Town of Canandaigua

5440 Route 5&20 West
Canandaigua, N.Y. 14424

2017 WATER MASTER PLAN

for the

TOWN OF CANANDAIGUA

August 2017 (rev. 11/15/17)

MRB Group Project No. 0300.16002.000

Adopted by the Town Board on _______ by Resolution #________

Prepared by:

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EXECUTIVE SUMMARY

Created by Town Board resolution in April 2014, the Citizen's Implementation Committee (CIC) was tasked to revisit every goal and action step identified in the Town of Canandaigua's adopted 2011 Comprehensive Plan Update.

Working on concert with the recently adopted Agricultural Enhancement Plan and Sewer Master Plan, the CIC identified a need to prepare a Water Master Plan as part of the implementation plan for the Town's Comprehensive Plan and recommended to the Town Board that completion of this document occur as part of the 2017 goals. The Town Board authorized MRB Group to prepare the Water Master Plan with the Town's Public Works Committee and the CIC.

The Town of Canandaigua has undergone significant growth over the past decade. The water infrastructure serving the Town experienced a much higher and extended maximum day demand in 2016. This event highlighted a number of deficiencies with the system including source, storage and distribution.

This Water Master Plan identifies the two most significant recommended improvements to the Canandaigua Consolidated Water District: 1) replacement of the West Street Pump Station with a new Pump Station near Middle Cheshire Road, adjacent to the City of Canandaigua's water storage tanks and 2) replacement of the Cramer Road Water Storage Tank with twin storage tanks with a total volume of not less than 1.8 million gallons. In addition to these improvements, several beneficial watermain linkages/replacements are outlined to resolve pressure issues in the higher elevations of the distribution system such as adding a parallel 12" line to the Cramer Road Water Tank.

The purpose of this Water Master Plan is to provide the Town with a comprehensive planning tool for the next 30 years that would provide current factual data and other information relative to the water system serving the Town. The Water Master Plan will be utilized and shared amongst the Town’s Boards, as they consider new development in the Town and the potential impact to the water system.

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Acknowledgements

This document was prepared in collaboration with:

- The Public Works Committee, comprised of:
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- The Citizens Implementation Committee, comprised of:
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    2. Ray Henry, Historian
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    5. Gary Davis, former Zoning Board Member
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    7. Joyce Marthaller, Environmental Conservation Board Chair
    8. Patricia Venezia, Environmental Conservation Board Member
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LIST OF ACRONYMS

ADF	Average Daily Flow
CIC	Citizen's Implementation Committee
EDU	Equivalent Dwelling Unit
GPM	Gallons per Minute
HGL	Hydraulic Grade Line
IMA	Inter-Municipal Agreement
IUP	Intended Use Plan
MGD	Million Gallons per Day
OCIDA	Ontario County Industrial Development Agency
O&M	Operation and Maintenance
PDR	Purchase of Development Rights
PPL	Project Priority List
TDH	Total Dynamic Head
WTP	Water Treatment Plant (drinking water)
NYSDOH	New York State Department of Health
NYEFC	New York State Environmental Facilities Corporation
TTHM	Total Triahalomethanes
HAA5	Five Haleocitic Acids
DBP	Disinfection Byproducts
WD	Water District

I. INTRODUCTION

In 2014, the Town Board charged the CIC with reviewing the 2011 Comprehensive Plan and making recommendations regarding the implementation of the plan. After lengthy review, the Town Board adopted an updated series of action in 204 steps relating to the implementation. In January 2015 the CIC held a strategic planning session to identify the initial action items. The development of a Town of Canandaigua Water Master Plan ranked as one of the top priorities after the completion of an Agricultural enhancement Plan and Sewer Master Plan. Specifically the adoption of a water master plan relates to goal #9 of the Town of Canandaigua Comprehensive Plan. The Water Master Plan was assigned to the Town's Public Works Committee and the Town Engineer for creation of the document.

This Master Plan considers the needs of the Town of Canandaigua water system and future growth in the Town of Canandaigua with respect to the Town's Comprehensive Plan to the year 2050. This Master Plan updates improvements contemplated in the 2011 *Hydraulic Analysis Update for the Town of Canandaigua Water Distribution System,* considers additional improvements identified by the Public Works Committee, and reviews potential service areas.

This document will consider the needs of the water system, both system integrity and water quality, and consider the future growth of the Town. The Water Master Plan will include a plan for infrastructure improvements to continue the high level of service to its customers/future growth as well as prepare a plan for the expansion of public water to areas currently unserved in the event public interest warrants.

II. BACKGROUND

The Town of Canandaigua is in Central Ontario County surrounding the City of Canandaigua. Canandaigua Lake and the Towns of Hopewell, Farmington, East Bloomfield, Bristol, South Bristol and Gorham bound the Town of Canandaigua.

Public water is provided in the Town by a complex array of water districts. The Town of Canandaigua includes three parent water districts administered by three separate municipalities consisting of six general service areas. The water districts are:

1. *Canandaigua Consolidated Water Districts,*
3. *Canandaigua-Farmington Water District*, and
4. *Canandaigua-Hopewell Water District.*

Town of Canandaigua also administers the *Town of Bristol Water District.*

The service areas include:

1. Canandaigua Consolidated,
2. Canandaigua-Bristol,
3. City of Canandaigua supplied areas,
4. Canandaigua-Farmington Water District,
5. Canandaigua-Hopewell Water District, and;
6. City of Canandaigua billed.

Appendix A includes an overall Town of Canandaigua Water District Map based on data provided by Ontario County Planning. The map also includes water districts in East Bloomfield and Bristol that are supplied by Town of Canandaigua. Also shown are two pending water districts: Rossier Road and Woolhouse Road (Extension 42), and County Road 32 (Extension 41). As of the writing of this *Master Plan*, these two districts were moving through the district formation process.

A. Canandaigua Consolidated Water Districts

The Canandaigua Consolidated service area, the City of Canandaigua supplied areas, and the Canandaigua-Bristol service area comprise the *Canandaigua Consolidated Water Districts*, referenced as the "Town of Canandaigua Water Districts" in the Annual Water Quality Reports. The Town of Canandaigua administers the district. Ontario County Planning documents and Town of Canandaigua water meter account information identify the original water districts that were consolidated to form the *Canandaigua Consolidated Water Districts*.

Table II.1: Canandaigua Consolidated Water Districts

DISTRICT CODE	DISTRICT NAME	FINACIAL CODE
WD-247	Canandaigua Consolidated Water District	S247
--	Canandaigua Consolidated Water District - Par	--
WT243	Canandaigua Consolidated Water District 8	S243
WT244	Canandaigua Consolidated Water District 9	S244
WT241	Canandaigua Consolidated Water District Extension 6	S241
WO245	Canandaigua Consolidated Water District Extension 31	S245B
WO246	Canandaigua-Bristol Water District	S246A
WO-248	Hickox Road Water main Extension 38	S248D
WA248	Hopkins-Grimble and County Road 32 Water District	S248A
WO249	Nott Road Water District Extension 40	S249A
WD249	Parrish Street Extension Water District Ext. 20	S249
WT245	The West Lake Road Benefit Basis Water District	S245A
WT246	Wyffels Road Water District Extension 10	S246
--	Beecher Tract Water District Extension	--
--	Canandaigua Consolidated Water District 11	--
--	West Lake Boulevard Water District Extension	--
WD262	East Bloomfield Water District 2	--
--	East Bloomfield Water District 2 Extension 1	--
Pending	Woolhouse Road & Rossier Road	Pending
Pending	CR32 (Bristol Rd)	Pending

The Town of Canandaigua purchases water from the City of Canandaigua, which owns and operates a water treatment plant located at 3772 County Road 16 on the west shore of Canandaigua Lake. A pump station at 3178 West Street pumps water purchased from the City to the Cramer Road Tank. Town of Canandaigua administered areas contain approximately 85,000-feet of 12-inch diameter water main, 300,000-feet of 8-inch diameter water main, 14,000-feet of 6-inch diameter water main, and 8,000-feet of 4-inch or less water lines.

The Town of Canandaigua sells water to Town of East Bloomfield through a master meter connection on Routes 5&20 at the Town line. Town of East Bloomfield administers the East Bloomfield water districts. Water demands however, are included in the Canandaigua Consolidated Water District service area demands.

City of Canandaigua owns and operates a transmission main that runs along County Road 16 between its water treatment plant and the City limits. City of Canandaigua services water customers along the County Road 16 main. Even though this main is in the Town of Canandaigua, the properties served by the main are not included in the *Canandaigua Consolidated Water Districts*.

B. Town of Bristol Water District

The Town of Canandaigua supplies the Town of Bristol Water District (Code SD201) through a connection on Goodale Road (Montanya Road). The district is in the Town of Bristol but is serviced by the Town of Canandaigua. Annual Water Quality Reports reference the district by the same name.

C. Canandaigua-Farmington Water District

Town of Farmington administers the Canandaigua-Farmington Water District and its service area. Records indicated that the district consists of four former, Town of Canandaigua water districts.

Table II.2: Canandaigua-Farmington Water District

DISTRICT CODE	DISTRICT NAME
WD241	Canandaigua-Farmington Water District
WT248	Risser Road Extension Water District
--	Emerson-Allen-Townline Road Water District Extension
--	North Road and Andrews Road Water District Extension

D. Canandaigua-Hopewell Water District

Town of Hopewell administers the Canandaigua-Hopewell Water District. A water main on Chapin Road (State Route 21), between the City of Canandaigua and County Road 22 is part of the *Canandaigua-Consolidated Water Districts* but is currently billed and administered as part of the Canandaigua-Hopewell Water District.

The Inter Municipal Agreement (circa 1970's) between the Towns of Canandaigua and Hopewell gives the administration duties to the Town of Hopewell. The agreement also included a clause that once the debt service was retired, the Town of Canandaigua would take over ownership of the water mains.

As of June 2017, Town of Canandaigua and Town of Hopewell were in discussions concerning transition of ownership and administration duties of the *Canandaigua Hopewell Water District* as these districts no longer have debt service. Preliminary discussions indicate that the Canandaigua water mains will be consolidated into the *Canandaigua Consolidated Water Districts*.

E. Nomenclature

Because of the similar names between the water districts and service areas, and the overlap between the two, this *Water Master Plan* will endeavor to utilize *italics* to indicate a water district name. Service area names are in plain text. The figure in Appendix B graphically shows the locations of the service areas. Service area boundaries are a general representation only, not intended to show hard borders.

III. POPULATION GROWTH

Population growth in this document was evaluated using three methods: 1) using census data and regional planning documents that consider long term planning durations, 2) utilizing more recent housing trends/permitting in the Town to indicate the short term growth trends as indicated in the Town's *Agricultural Enhancement Plan*, 3) maximum buildout analysis based on current zoning in potential growth locations as indicated by the Town's *Sewer Master Plan*. Regional planning documents often require substantial correction based on short-term population trends at the local level. Canandaigua has experienced significant growth over the past 10-15 years.

