parts per billion	2023	1	0.0 ppb	15 ppb	Lead service lines, corrosion of household plumbing including fittings and fixtures; Erosion of natural deposits.
Copper	No	0.7 ppm	0 ppm to 1.7 ppm	Parts per million	2023	1	1.3 ppm	1.3 ppm	Corrosion of household plumbing systems; Erosion of natural deposits.

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 water with lead over many years could develop kidney problems or high blood pressure. Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.

2023 Well Partial Chemistry Data

		TP202	TP223	TP201	TP204	TP209	TP203	TP211	TP205	TP207	TP206	TP224
Partial Chemistry Individual Points of Entry Results	2023	Amberly	Garden Lane 5	Milham	Pershing	Portage Creek	Rolling Hills	Shuman	Wedgewood	Westfield	Winterforest	WTP
	(POE) Chloride (mg/L)	66	56	81	101	84	12	16	124	36	27	163
	(POE) Fluoride (mg/L)	0.75	ND	0.72	0.50	ND	ND	ND	0.67	0.45	ND	0.71
	(POE) Hardness (mg/L)	296	369	337	290	372	294	285	303	279	267	368
	(POE) Iron (mg/L)	ND	0.63	0.28	0.31	0.55	1.00	1.40	ND	0.45	0.63	ND
	(POE) Nitrate (mg/L)	2.30	ND	ND	ND	ND	ND	ND	1.00	0.60	ND	ND
	(POE) Nitrite (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	(POE) Sodium (mg/L)	37	14	42	53	16	5	7	79	22	6	74
	(POE) Sulfate (mg/L)	26	51	39	ND	40	41	48	27	ND	34	46

Partial Chemistry Results Summary	2023	Minimum	Maximum	Non-Weighted Average
	(POE) Chloride (mg/L)	12	163	70
	(POE) Fluoride (mg/L)	ND	0.75	0.63
	(POE) Hardness (mg/L)	267	372	315
	(POE) Iron (mg/L)	ND	1.40	0.66
	(POE) Nitrate (mg/L)	ND	2.30	1.30
	(POE) Nitrite (mg/L)	ND	ND	ND
	(POE) Sodium (mg/L)	5	79	32
	(POE) Sulfate (mg/L)	26	51	39

Appendix E

Water Shortage Response Plan

5.8.7 Water Shortage Response Plan

The City of Portage water system has been designed to minimize potential for occurrences of a water shortage. The facilities have adequate resources and the ability to respond to emergency scenarios, such as power outages, water main breaks, and water treatment and storage failures. This plan has been prepared to provide basic information on how the city would approach a water shortage, should one occur.

Per city ordinance the water distribution system is under the supervision and control of the City Manager. The City Manager or designee is authorized to make such rules, order or regulations as deemed advisable and necessary to ensure the efficient management and operation of the system including declaring and rescinding a water shortage notice.

In the event that water restrictions are necessary, the Director of Transportation and Utilities or the Deputy will initiate a news release. The Public Information Officer will manage the production and distribution of all public information, including news releases to media contacts, internet content and social media.

It is unlikely that in an emergency imposing water use restriction in steps will be possible. However, it is desirable to impose and lift usage restrictions in a progressive manner. Therefore, the restriction believed to be required to reduce demands to manageable levels should be implemented in one step. Relieving the restriction in two or more steps is preferable.

Level One – All uses of water permitted, except that lawn sprinkling and other outside plant watering is limited to two days a week for each household. Even numbered premises may water on Tuesdays and Thursdays. Odd numbered premises may water on Wednesdays and Fridays. Car washing is permitted anytime.

Level Two – Same as Level One, except that lawn sprinkling and other outside plant watering are limited to 4 a.m. to 8 a.m. time period.

Level Three – Water usage is limited to basic human needs, such as drinking, food preparation, bathing and other household uses; limited attended watering of outside plants using a hand-held hose; fire protection and public health and safety; as well as for essential industrial and commercial operations.

Level Four – Water usage is limited to basic human needs, public health and safety requirements and fire protection.

Level Five – Water service restricted to all customers except medical facilities, critical needs and limited fire protection to the extent that isolation of parts of the distribution system is possible through closing valves. Potable water for drinking and food preparation will be provided at selected “water points” manned by the City or other public emergency operations entities.