The Genesee – Finger Lakes Regional Planning Council (GFLRPC) indicates that the Towns of Canandaigua, Bristol and East Bloomfield are areas set for future population growth throughout the planning period. Growth consists of residential (including apartments, townhomes, single-family homes and multi-family homes), commercial and industrial development within existing and expanded service areas. It is beyond the scope of this document to determine which form of development is more likely to occur to meet the future growth needs of the Town of Canandaigua.

There are two aspects to population growth considered by this *Water Master Plan*. The first is the overall growth in the entire Town of Canandaigua, and the second is the growth in population served by water.

Town of Canandaigua population growth is a function of population migration, housing unit occupancy ratios, and development trends over the planning period (2015 to 2050).

The growth in population served by water is also dependent on the same factors as Town population growth but also considers population with access to public water but not currently served, water district formation to serve areas desiring public water, and similar growth considerations in other Towns supplied by the Town of Canandaigua. Currently Town of Canandaigua supplies water districts in the Towns of East Bloomfield and

Bristol. This *Water Master Plan* utilizes population growth based on population served by water to assess the impact of growth on the existing water system infrastructure.

A. Population with Water Estimate

Not all people in the Town of Canandaigua have access to public water and of those that do, not all are connected to public water. In order to assess the impact of growth on the water system, it was necessary to estimate the number of residents on water in each of the service areas utilizing a multi-step process.

The first step involved reviewing US Census data for population and occupied housing unit estimates to determine the number of people per occupied housing unit. The most recent published data is the 2015 US Census ACS Estimates.

Table III.1: 2015 US Census Estimates

Town	Total Population	Occupied Units	Capita/Unit
Canandaigua	10,390	4,383	2.37
Bristol	2,175	846	2.57
East Bloomfield	3,634	1,449	2.51

GIS tax parcel information provided by Ontario County Planning was then reviewed to identify parcels served by water and number of such parcels in each service area. The tax parcel information includes data on water supply: community/public, private, or none. Individual Town assessors provide this information to the County. The number of parcels designated with public water is greater than the number of water accounts. This method however, provides a reasonable estimate for the overall distribution system since, on average, the ratio of services to watered parcels is uniform.

After determining the number of watered parcels in a service area, the data was further broken down by type: agricultural, residential, commercial, vacant land or other uses. Equivalent dwelling units (EDU) were then assigned to each residential, commercial residential (apartments), and commercial parcel based on dwelling type. EDU were not assigned to agricultural lands or other types of property to simplify the review process and because anticipated growth in the system is expected to be more residential in nature.

The total number of EDUs was then compared to the US Census number of occupied units. EDUs assigned to commercial-residential and commercial properties were adjusted until the two values matched.

Population estimates for each service area were then made based on the number of EDU in the area and the occupancy ratio (capita/unit).

Based on this, the 2015 population estimate of peopled served by water in the *Canandaigua Consolidated Water Districts* is 5,184. The balance of the Town population either does not have access to public water or is located in other water districts.

The *Canandaigua Consolidated Water Districts* supplies water to the Town of East Bloomfield with an estimated 510 people on water and the *Town of Bristol Water District* with a population served by water of approximately 132.

B. Existing Town Population Estimates

GFLRPC provides historical population data and population projections for Ontario County and Town of Canandaigua based on US Census Data. GLRPC's population projections for Ontario County show a steady, yet tapering increase through the year 2050 (

Table III.2).

Table III.3 lists the population growth and projection for Town of Canandaigua from 1980 to 2050 as reported by the GFLRPC.

Table III.2: Ontario County Population

Year	Population	% Change
1980	88,909	12.8%
1990	95,101	7.0%
2000	100,224	5.4%
2010	107,931	7.7%
2020	111,117	3.0%
2030	113,818	2.4%
2040	116,163	2.1%
2050	118,234	1.8%

Table III.3: Town of Canandaigua Population

Year	Population	% Change
1980	6,060	11.8%
1990	7,160	18.2%
2000	7,649	6.8%
2010	10,020	31.0%
2015	*10,390**	*3.7%*
2020	10,593	2.0%
2030	11,080	4.6%
2040	11,502	3.8%
2050	11,875	3.2%

*US Census five year estimate.

C. Potential Future Population

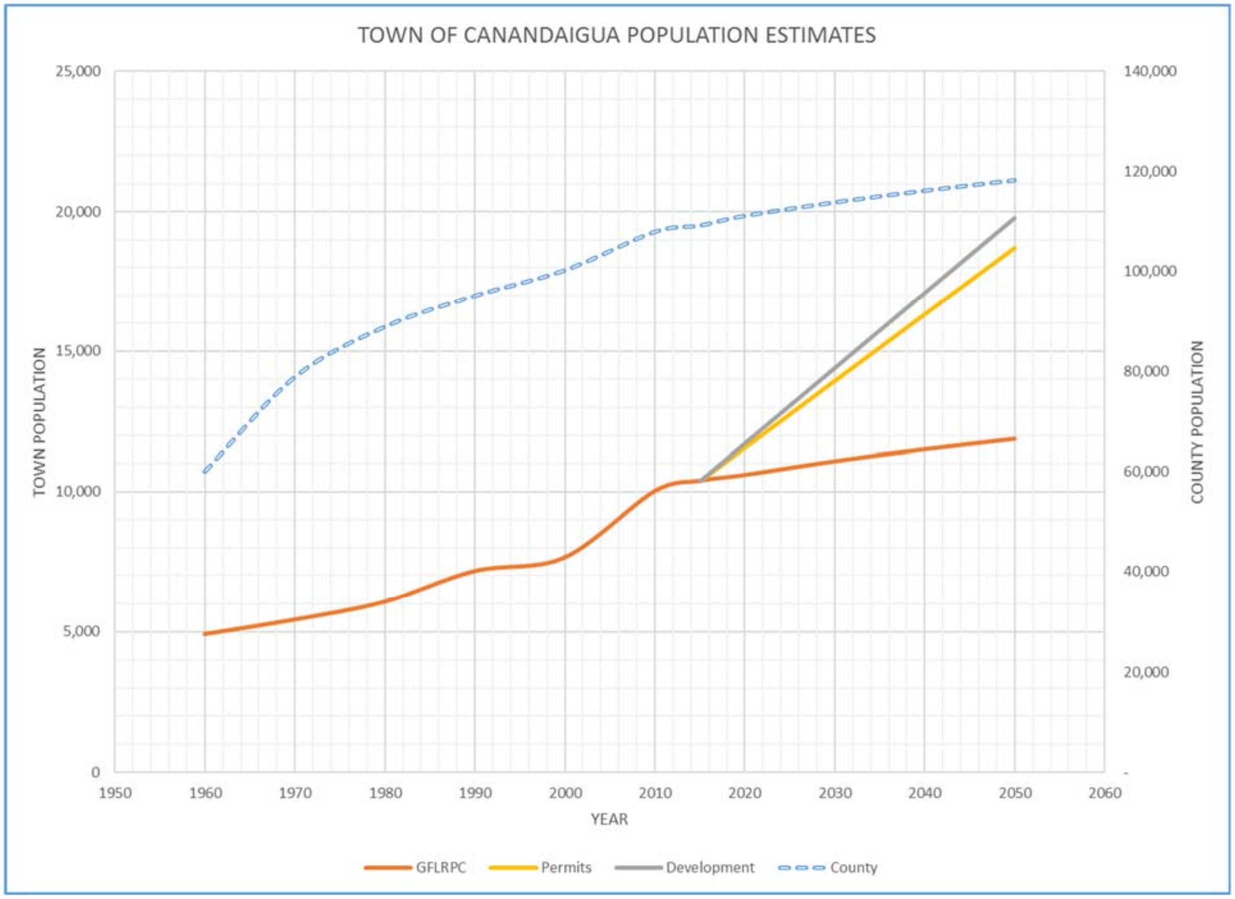
Anticipated future residential development will likely occur in areas in close proximity to public sewer and water, and where zoning is favorable to development. As stated above, three methods were utilized to estimate population growth in the Town of Canandaigua.

The first is acceptance of the GFLRPC projections resulting in a 2050 population estimate of 11,875. The GRLRPC projected populations show a significant decrease in growth (on a "% Change" basis) when compared to previous years. Considering this, recent development trends, and the number of Town issued housing permits over the past several years, the GFLRPC projections likely underestimate future population growth in the Town.

The second method was simple linear growth based on the average number of residential building permits issued per year. The *Town of Canandaigua Agricultural Enhancements Plan* (LaBella Associates, December 2016) indicates that from 2004 to 2015 the Town issued, on average 118.8 residential permits. The "Projected Development Section" of the *Agricultural Enhancements Plan* states that the Town can expect 100 new dwellings per year. Based on this, the estimated population in year 2050 is 18,687.

Lastly, the *Sewer Master Plan for the Town of Canandaigua* (MRB Group, 2/29/2016) reviewed possible future growth areas for the Town's sewer system. Growth in these areas may also potentially affect water demand. (Refer to the *Sewer Master Plan* for a description of the analysis utilized to estimate growth in these areas.) The final population growth method was an analysis of developable land and potential water district extensions in existing service areas and in possible future growth areas. This method produced the most conservative results with a 2050-projected population of 19,782. This method also produced estimated Town population growth and an estimated growth of water customers.

Figure III.1: Population Projections



D. Water Supply Population Growth

This *Water Master Plan* also considered population within the various supply areas by reviewing the number of parcels potentially in existing service areas that may be available through district expansion without further subdivision. The following summarizes the possible future growth areas by Service Area. Included is future growth due to development as identified in the *Sewer Master Plan for the Town of Canandaigua*.

1. Canandaigua Consolidated Service Area

The Canandaigua Consolidated Service Area has an estimated existing population of 5,184 served by water including 510 people in East Bloomfield. The West Street pump station supplies this portion of this service area. Potential growth from within the existing service area is 118 EDU.

There are limited areas in the Town of Canandaigua for water district expansion due to the elevation of the Cramer Road tank. Those areas that can potentially be added as water districts may yield an additional 58 EDU.

Consideration was also given to raising the Cramer Road tank and adding a new tank on Smith Road. This increased service area may potentially yield an additional 283 EDU.

Potential long-term development in the Town of East Bloomfield based on new districts is limited by the City of Canandaigua's water supply permit. The permit includes a delineated supply area for the City of Canandaigua. Potentially East Bloomfield may yield an additional 250 EDU.

Located in the southwest portion of the Town is an area of high elevation, above the potential service area that may be served by a tank on Smith Road. This area includes parcels in the Town of Canandaigua and Bristol. This area can potentially be served by a dedicated, pressure booster station and can add 79 EDU.

The following areas were identified in the *Sewer Master Plan* as areas of potential development through subdivision of land.

SCR-1 Area: The probable maximum build out of vacant parcels in the SCR-1 zoned areas could conservatively yield 1,032 EDUs.

Outhouse Park Area: The probable maximum build out of the Outhouse Park Area could conservatively yield 318 EDUs.

The total future population of the Canandaigua Consolidated Service Area at the end of the planning period is 1,350 EDU. The potential future population is 10,300.

2. Canandaigua-Bristol Service Area

The Canandaigua-Bristol service area is the service area upstream of the Pierce Park pump station including the *Town of Bristol Water District*. The 2015 estimated population in this service area is 175 (69 EDU). Growth within the exiting Canandaigua-Bristol Service Area may potentially add 50 EDU.

Long term growth, based on new districts within the supply area as limited by the City of Canandaigua's water supply permit may yield an additional 548 EDU. This growth includes parcels in the Town of South Bristol extending south to the Bristol Mountain Resorts.

The potential future population of the Canandaigua-Bristol service area is 1,410.

3. City of Canandaigua Supplied Service Areas

The City of Canandaigua supplied service areas are close to full buildout and has an estimated existing population of 449. The estimated growth in this area is 16 EDU or 37 people.

4. Canandaigua-Farmington Water District Service Area

The estimated population served by water in this service area is 2,523 people. Potential growth in and expansion to the Canandaigua-Farmington service area may yield a population of 5,481.

Most of the growth is anticipated from development as identified in the *Sewer Mater Plan*. These areas include the following.

Uptown Area: The Uptown Area, which is immediately north of the City between Brickyard and CR 28

MUO-2 Area: This area is in the most northern portion of the Town, in the immediate vicinity of NYS Rte. 332.

Potential development in the northwestern portions of the Canandaigua-Farmington service area may potentially be limited by the Padelford Brook Greenway, an area created by the Town of Canandaigua in 2015 that is identified as being agriculturally significant.

5. Canandaigua-Hopewell Water District Service Area

Limited open space is available in this area for development due to the Canandaigua Outlet, the Village of Palmyra raw water line, and Village of Newark raw water line. The estimated population served by water in this area is 1,042. As of the writing of this *Water Master Plan*, a large apartment complex with up to 300 units located on County Road 10 is under review. This development may add over 712 people.

The *Sewer Master Plan* identified the NYS Rte. 364 Corridor Area as an area of potential development. The NYS Rte. 364 area is on the eastern side of the Town, just south of Route 5 & 20 West. This area is zoned CC, R-1-20, MH and MR. This area is also within the potential MUO-3 extension.

6. City of Canandaigua Billed Service Area

The City of Canandaigua billed service area runs along County Road 16 has an estimated population of 234. There is room for potential growth through construction on existing parcels. The potential increase in this area is 41 EDU for a population increase of 96.

7. South Bristol

Located in the Town of South Bristol is the Bristol Harbor development on the west shore of Canandaigua Lake. The development is served by private water supplies and has expressed an interest in obtaining public water. This area of South Bristol is outside the permitted supply area for the City of Canandaigua. A modification to the City of Canandaigua water supply permit would be needed to supply Bristol Harbor. This development, can potentially add 1,141 people if added to the supply area.

8. Total Water Supply Population Growth

The estimated population currently supplied with water by the Town of Canandaigua is approximately 9,604. Based on the development potential discussed in this section, the potential future population served by water is 23,296, not including Bristol Harbor.

Table III.4 - Water Supply Area Population

Year	CCSA	CBSA	City SA	CFSA	CHSA	City Billed	Total
2015	5,184	175	449	2,523	1,040	234	9,604
2020	5,993	394	454	3,330	1,142	247	11,560
2030	7,611	834	465	4,942	1,346	275	15,472
2040	9,229	1,273	475	6,555	1,550	302	19,384
2050	10,847	1,712	486	8,168	1,754	330	23,296

Table III.5 - Water District Population

Year	CCWD	BWD	CFWD	CHWD	Total
2015	5,676	132	2,523	1,040	9,371
2020	6,506	394	3,330	1,142	11,371
2030	8,165	834	4,942	1,346	15,287
2040	9,825	1,273	6,555	1,550	19,202
2050	11,484	1,712	8,168	1,754	23,118

IV. WATER DEMAND

A. EXISTING WATER DEMANDS

Two sources of water demand information were available for review: Annual Water Quality Reports and Water Meter Readings. Water use estimates were also available based on service area population.

1. Annual Water Quality Reports

Town of Canandaigua's *Annual Water Drinking Quality Reports for the Bristol-Canandaigua Water Districts* provide "Facts and Figures" separately for the *Town of Canandaigua Water Districts* and the *Town of Bristol Water District*. According to the Water Department, the total amount of water purchased from City of Canandaigua noted in the reports is the sum of the two districts.

According to the 2015 *Annual Drinking Water Quality Report for the Bristol-Canandaigua Water Districts*, the total water purchased from City of Canandaigua by the Canandaigua Water Districts in 2015 was 163,883,000 gallons with total sales of 149,040,000 gallons for a total loss of 14,843,000 gallons (approximately 9.1%). Average day purchase was 449,000 gallons. The single highest day was 978,000 gallons, for a maximum day ratio of 2.18.

TR-16, *Guide for the Design of Wastewater Treatment Works* (1998 Ed.), Figure 2-1, Ratio of Extreme Flow to Average Daily Flow, shows a maximum 24-hour ratio for 449,000 GPD of 2.4. This ratio is similar in magnitude to the 2.18 ratio in 2015 for water. The Figure also shows a Peak on Maximum Day ratio of 4.2, indicating that the peak hour water demand in 2015 was approximately 1,310 gpm.

The 2016 *Annual Drinking Water Quality Report for the Bristol-Canandaigua Water Districts*, reports that the total water purchased from City of Canandaigua by the Canandaigua Water Districts in 2016 was 202,000,000 gallons with total sales of 174,000,000 gallons for a total loss of 32,000,000 gallons (approximately 15.5%).

Average day purchase was 564,000 gallons. The single highest day was 978,000 gallons, for a maximum day ratio of 2.23. The TR-16, Figure 2-1 derived Peak on Maximum Day ratio of 4.2 is the same. The estimated peak hour demand is therefore 1,646 gpm.

Table IV.1: Town of Canandaigua Water Districts

Demand	2015	2016	Unit
Average Day	449,000	486,000	gallons
Maximum Day	978,000	1,059,000	gallons
Peak Hour	1,310	1,418	gpm

Table IV.2 summarizes a similar review of the *Town of Bristol Water District*.

Table IV.2: Town of Bristol Water District

Demand	2015	2016	Unit
Average Day	10,800	18,300	gallons
Maximum Day	35,000	53,000	gallons
Peak Hour	39	53	gpm

2. Water Meter Readings

Town of Canandaigua has master meters located at each districts' boundary that record the volume of water used by the district. Additionally, each water service has a water meter that records the volume of water used per customer. Town of Canandaigua receives revenue based on the volume of water recorded by the service meters and then reimburses the City of Canandaigua based on the volume of water recorded at the master meter. Water use data reported in the table in Appendix C summarizes on metered sales data provided by the Water Department. Included in the table are purchase estimates per quarter that are based on the ratio of water purchased to sold as determined from the 2015 Annual Water Quality Report.

2016 was an unusually dry year with prolonged high demands. As shown in Appendix C, the third quarter was the highest on record with total sales of 58,710,000 gallons. The estimated average daily amount purchased was 781,000 gallons. The TR-16, Figure 2-1 ratios for this demand are 2.3 for maximum day and 3.9 for peak hour. The estimated maximum day demand is 1,796,000 gallons; estimated peak hour is 2,115 gpm.

The table in Appendix C also shows that the third quarter of 2015 had the highest demand for that year. The table also shows that from 2015 to 2016 that 46 accounts were added to the service area. It is therefore likely that the significant increase in water use from 2015 to 2016 was not only caused by a drought, but that new residents attempting to establish new lawns exacerbated it.

Table IV.3 summarizes the estimated water demands for the *Town of Canandaigua Water Districts* for 2015 and 2016 based on metered sales. Table IV.4 shows similar data for the *Town of Bristol Water District*.

Table IV.3: Town of Canandaigua Water Districts

Demand	2015	2016	Unit
Average Day	468,000	540,000	gallons
Maximum Day	1,020,000	1,205,000	gallons
Peak Hour	1,370	1,570	gpm

Table IV.4: Town of Bristol Water District

Demand	2015	2016	Unit
Average Day	11,200	17,500	gallons
Maximum Day	36,500	50,700	gallons
Peak Hour	40	51	gpm

3. Population Based Estimates

In 2015, the estimated population served by water was 5,808 and the total system average day demand was 479,000 gallons. The estimated water use is therefore 83 gallons per capita-day. The following two tables list the estimated demands for the two Town of Canandaigua Administered water districts based on population. No estimates were made for 2016.

Table IV.5: Town of Canandaigua Water Districts

Demand	2015	Unit
Average Day	468,000	gallons
Maximum Day	1,020,000	gallons
Peak Hour	1,370	gpm

Table IV.6: Town of Bristol Water District

Demand	2015	Unit
Average Day	10,900	gallons
Maximum Day	35,500	gallons
Peak Hour	39	gpm

B. Potential Future Water Demands

Each method for estimating existing system demands produced similar results. For purposes of the *Water System Master Plan*, future demands are based on:

1. 2015 meter read data as the base average day demand,
2. population projections based on the more conservative parcel based potential growth estimates, and
3. estimated water use of 83 gallons per capita-day.

Table IV.7: Future Water Demands

Town of Canandaigua Consolidated Water Districts

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	464,957	532,165	666,581	800,997	935,413	gallons
Maximum Day	1,012,768	1,159,161	1,451,947	1,744,732	2,037,518	gallons
Peak Hour	1,356	1,552	1,944	2,336	2,728	gpm

Town of Bristol Water District

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	14,431	32,557	68,810	105,063	141,316	gallons
Maximum Day	46,970	105,967	223,962	341,956	459,951	gallons
Peak Hour	52	118	248	379	510	gpm

Total Water Districts

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	479,388	564,722	735,391	906,060	1,076,729	gallons
Maximum Day	1,044,202	1,230,078	1,601,829	1,973,580	2,345,331	gallons
Peak Hour	1,398	1,647	2,145	2,643	3,140	gpm

C. Agricultural Demands

Metered water use data provided by the Town of Canandaigua includes water use for all properties. Water use estimates are based on residential and commercial properties with the total demand averaged over each. Within the meter data are readings for agricultural properties. Their use is included in the demands applied to the property types.

One agricultural property of note is the Knopf Farm, a Dairy that used over 194,000 gallons in the third quarter of 2016. This represents an average day demand of 21,800 gallons per day. A paper, *Scientific Data for Developing Water Budgets on a Dairy* (J.P. Harner, ect., March 6-8, Reno, NV) studied water use at several dairies and concluded that the annual daily water required for a lactating cow ranges from 57 gallons per day to 72 gallons per day. Water use includes (not an exhaustive list) consumption by the herd, cleaning and cooling. This indicates that the size of the Knopf heard is between 300 to 380 head. The Knopf Farm is located on Cooley Road in the Northern zone of the Canandaigua Consolidated service area. The Knopf farm water supply is provided through the West Street Pump Station.

Two other dairies in the Town of Canandaigua have access to public water but are not included in the water meter data. One farm is on County Road 30, also in the North zone. The second is on Sand Hill Road in the Canandaigua-Farmington service area. The size of the herds are unknown but should be taken into consideration if either dairy applies for a water service. Based on the paper, a heard with 100 head may require the same water needs as a 40 to 55 lot, single-family residential subdivision.

D. INDUSTRIAL DEMANDS

The Town's Comprehensive Plan directs industrial and commercial development to the north and east of the City of Canandaigua. These areas are within the Canandaigua – Farmington WD and Canandaigua – Hopewell WD. Industrial/commercial demands vary significantly depending on the type of facility proposed. Industrial/commercial development typically will have fire demands significantly higher than residential demands. Each industrial/commercial development needs to be evaluated based on its specific demands. In general, the existing distribution system in the Canandaigua – Farmington WD is more suitable to greater industrial/commercial demands due to the size of the mains, looping, and interconnections. Canandaigua - Hopewell WD could require significant improvements to accommodate greater water/fire demands.

V. EXISTING WATER SYSTEM

Town of Canandaigua's water system includes six general service areas. This *Water Master Plan* primarily examines the Canandaigua Consolidated, Canandaigua- Bristol, and the City of Canandaigua supplied service areas. Comments on the Canandaigua-Farmington, Canandaigua-Hopewell, and City Billed service areas are provided where appropriate for a more comprehensive assessment.

Appendix D includes a, *Water Distribution System Hydraulic Analysis* (MRB Group, 2017) (*Hydraulic Analysis*). Exhibit A, *Existing Water System Schematic 2017,* of the *Hydraulic Analysis* is a schematic of the existing distribution system,

A. SOURCE

City of Canandaigua owns and operates a surface water treatment plant located on County Road 16 (CR 16) in the Town of Canandaigua. The City is permitted to take 9.0 million gallons of water per day from Canandaigua Lake, limited to an annual average of 6.0 MGD (Water Supply Permit effective 8/26/2011). The City currently supplies water through a 30-inch transmission main on Middle Cheshire Road that runs from the City reservoirs to Parrish Street where it splits into a parallel 24-inch and two 12-inch lines along West Street. The West Street pump station draws off one of the 12-inch lines to supply the Canandaigua Consolidated service area and fill the Cramer Road tank. A City owned 16-inch transmission main along CR 16 supplies Town water districts on Bedford Road and West Lake Blvd. The Town water district along Fallbrook Park is supplied from a City 12-inch main in the Roseland area.

City of Canandaigua supplies the *Canandaigua-Farmington Water District* through water meters on Brickyard Road, Middle Lake Drive and North Main Street.

City of Canandaigua also supplies the *Canandaigua-Hopewell Water District* through metered connections on Lakeshore Drive, County Road 10, Ontario Street and State Route 21 (Chapin Road). As previously noted, the section of water main on Chapin Road is actually in the *Canandaigua-Consolidated Water Districts* but is currently being administered by Town of Hopewell. An 8-inch water main on State Route 384 is in the *Canandaigua-Hopewell Water District* but is supplied by Town of Hopewell after its pump station on Lakeshore Drive. This water main is in a different pressure zone than the Fallbrook water main out of the City.

As noted previously, as of the writing of this report, Town of Canandaigua is exploring the potential of taking over water mains located in the Town of Canandaigua that are now part of the *Canandaigua-Hopewell Water District*. When the transition is complete, metering in the service area by and between Town of Canandaigua and Town of Hopewell is subject to change.

B. DISTRIBUTION

The topography of the Canandaigua Consolidated Water District (CCWD) varies considerably. Elevations range in the district from approximately 688 feet to elevation 1,414 feet. The highest point is near 6230 Goodale Road in the Canandaigua-Bristol service area. The CCWD distribution system contains roughly 70 miles of watermain.

The distribution system consists primarily of 8-inch and 12-inch water main. The majority of the water main installed before 1975 is Asbestos Cement Pipe (ACP), after 1970 the Town opted to install polyvinyl chloride (PVC) water main. See Appendix H for a Watermain Age Map.

The majority of the 12-inch water main is located along Middle Cheshire Road and NYS Rte 21. The 12-inch water main on Middle Cheshire Road extends from the pump station on West Street to the intersection of Wells Curtice Road. The 12-inch water main on NYS Rte 21 extends from the intersection of Parrish Street Extension to the intersection of Cramer Road. All but 1,225-feet of water main on Parrish Street Extension is 12-inch, the remainder is 8-inch pipe. There is also 12-inch water main on Hickox Road from Route 5 & 20 to NYS Rte 21; and on County Road 32 from Hickox Road to Hopkins Road.

Eight-inch (8-inch) water main extends from the Middle Cheshire Road west along Johnson Road, Nott Road, and Bristol Road /County Rd 32 and east (and west) along Wells Curtice, Foster and Butler Roads. The 8-inch water main along County Road 32 extends west to Hickox Road then north a short section of 12-inch water main to the intersection of US Rte 5 & 20. The 8-inch water main then continues west along U.S. Rte 5 & 20 and northwest along Cooley Road to the Town of East Bloomfield and east on U.S. Rte 5&20 to just east of the Town Hall. A pressure-reducing valve is located along the Cooley Road water main just north of the US Rte 5 & 20 intersection.

The water mains along Wells Curtice Road, Foster Road, Wyffels Road, and Hillcrest/Landings convey water to the 8-inch water main on West Lake Road. PRVs are installed along all of the water mains that feed West Lake Road.

The remainder of the water system consists of 8-inch ACP and PVC water main, and some ductile iron pipe. The water main in the Fallbrook Park area is reportedly a mixture of 4-inch and 6-inch cast iron and AC pipe. A map of the water system showing the existing watermain material types is included in Appendix G for reference.

With the exception of the water main in the Fallbrook Park area and the Hamlet of Cheshire area, the remaining distribution system is reputably in fair to good condition. The water main in Fallbrook Park and the Hamlet of Cheshire are in fair to poor condition. As a rule of thumb, it is recommended the Town budgets for replacement of approximately 1% of the existing distribution system to not allow the distribution to age beyond its useful life.

Other concerns from the operators has been the desire for non-plastic services (copper services show signs of early pitting), corrosion of unprotected steel hardware due to aggressive soils, and the generally high pressures in the distribution system causing early failure of system components.

The *Hydraulic Analysis* of the existing distribution system indicated that the pipes have good hydraulic capacity, similar to new pipe. The analysis identified the following, potential conditions that limit flow in the system.

1. Middle Cheshire Road between West Ridge Run and hydrant, HYD-079. Results indicate that there may be a valve that is almost closed along this section of 12-inch pipe. The valve affects the entire distribution system since it limits flow capacity between the West Street pump station and the Cramer Road tank.
2. County Road 16 between Wyfels Road and Marel Lawn. Results indicate that there may be a partially closed valve in this section of 8-inch pipe. This valve reduces available fire flow in the PRV served areas.
3. Bristol Street at West Street. There appears to be a partially closed valve in the area of this intersection. The valve reduces flow from the West Street pump station to the rest of the service area.
4. Middle Cheshire Road between hydrant, HYD-081F and Cheshire Glen Road. Results indicate a partially closed valve in this area, which reduces available flow to the test hydrants.
5. County Road 16, south of Wells Curtice Road. A partially closed valve in this area reduces available flow to the south.
6. State Route 21 between Parrish Street Extension and County Road 32. Results indicate a reduced capacity of this entire 8-inch section of pipe due either to sediment in the line or multiple, partially closed valves. This restriction reduces the available flow from the West Street pump station to the rest of the system.
7. The 8-inch pipe to the Cramer Road tank appears to be under sized for existing system demands. Review of the maximum demands determined that head loss in the 8-inch main ranged from 3 to over 9 feet when the tank was filling. However, when the tank was the only source of supply to the Canandaigua Consolidated service area, the maximum head loss increased to over 18.6-feet (~8.1 psi). During a fire demand, the head loss further increases to over 48.6-feet (~21.1 psi). This significant loss reduces system pressure and available fire flow (design flow) during a fire.

C. Pressure Zones

Section 8.2.1 of the *Recommended Standards*, states, "…The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system shall be at least 35 psi and should be approximately 60 to 80 psi and not less than 35 psi. Section 7.3.1 of the *Recommended Standards* reiterates these requirements but adds a statement that "… When static pressures exceed 100 psi, pressure reducing devices shall be provided on mains or as part of the meter setting on individual service lines in the distribution system." There are multiple pressure zones in the Town of Canandaigua.

1. Control Valves

Table V.1 lists the control valves within the Canandaigua water system along with approximate inlet and outlet pressures as determined by the *Hydraulic Analysis*. Listed inlet and outlet pressures may vary from field conditions. The *Existing Water System Schematic* shows the locations of the valves. The valves define the boundaries between the various pressure zones within the different service areas.

Table V.1: Control Valves

ID	Description	Type	Size (in)	Elevation (ft)	Upstream (psi)	Downstream (psi)	Setting (psi)
V-8000	Town Hall	PRV	8	869.50	142	104	104
V-8002	Cooley	PRV	8	975.77	96	58	58
V-8004	Cedarbush	PRV	6	805.21	171	79	79
V-8006	West Ridge Run	PRV	8	918.38	135	58	58
V-8008	Wyffels Road	PRV	8	881.77	123	83	82
V-8010	Hillcrest Dr.	PRV	8	909.59	126	71	70
V-8012	Foster Rd	PRV	8	924.92	117	64	63
V-8014	Wells Curtice	PRV	8	853.98	147	95	95
V-8016	Bristol Tank	PRV	8	1147.28	88	12	12
V-8022	Montanye Rd	PRV	6	1231.08	209	41	52
V-8024	West Street PS	PSV	8	809.65	170	67	190

Town of Canandaigua has made a significant effort in adjusting the valves so that the smaller, 3-inch daily use valves that bypass the main body normally contribute flow to the lower pressure zones. These changes were made to reduce water age in the pipes on either side of the valves. Adjusting the valves, however, resulted in valve chatter and higher than expected velocity in the smaller valves. The net result being shorter valve seat life. The Town has also observed that during periods of low, late night demand that pressures downstream of the valves continue to increase, possibly indicating leakage around the valve seats.

2. Canandaigua Consolidated Service Area

The Canandaigua Consolidated service area contains five pressure zones:

1) Central,
2) North,
3) Cedarbush,
4) Northeast, and
5) Southeast.

a. Central Zone

The Cramer Road Tank controls pressures in the Central zone of the Canandaigua Consolidated service area. The Central zone is the area between the Cramer Road tank and the discharge side of the West Street pump station. Pressures in this zone fluctuate based on tank level, system demand, and pump operation in the West Street and Pierce Park pump stations.

A Figure, Pressure – Existing Cramer Road Tank, in Appendix E graphically shows typical daily pressures in the Canandaigua consolidated Water District, Central zone. Areas shown in Rose (light pink) are below DOH recommended minimum working pressures of 35 psi. Residents in these areas with access to public water may need a private booster pump for adequate supply pressure. Areas in green meet DOH requirements for normal working pressures. The tan areas require individual pressure reducing valves on each service in order to meet DOH requirements. Pressures at the outer edges of the tan zone are up to 187 psi, which can cause operational issues with hydrants and valves. Areas in white are below the pressure reducing valves that supply the Southeast and Northeast zones. Shading shown in the North zone are in relation to the Central zone. Not shown is an exclusion area for pressure in the North zone, below its controlling PRVs,

Table V.2 lists anticipated pressure ranges for system high points, low points, at an average elevation as determined by the *Hydraulic Analysis*. High system pressure (Max. Value) occurs during minimum system demands while both pumps in the West Street pump station are operating, the Pierce Park pump station is OFF and Cramer Road tank is near it high operating point. Low system pressures (Min. Value) occur during peak demands, when the West Street Pump Station is OFF, Pierce Park pump station is filling the Day Road tank, and the Cramer Road tank is at its lowest operating level. Average pressures occur during average day demands.

Table V.2: Central Zone Pressure

Location	Elevation (feet)	Max. Value (psi)	Min. Value (psi)	Average (psi)
West Street Pump Station	804.6	186.73	156.64	175.47
3266 Hopkins Rd	977.2	109.76	81.97	99.53
5625 Nott Rd	1,099.5	55.69	30.24	46.34
Woolhouse & Rossier Roads	1,123.9	43.61	21.54	35.58

5625 Nott Road is the highest point in the existing system. The intersection of Woolhouse and Rossier Roads will be the highest point when the associated Water District Extension #42 is complete. The lowest point in the system is at the West Street pump station. 3266 Hopkins Rd is representative of the average elevation in the system.

Individual services require pressure-reducing valves in order to comply with the *Recommended Standards* for pressure.

As noted previously, the variation in system pressure at each point is due in part to the pressure loess caused by flow in the supply line to the Cramer Road tank. The table also points out the broad range in elevations within the Central zone, over 295-feet. This elevation change alone, accounts for over 130 psi in discharge pressure from the West Street pump station.

b. North Zone

The North pressure zone is generally the area north of Route 5 & 20. Pressure reducing valves (PRV) on Cooley Road and Route 5 & 20 at the Town Hall control pressures in the North zone. Individual services require pressure-reducing valves in order to comply with the *Recommended Standards* for pressure.

Table V.3: North Zone Pressure

Location	Elevation (feet)	Max. Value (psi)	Min. Value (psi)	Average (psi)
Brace Road and CR 30	803.5	184.9	157.0	174.6
Cooley Road and Short Road	829.2	121.1	121.0	121.1
Cooley Road PRV	972.6	59.0	59.0	59.0

c. Cedarbush Zone

The Cedarbush pressure zone is a small zone west of West Street that encompasses the dwellings associated with the Quailbush Homeowners Association. Pressures in the area range from 72.5 psi to 80 psi.

d. Northeast Zone

The Northeast pressure zone includes the Ridge Run and Saddleback developments. A PRV on West Ridge Run at Middle Cheshire Road and closed valves on Butler Road (one near Middle Cheshire Road and one near County Road 16) control pressures in the Northeast zone. Individual services require pressure-reducing valves in order to comply with the *Recommended Standards* for pressure.

Table V.4: Northeast Zone Pressure

Location	Elevation (feet)	Max. Value (psi)	Min. Value (psi)	Average (psi)
Butler Road at East Brook	727.3	140.8	140.6	140.7
Hunters Way at West Ridge Run	822.8	99.4	99.2	99.4
West Ridge Run PRV	903.5	64.5	64.4	64.5

e. Southeast Zone

Pressures in the Southeast zone are controlled by four (4) PRVs located on Wyffels Road, Hill Crest Drive, Foster Road and Wells Curtice Road. The Southeast zone runs along County Road 16 south of the City of Canandaigua water treatment plant. Individual services require pressure-reducing valves in order to comply with the *Recommended*

Standards for pressure. The western portions of Misty Hill Road, Emerald Hill Road, Lake Hill Road and Marella View are up-hill from the water main on CR16 that supplies the associated developments. These areas are also by served single pipes. Several locations are also above the elevation of the nearest PRV that serves the Southeast zone. The *Hydraulic Analysis* found that while daily working pressures at these locations are fairly constant, a fire demand on the low end of the individual supply lines can result in pressures below 20 psi. As a result, fire hydrants in the area should be color coated according to AWWA standards to indicate maximum flow allowed from the hydrants in order to a maintain 20 psi system pressure.

Table V.5: Southeast Zone Pressure

Location	Elevation (feet)	Max. Value (psi)	Min. Value (psi)	Average (psi)
CR16 at City Water Plant	687.9	167.2	166.2	166.6
End of Pipe, Duel Road	783.5	125.8	124.7	125.3
North end of Misty Hill Drive	953.2	52.3	51.5	51.9

f. Lower Zone Summary

A Figure, Pressure – Lower Zone, in Appendix F graphically shows typical daily pressures in the Southeast, Northeast and North zones, below the PRVs. Areas in white are the Central zone. Areas in green meet DOH requirements for normal working pressures. The tan areas require individual pressure reducing valves on each service in order to meet DOH requirements. Pressures at the outer edges of the tan zone are up to 165 psi, which can cause operational issues with hydrants and valves.

3. Canandaigua-Bristol Service Area

The Canandaigua-Bristol service area contains four pressure zones. The first is the area between the Pierce Park pump station and a pressure reducing valve near Bristol Road. Pressure in the first zone is maintained by the Pierce Park pump station that operate on variable frequency drives to maintain a constant discharge pressure.

The second is a short stretch of water main between the PRV and a pressure sustaining valve that supplies the Day Road tank (in the Town of Bristol). Pressures are maintained by the two valves.

The third is the area downstream of the Day Road tank with pressure controlled by the level of the tank.

The last is a small area along the high point of Goodale Road, which is served by its own booster pump station located near 6230 Goodale Road that is also designed to maintain a constant discharge pressure.

4. City of Canandaigua Supplied Service Areas

Pressures in the City of Canandaigua supplied services areas, and the Canandaigua-Hopewell service area, are controlled by the water level in the City of Canandaigua reservoirs located at its water treatment plant. Pressures fluctuate based on system demands, operation of the West Street pump station, operation of the Town of Hopewell pump station on Lakeshore Drive, and demands in the Canandaigua-Farmington Service Area.

A Figure, Pressure – City Reservoirs, in Appendix G graphically shows typical daily pressures in the City of Canandaigua Supplied service areas. The City supplied zone complies with DOH requirements. Shaded areas in the Town of Canandaigua, not served by the City, represent areas that could potentially be served by the City.

5. Canandaigua-Farmington Service Area

The City of Canandaigua reservoirs also control pressures in the Canandaigua-Farmington service area. This service area contains the Brickyard Road tank and is considered its own pressure zone due to pressure loss across the meters and check valves that supply the area.

The *Canandaigua-Farmington Water Districts*' Brickyard Road tank is normally hydraulically locked out of the system. (The hydraulic grade, system pressure expressed in feet of water, at the tank is greater than the height of the tank, which prevents flow into or out of the tank.) Studies of the tank have found that it can contribute water during peak demands.

A study of the *Canandaigua-Farmington Consolidated Water District*, which includes the Town of Canandaigua's, *Canandaigua-Farmington Water District*, found that a large industrial water user routinely tests its fire pumps for insurance underwriting purposes. The study found that the fire pump tests can have a significant impact on the Canandaigua-Farmington service area pressures depending on location within the system with respect to the industry. The City of Canandaigua supplied areas also see some influence, to a lesser degree, caused by the fire pump tests.

D. Pump Stations

There are three pump stations in the Canandaigua Consolidated service area: West Street, Pierce Park and Goodale Road.

1. West Street Pump Station

The West Street Pump Station is located at 3176 West Street, was constructed in 1994 and includes two horizontal split case Aurora Model 420, 4x5x12 pumps with 100 HP, 1,750-rpm motors. Service on the pumps since commissioning includes replacement of pump shafts, bearings, sleeves and seals.

West Street pump station is a duplex station originally designed with one pump as a backup. Over the past few years, there has been an increasing reliance on running both pumps to satisfy maximum daily and peak demands. During the unusually dry summer of 2016, both pumps operated for long periods and barely met system demands with minimal change in the Cramer Road tank water level.

A pump performance test conducted by Siewert Equipment Company in September 2010 determined that the pumps then operated between 656 gpm at 263 feet and 665 gpm at 254 feet. The test results match the performance curve for the pump with a 12-inch impeller and match measured flows reported by the Town of Canandaigua. At these, flow rates, the pumps are operating at approximates 63 BHP assuming they are 70% efficient as indicated by the manufacturers curve. Variations in flow and head are due to changing system demands and level in the Cramer Road tank. Appendix H includes a copy of the pump curve.

Analysis of the pumps indicates that during average day demand a single pump typically supplies 560 gpm to 608 gpm depending on tank level, system demands, and time of day. The difference in flow between that measured by the Siewert test and the pump analysis is likely due to changes in system conditions over the intervening 7-years. Changed conditions include the potentially closed valves identified *Hydraulic Analysis*.

Analysis of the pumps also indicate that during normal maximum day demands, with two pumps operating, that the total flow from the station ranges from 820 gpm to 980 gpm depending on tank level and time of day.

Flow data provided by Town of Canandaigua and the *Hydraulic Analysis* also showed that during the summer of 2016, that station flow exceeded 1,000 gpm, during maximum day, peak demands. Results indicate that at the same time, system demands were low, the Cramer Road tank was filling, and the Pierce Park pump station was filling the Day Road Tank.

Table V.6 summarizes the anticipated demands in the Canandaigua Consolidated Service Area, which is the area supplied by the West Street Pump Station / Cramer Road tank.

Table V.6: Canandaigua Consolidated Service Area Demands

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	297	344	436	529	622	gpm
Maximum Day	647	748	950	1,152	1,354	gpm
Peak Hour	1,247	1,443	1,832	2,222	2,611	gpm

The *Recommended Standards for Water Works* states that, "Each booster pumping station shall contain not less than two pumps with capacities such that peak demand can be satisfied with the largest pump out of service."

Comparing Table V.6 to the capacities of the pumps shows that the station provides:

- Average Day demands with one pump operating (297 gpm System < 560 gpm One Pump), and
- Maximum Day demands with two pumps operating (647 gpm System < 820 gpm Two Pumps).

Peak hour demand relies on flow from the pump station and the Cramer Road tank (980 gpm Two Pumps Max < 1,247 gpm System). Therefore, the station does not comply with the *Recommended Standards* since it does not supply maximum day or peak demand with the largest pump out of service.

During review of the system, Town personnel expressed a concern about the capacity of the water mains that supply the West Street pump station. West Street pump station draws from a City of Canandaigua 12-inch water main on West Street. The main runs from Parrish Street, past the pump station to Bristol Street, then east along Bristol Street. Parallel to the 12-inch main is a 24-inch, City of Canandaigua transmission main that supplies water to the City. The 12-inch main and 24-inch main interconnect at the intersection of Bristol Street and Thad Chaphin Street (approximately 2,300-feet north from the station). Hydrant flow tests and modeling of the City of Canandaigua system in 2012[1] determined that there is a closed valve connection between the two lines on Parrish Street at West Street (460-feet south). Analysis of the 12-inch water main on West Street indicates that flow in the line is split roughly 60/40 to 70/30 while the pump station is operating, depending on system demands. Most flow comes from the north of the pump station. When the station is off, flow in the 12-inch line is normally from north to south.

[1] *Hydraulic Modeling of the City of Canandaigua Water Distribution System*, MRB Group, November 2012.

During the summer of 2016, suction pressures at the station dropped to ~46 psi during peak demands. Normal suction pressures range from 59 psi during average day demands to 50 psi during maximum day demands. The change in suction pressure is a function of pump flow rate, hydraulic losses in the 12-inch suction line that feeds the station, and hydraulic losses in the transmission main from the City tanks to the distribution system. Hydraulic losses in the transmission main affect the entire City of Canandaigua service area.

As suction pressure drops, the discharge pressure (head) needed to fill the Cramer Road tank increases (assuming a constant level in the tank). As head increases, the capacity of the pump decreases. For example, based on the pump curve the discharge head from the pumps at 600 gpm is ~253-feet. A 9 psi change in system pressure increase the discharge head by ~21-feet to ~274-feet. Available pump flow at this head is ~500 gpm. A further reduction by 4 psi results in a head of ~283-feet and pump capacity of ~490 gpm.

As noted previously, during the summer of 2016 the lowest suction pressure was ~46 psi with both pumps running. Under this condition, the total flow from the station was 890 gpm (~445 gpm/pump) with a head gain of ~284-feet. Analysis results indicate that this low pressure occurred during peak demands, with the Pierce Park pump station off, and the Cramer tank lower than normal and draining.

The *Hydraulic Analysis* indicates that the system relies on flow from West Street pump station and flow form the Cramer Road tank to satisfy peak demands. Flow from two pumps reduced the flow needed from the Cramer Road tank (~180 gpm vs. ~460 gpm).

Hydraulic analysis of the system did not identify a specific, hydraulic restriction in the 12-inch supply line that could affect pump station operation. The hydraulic analysis did confirm that the station does not comply with the *Recommended Standards* since it cannot provide peak demands with the largest pump out of service.

Review of the pumps and their associated service records indicate that they are near the end of their useful design life and need replacement.

Upgrading the station should also give consideration to changing the location of the station to the City of Canandaigua tank site. Moving the station to this location provides more uniform suction head due to the relatively constant level of the City of Canandaigua tanks. It also reduces the impact on the City of Canandaigua system while operating by eliminating the additional pressure loss in the City transmission main due to flow to the station.

2. Pierce Park Pump Station

The Pierce Park pump station was installed in 2007 and supplies the Canandaigua-Bristol service area. The station contains six pumps consisting of two low flow pumps each rated at 49 gpm at 320 feet, a service pump rated at 165 gpm at 330 feet, and three high flow pumps rated at 300 gpm at 415 feet. The station is also designed to provide 500 gpm of fire flow utilizing two, 300 gpm pumps.

The station is designed to maintain a constant discharge pressure based on a signal from a remote pressure sensor located in a small, residential booster station at the top of the hill on Goodale Road. Pump speeds are adjusted to maintain a constant discharge pressure with additional pumps added as demands increase.

The Pierce Park pump station fills the Day Road tank through a pressure reducing valve and a pressure sustaining valve. When the Day Road tank calls for water, the pressure-sustaining valve becomes active allowing the tank to fill. When the valve becomes active, the pressure at the high point on Goodale Road drops which, in turn, turns on additional pumps in the Pierce Park pump station. When the tank is full, the pressure sustaining valve closes and pumps are cycled off in the pump station. Currently the pump station experiences low pressures that turn off the pumps, resulting in minimal to no flow downstream of the station.

Table V.7 summarizes the anticipated water demands of the Canandaigua-Bristol service area, which is the area supplied by the Pierce Park pump station. Demands listed in the table are system demands only, they do not included the flow rate of the pump station when the Day Road tank fills.

Table V.7: Canandaigua-Bristol Service Area Demands

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	10	23	48	73	98	gpm
Maximum Day	22	49	104	159	214	gpm
Peak Hour	42	95	201	306	412	gpm

Review of the station determined that it normally performs as intended. Pump operation cycles through the jockey pumps and service pump as system demands increase. Normally the service pump operates during maximum day demand. The estimated existing peak flow from the station is ~196 gpm, which occurs during peak demands while the Day Road tank fills at ~154 gpm.

Analysis of the station found that under certain conditions that momentary changes in system pressure prevented to model from converging. This would cause the model to fail because no viable solutions could be determined based on the set-up variables. On closer review it appears that when the control valve that fills the Day Road tank first opens that upstream pressures drop significantly causing the Pierce Park pump station to turn off. This situation has been observed in the field. It is recommended that a hydropneumatic tank be installed in the Pierce Park pump station to buffer sudden changes in system pressure and improve pump station operation.

Review of potential population growth in the service area indicates that most is expected in the Town of Bristol and potentially into South Bristol, downstream of the Day Road tank. The anticipated year 2050 demands in the area downstream of the tank are average day 81 gpm, maximum day 176 gpm, and peak hour 340 gpm.

At a minimum, flow to the tank should equal the peak demand thus allowing the tank to refill while satisfying maximum day demands. This can be accomplished by adjusting the pressure sustaining valve on the fill line to maintain a lower upstream pressure, which allows a greater flow. Doing so, transfers the peak demand to the Pierce Park pump station so it needs to provide a minimum of 412 gpm with the largest pump out of service. This peak flow plus a 500 gpm fire demand results in a needed pump station capacity of 912 gpm. As noted previously the station can provide 700 gpm with two high flow pumps running. The pump station does not provide the required capacity needed for year 2050.

Assuming 700 gpm flow includes fire demand, the maximum system demand available from the station is (700 – 500 =) 200 gpm. 200 gpm is approximately the anticipated peak hour demand of the system in 2030. Therefore the station appears to have sufficient capacity to year 2030 dependent on actual population growth and development trends.

3. Goodale Pump Station

Located at the high point on Goodale Road is an underground, domestic booster pump station that supplies approximately 17 dwellings along Goodale Road. The design flow rate of the station is 57 gpm at 210 feet of head. The pump operates with a variable frequency drive designed to provide a constant discharge pressure. The station draws off the discharge line from the Pierce Park Pump Station. The station does not provide fire protection; fire protection is provided by the Peirce Park transmission main that runs parallel to the Goodale service area.

E. System Storage

1. Canandaigua Consolidated Service Area

The Cramer Road tank is located approximately 1100 feet south of the Cramer/Rosier Road Intersection. The painted steel storage tank is 1.5 million gallons in size, 85.6 feet in diameter, and the depth to overflow is approximately 35 feet. The base of the tank is at elevation 1177.8 feet, based on the NAD88 datum[2]. Due to concerns with tank turn over time (water age), the tank's high water level is set to approximately 32 feet, in the

[2] Town of Canandaigua, 4/25/2017.

summer the low level is set at 23 feet, and in the winter the low level is set to 26.5 feet. The tank maintains the hydraulic grade in the Canandaigua Consolidated service area.

The Cramer Road tank was last inspected on June 11, 2016 by Liquid Engineering Corporation. A copy of the inspection report is included in Appendix I. The inspection identified several significant coating failures and recommended, amongst other items, a full sand blast and recoat of the inside and outside of the tank, and that deteriorated columns be reinforced or replaced.

Review of the Cramer Road tank (Appendix J) concluded that the tank does not have sufficient volume to meet existing system demands. The lack of storage is due to pressure losses in the supply line to the tank during peak demands and ground elevations within the existing service area. It is recommended that the supply line be replaced with a 16-inch line and that the tank be replaced with at least 1.8 million gallon elevated tank to provide needed storage for existing and future demands to the year 2050 and to better serve the existing high points in the service area.

2. City of Canandaigua

City of Canandaigua provides storage in the City of Canandaigua supplied service areas through the reservoirs located at its water treatment plant on West Lake Road (CR16). These reservoirs have a capacity of 11 million gallons. City of Canandaigua's water supply permit delineates the City's geographic supply area limits. In general, the area includes the City proper; Towns of Canandaigua, Farmington, Hopewell, Manchester, Bristol, East Bloomfield and a small portion of South Bristol; the Village of Manchester; and other small districts that extend into other surrounding Towns. The City's Water Supply Permit is limited to an annual average of 6.0 MGD.

A 2012 study[1] of the City of Canandaigua water system estimated that the then average daily production was 3.34 million gallons with an estimated maximum day production of 6.06 million gallons. Based on this, the City reservoirs have sufficient capacity to provide over 1.8 days of supply from storage during maximum day demands.

The City's two, 4.5 million gallon tanks were placed into service in 2008 and 2009. The City's 2 million gallon tank was placed into service in 1959 and was refurbished in 2009. All three tanks were last inspected in 2016 by Conrady and are reputedly in good condition. The report did recommend minor repairs to the 2 MG tank, which the City has since made.

Further investigation into the condition of these tanks and detailed review of storage volumes are beyond the scope of this document.

3. Canandaigua/Bristol and Bristol Water District No. 1

The Day Road tank provides storage for the lower portion of the *Town of Bristol Water District*. There is no storage in the upper portion of the Canandaigua-Bristol service area. Instead, this area relies on the operation of the Pierce Park pump station and Goodale pump station for pressure and supply.

The Day Road tank is a glass lined steel tank placed in service in 2007. Interior and exterior tank inspections are recommended every 10 years. The cathodic protection system requires replacement every 10 years as well. As of the writing of this report, the tank is due for inspection. Further investigation into the condition of the tanks are beyond the scope of this document.

Review of the Day Road tank (Appendix J) determined that it is adequately sized for existing demands. The Day Road tank service area would benefit from an ISO review to determine the actual needed fire flow and duration for the service area. A second, 200,000 gallon tank may be necessary by year 2050 as the service area expands.

4. Canandaigua – Farmington and North Farmington Water Districts

Storage in the Canandaigua-Farmington service area is provided by a combination of the City reservoirs and Brickyard Road tank. As discussed previously, studies of the Brickyard Road tank conducted for the Town of Farmington, as administrator of the water district, found that the tank is normally locked out of the system; its overflow elevation is below the hydraulic grade of the system. The tank does contribute water during peak hour and fire demands depending on proximity of the fire to the tank.

As of the writing of this *Water Master Plan*, the *Canandaigua Farmington Consolidated Water District*, which collectively includes water districts in the Town of Canandaigua and Town of Farmington, is planning to replace the Brickyard Road tank with a taller tank designed to float off the system. Included in the project are transmission improvements along Brickyard Road and Canandaigua-Farmington Town Line Road. Details of the tank project are included in the report, *Preliminary Engineering Report for the Brickyard Road Tank and Transmission Main Improvement*, (MRB Group, July 2016).

A 2015 inspection of the Brickyard Road tank[3] found that it is in fair condition with localized areas of heavy corrosion. The inspection recommended replacement or repair of the tank. Originally built in the 1960, the tank has been re-coated twice and is nearing the end of its useful life. Further investigation into the condition of the tanks are beyond the scope of this document.

5. Canandaigua –Hopewell Water District

The small portion of the *Canandaigua-Hopewell Water District* along County Road 364 (East Lake Road) relies on storage in the Town of Hopewell water tank located on Routes 5&20 near County Road 247.

The Town of Hopewell tank was last inspected circa 2012. As a result of the inspection, the tank was recoated and a new access ladder added in 2014. Town of Hopewell is currently adding mixing and a THM removal system to the tank. Further investigation into the condition of the tank and its storage volumes are beyond the scope of this document.

[3] *Steel Potable Water Reservoir Inspection Report (ROV)*, Liquid Engineering, 7/29/2015.

F. FIRE FLOW

1. Needed Flow

ISO provides guidance for insurance underwriters to establish a Public Protection Classification for fire insurance rating. The Public Protection Classification process considers types of structures in a community, equipment owned by the local fire department, department response time and distances between or existence of fire hydrants within a community. ISO's needed fire flows for a structure is based on a point system that considers type of structure, building use, material of construction, communication between and within buildings, and distance between structures. ISO has established that for one and two family dwellings not exceeding two stories in height, needed fire flow can range from 500 gpm for dwellings that are over 100-feet apart to 1,500 gpm for dwellings that are less than 10-feet apart. New York State Department of Health reviews proposed water districts in rural residential areas based on a minimum of 500 gpm.

Needed fire flow for non-residential property is determined by insurance underwriters based on a point system established by ISO. Based on ISO guidelines, needed fire flow to a facility shall not exceed 12,000 gpm nor be less than 500 gpm. ISO guidelines also state that fire flow duration should be two hours for needed fire flows up to 2,500 gpm and three hours for fire flows from 3,000 gpm to 3,500 gpm. Needed fire flow greater than 3,500 gpm are not considered when establishing a community rating.

The *New York State Fire Code (2015), Appendix B, Fire-Flow Requirements for Buildings (Fire Code),* provides fire flow requirements based on building type, group, and fire protection area. Associated with the flow requirements are flow durations that are similar to ISO guidelines. The *Fire Code* shows a duration of 4-hours for needed fire flows 4,000 gpm and greater. The *Fire Code* contains a provision that allows reducing the needed flow to 25% for structures protected by a listed automatic sprinkler systems; duration remains unchanged. The highest flow rate listed in Table B105.1(2) of Appendix B to the *Fire Code* is 8,000 gpm with a duration of 4-hours.

Town of Canandaigua's zoning was reviewed to estimate the minimum needed fire flow for residential properties, needed for full ISO credit, based on side and rear setback requirements for Principal and Accessory Buildings. Needed fire flows listed in Table V.8 are only applicable to one and two family dwellings not exceeding two stories. Refer to the *Fire Code* and ISO to determine actual needed fire flow for all structures. (See Chapter 220: Zoning, of the Town of Canandaigua Code for descriptions of the zoning districts.)

Table V.8: ISO Needed Residential Fire Flow

Distance Between Buildings	ISO Needed Fire Flow	Zoning District (Principal)	Zoning District (Accessory)
More than 100 ft	500 gpm	MR, and LI	N/A
31 – 100 ft	750 gpm	R-1-20, R-1-30, AR-1, AR-2, RR-3, MR, CR-1, NC, CC, I, & LI	AR-1, AR-2, RR-3, MR, NC, CC, I, & LI
11 – 30 ft	1,000 gpm	RLD, MH, & RB-1	R-1-20, R1-30, RLD, SCR-1, & RB-1
10 ft or Less	1,500 gpm	N/A	N/A

The *Fire Code* establishes needed fire flow for all buildings. ISO establishes needed fire flow for insurance underwriting purposes. Actual needed fire flow may be different from that shown in Table V.8 and is established by the Fire Marshal and Code Enforcement Officer.

Minimum setbacks for PUD, IZ, and MUO districts are established during the approval process. Likewise, actual needed fire flow is established by the Fire Marshal and Code Enforcement Officer during design based on ISO guidelines, and the *Fire Code*.

2. Available Fire Flow

Available fire flow in the distribution system is a function of system topography, pipe characteristics, valve settings, pump operation, tank levels and system demands. In general, the *Hydraulic Analysis* concluded that available fire flow (design flow) in the Canandaigua Consolidated service area is limited by ground elevations in the area in relation to the tank and by significant pressure losses in the tank supply line during high flows.

As discusses in the *Hydraulic Analysis*, design flows during average day demands are typically greater than 1,000 gpm in the Canandaigua Consolidated service area during average day demands. During peak demands, when the West Street pump station is off and the Pierce Park pump station is filling the Day Road tank, design flows are less than 350 gpm due system high points and pressure losses in the Cramer Road tank supply line. Design flows are above 900 gpm once the Cramer Road tank drains and the West Street pump station turns on. Analysis of the system found that under this condition the Day Road tank continues to drain. Adding the second West Street pump increases design flow to above 1,000 gpm.

Review of the system also found that increasing the size of the supply line to the Cramer Road tank to 12-inches increases design flow to above 1,000 gpm during peak demands, when the West Street pump station is off and the Pierce Park pump station is filling the Day Road tank. It is recommended that the supply line to the Cramer Road tank be increased to 16-inches to accommodate the year 2050 demands.

Design flows in areas served out of the City along CR16 range from 520 gpm to 2,825 gpm depending on location and proximity to the City of Canandaigua. Areas along the water main that serves West Lake Blvd, and heading north, have design flows below 750 gpm This flow may not be suitable for the close, residential housing in this area. Improvements to the water main, such as connecting its north end back to the water main on Couty Road 16, are recommended in order to increase design flows in the area.

Design flows along Fallbrook Place, extending south to Otetiana Point are typically below 400 gpm due to the condition and size of the water mains. Flow in these areas are influenced to some extent by operation of the Town of Hopewell pump station located on Lakeshore Drive. It is recommended that the water line be replaced, and possibly connected to the water main on SR 364 through a PRV, in order to improve design flows in this area.

Hydrant flow tests, coupled with review of the hydraulic model developed for the *Hydraulic Analysis,* are recommended to determine if adequate design flow is available for developments without further system improvements.

G. WATER METERS

The Canandaigua Consolidated Water District includes 2,440 water meters. The majority of the meters are residential ¾" brass Badger water meters with an Orian reader head. The District currently has approximately eight commercial/industrial meter connections.

The District's last water meter upgrade included converting the meter reading heads to radio read technology for the entire CCWD in 2011/12. The operators estimate that roughly 1400 of the water meters are more than 10 years old as of 2017. An additional 600 meters will be 10 years old by 2018/19 with the balance of the meters less than 10 years old.

With advancements in meter communication technology, the next meter replacement for should utilize an Advanced Metering Analytics (AMA) or Automatic Meter Reading (AMR) technology that includes a cellular end point connection. These types of meters can increase the amount of information available to the operators and potentially minimize water loss liability. Typically water meters have a probable useful life of 20 years. The later service years of a meter have decreased accuracy, and thus require replacement to capture water consumption (i.e. revenue) for the district.

Based on the age of the current inventory of water meters, a water meter replacement plan should be developed to replace all of the meters more than 10 years old in the short term. This can be accomplished by replacing roughly 400 meters per year over a 6/7 year period, with the goal to be completely converted to AMA technology by 2025.

VI. WATER QUALITY

The Town of Canandaigua and all of the service areas within the Town purchase water from the City of Canandaigua. The City of Canandaigua is solely responsible for the source water quality. Distribution water quality is the responsibility of the Districts. Those water quality parameters include free chlorine residual, bacteriological, lead/copper and disinfection byproducts.

A. LEAD/COPPER

A review of the available water quality reports for each of the three water districts have not indicated that lead/copper concentrations in the distribution system have reached any actionable level and therefore not a concern for this system. The City of Canandaigua adjusts the pH of the water using caustic as a treatment technique to control corrosion in the distribution system.

B. FREE CHLORINE

Free chlorine residuals and Total Triahalomethanes were sampled at strategic locations across the distribution system on January 20, 2017. A map of the sample locations is shown in Appendix M. A table of the sample results is below.

Table VI.1: Chlorine & TTHM Sample Results

Sample Number	Sample Location	Free Chlorine (mg/l)	TTHM (mg/l)
1	County Road 30	0.11	0.053
2	Bristol Road near Cornell Rd.	0.82	0.032
3	Middle Cheshire Road	0.81	0.034
4	County Road 16 @ German Bros.	0.60	0.040
5	Foster Road	0.33	0.039
6	Wells Curtice Road	0.66	0.038
7	County Road 16 @ 5080	0.09	0.074
8	Gooddale Road	0.91	0.049
9	NYS Rte 21	0.63	0.044

MCL for TTHM = 0.08 mg/l; MCL for HAA5 = 0.06 mg/l

The chlorine residual can be used as an indicator of the age of the water in a distribution system. The lower the residual, generally the older the age of the water. The south end of the system on CR 16 represents some of the oldest water in the system. Periodic flushing of the mains is recommended to “freshen” the water and maintain a chlorine residual.

The Bristol Water District was not included within the sample area. This area consistently has low or no chlorine residuals due to the large diameter watermain serving this area and the relatively low water demands of the district. The Canandaigua – Bristol service area includes a chlorine booster station to increase the residual chlorine from the City supplied water. Chlorine residuals leaving the booster station are generally higher than normal (greater than 3 mg/l) to hold a trace amount of chlorine at the ends of the Bristol system. An additional chlorine booster location should be considered to provide a more stable and desirable residual.

C. Disinfection Byproducts

The Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules (DBPRs) are part of the suite of Microbial and Disinfection Byproducts Rules (MDBPs). MDBPs are a series of interrelated regulations that address risks from microbial pathogens and disinfectants/disinfection byproducts. Disinfection byproducts are formed in drinking water by the interaction of the disinfectant (chlorine) and organics over time.

The DBPRs specifically regulate exposure to Total Triahalomethanes (TTHM) and Five Haloacetic Acids (HAA5). These two parameters are monitored at points in the distribution system expected to have the oldest water. For the Canandaigua Consolidated Water District, these locations are at Ononda Park and the end of Cooley Road. For the Bristol Water District, the location is at 4280 State Route 64. TTHM and HAA5 have established Maximum Contaminate Levels (MCLs) set at 0.08 mg/l and 0.06 mg/l respectively based Local Running Annual Averages (LRAA).

As of the May 2017 quarterly results for TTHM and HAA5, the calculated LRAA for both test locations in the Town of Canandaigua are well below the MCL. However, the LRAA for the Bristol Water District is above the MCL for TTHMs at 0.082 mg/l. The Town should develop and implement a TTHM removal plan. This plan could consider installing an aerator at the Day Road Tank to reduce/remove TTHMs. A summary of the TTHM/HAA5 sample results and calculated LRAA for each location is included in Appendix N.

VII. Agriculture

The Town completed its first Agricultural Enhancement Program (AEP) in December 2016 (prepared by LaBella & Associates) to further the Town's commitment to the preservation and protection of agriculture. As this was the top priority identified in the Comprehensive Plan Update, this Water Master Plan will consider the potential impacts to agriculture because of public water availability.

Public water can be considered an asset for agricultural activities/businesses. As noted in the AEP, the lack of access to public water can increase production costs and affect efficiency. Access to public water can greatly affect livestock and dairy farms during drought conditions. Agricultural businesses such as wineries and breweries that are water intensive operations are typically sited in location having access to public water. Cash crops such as the Wegmans organic farm benefit from public water and recently expanded its use of public water for irrigation. Lastly, fire protection based on having an adequate supply of public water to fight fires can be considered a benefit to agricultural businesses.

The largest perceived detriment to agriculture from access to public water is the potential added development pressure. It should be noted that intensive development typically occurs where public sewer is available (with public water). The Town can minimize the development pressure with future expansion of the water system by adopting lateral water restrictions. The Town's Sewer Master Plan recommended adoption of service lateral restrictions to minimize negative impacts to agricultural lands and included an example of a typical resolution in Appendix N. Lateral water restrictions would restrict access to public water to existing lots of record at the time of district formation.

In general, public water is a benefit to agriculture and agricultural business. The Town should consider public water extensions that would support agriculture/agricultural business a benefit to the Town. The Town should consider increasing the affordability of public water when agricultural businesses are within proposed water districts.

VIII. TRANSFER OF DEVELOPMENT RIGHTS (TDR) PROGRAM

The Town is currently developing a TDR program (prepared by BFJ Planning) as a way to manage development pressure in the Town while protecting agricultural/environmental sensitive areas of the Town. The current draft report (dated August 2017) indicates the MUO-1 and MOU-3 (and MOU-3 extension) as the receiving areas for increased density development. These areas are within the Canandaigua- Farmington WD and Canandaigua – Hopewell WD. The draft report suggests the receiving areas maximum density be increased from 8 units/acre to 16 units/acre within the MUO areas. The Canandaigua – Farmington WD distribution system is more suitable for the anticipated density increase. It is probably that the Canandaigua – Hopewell WD would require improvements to the distribution system accommodate the proposed density. The impacts to the distribution system as a result of the proposed TDR program have not been fully evaluated at the time of this document and once the TDR program is finalized, this section should be updated.

IX. SYSTEM EXPANSION

Based on information from the Town Water Superintendent, the following areas have expressed an interest in public water in recent years:

1. Woolhouse Road
2. Rossier Road,
3. Cramer Road,
4. Deuel Road,
5. Coye Road,
6. Moran Road
7. Smith Road
8. Ketchum Road
9. Knapp Road
10. Lucas Road
11. Seneca Point Road
12. Monks Road
13. State Route 21 (south)
14. County Road 32
15. Fisher Hill
16. McCann Road
17. Yerkes Road
18. Barns Road
19. Goff Road

With the exception of Cramer Road, Deuel Road, Yerkes Road, McCann Road and portions of Woolhouse Road, these areas require system improvements beyond just an extension of watermain to provide public water.

As part of the effort to improve the pressure zones in the system, consideration was also given to installing a new tank on Smith Road with a supply line that connects to Deuel

Road. A tank on Smith Road would be filled by the Pierce Park pump station; the station would be modified to fill the tank based on level. The new tank would supply the Day Road tank and allow district formation above (elevation) the current Central pressure zone. Anticipated pressures in the modified zones with a tank on Smith Road are shown in Appendix J.

A tank on Smith Road cannot supply potential growth south and west of the tank site. Elevations in this area are significantly higher. These are the highest points in the Town of Canandaigua. If the residents in this area request public water, a pressure demand booster station would be needed. The station would work similarly to the existing Pierce Park pump station and include a hydropneumatic tank for pressure equalization. Potential future service areas are shown in Appendix K.

X. PROPOSED SYSTEM IMPROVEMENTS

A. SYSTEM IMPROVEMENTS

Review of the system identified several improvements that can be made to bolster overall system performance. Figure VII-1, "Proposed Improvements", in Appendix L is a map of the proposed distribution system improvements. The improvements listed below are categorized between those improvements having a High Priority, Moderate Priority, and Low priority. Improvements categorized with the same level of priority are not further weighted; however, understanding must be given that some improvements are necessary for other improvements to be feasible. The improvements considered in this Master Plan include the following:

1. High Priority Improvements:
    - Build a second booster pump station at the City of Canandaigua water plant that serves a replacement primary supply to the Cramer Road tank. The existing West Street pump station would remain in service as a backup station.
    - Replace the Cramer Road tank with twin 0.9 MG tanks and raise to increase its service area and improve overall system Design Flows. Include a mixer/THM Removal system for quality improvements.
    - Replacement of 8" watermain on Nott Road with 12" water main to Middle Cheshire Road.
    - Install approximately 3,500 LF of 8-inch diameter PVC watermain along Cramer Road from the existing 8-inch watermain on Cramer Road to the existing 12-inch watermain at the intersection of Rock Oak Hill Road
    - Install 1,430 feet of 16-inch PVC pipe as a dedicated tank discharge line to the Cramer Road Tank.
    - Install back pressure sustaining feature on PRVs serving the northern part of the Town to minimize low pressure during emergency flows experienced at Hopkins/Grimble Roads
    - Provide an interconnection between the Fallbrook water main and the exiting main along State Route 364 in the Canandaigua-Hopewell Water District. Include a pressure reducing valve.

- Install mixing at the Day Road water storage tank to improve water quality in advance of the revised Disinfection Byproduct Rule regulating THMs and HHAs.
- Painting of hydrant bibs and bonnets according to AWWA as follows:
    i. 1500 gpm or greater – Blue
    ii. 1000 gpm to 1500 gpm – Green
    iii. 500 gpm to 1000 gpm - Orange
    iv. Less than 500 gpm - Red

2. Moderate Priority Improvements:
    - Annual Watermain Replacement Project – replace roughly 1% of the existing distribution system or approximately 3,500 LF of main.
    - Pump upgrades in the West Street pump station are necessary for continued operation and to serve as a backup to the CCWD Booster Station. The existing pumps are nearing the end of their service life and need to be replaced.
    - Install a water storage tank as a redundant water supply/storage at a higher elevation than the Cramer Road Tank. One potential tank location is on Smith Road, approximately 2,000 feet south of Goodale Road with a base elevation of approximately 1,480.00 feet.
    - Relocate the pressure reducing valves to create service areas with pressures closer to the *Recommended Standards*. Reconfiguring the pressure zones will allow proper operation of valves and hydrants. A system with excessive pressure that prevents the proper operation of hydrants essentially does not provide fire protection.
    - Replace residential water meters with an Automatic Meter Reading style meter.
    - Install a hydropneumatic tank in the Pierce Park pump station.
    - Install 4,300 feet of 12-inch main on Bliss Road from SR 21 to Hickox Road

- Replace the aging 4-inch and 6-inch pipes in the Fallbrook Park area to 8-inch PVC
- Install approximately 12,600 LF of new 8-inch diameter PVC watermain along NYS Rte 21 from the intersection of Wells Curtice Road to the intersection of Deuel Road, then continue south along Deuel Road to the intersection of County Road 16.
- Install 3,900 feet of 8-inch main on Eastern Blvd from Bristol Road to the existing 8-inch on Buffalo Road.
- Install approximately 10,900 LF of 8-inch diameter PVC watermain along Smith and Lucas Road and connect the proposed watermain on Deuel Road. The Smith Road Tank is required to be completed.
- Install 11,100 LF of 8-inch diameter PVC along Woolhouse Road from the intersection of Nott Road to the intersection of CR 32 and connect to the existing watermain on Bliss Road.
- Any other improvement that would result in eliminating a dead end water main in the distribution system.

3. Low Priority Improvements:
    - Install 4,980 feet of 8-inch PVC watermain on Buffalo Street Extension from the existing 8-inch line near Routes 5 & 20 and the existing 8-inch line by Brookside. Also included is a pressure reducing valve near Routes 5 & 20.
    - Any other improvement that results in a dead end water main or extension of a dead end water main.

XI. OPINION OF PROBABLE COST

The following opinions of probable costs have been developed based on construction cost factors believed to represent market conditions in this region and are based on 2016 material bids for similar types and sizes of projects. The estimates are based on the installation of the watermain and other facilities by Town Forces except for specialized construction such as water storage tank/ pump station construction. The opinions of cost include construction contingency, and an estimate of engineering/legal/administration costs. Detailed construction estimated should be prepared in conjunction with an Engineer's Report prior to undertaking any of the listed improvements.

- Buffalo Street Extension Watermain – $325,000.00
- Eastern Boulevard Watermain - $205,000.00
- Bliss Road Watermain - $330,000.00
- Cramer Road Watermain – $210,000.00
- Duel Road Watermain – $713,000.00
- Smith Road Water Storage Tank & Pierce Park Pump Station – $1,625,000.00
- Cramer Road Water Storage Tank Improvements & 16" Line – $3,500,000.00
- PRV relocation including SCADA - $750,000.00
- Canandaigua Consolidated WD Booster Station – $3,000,000.00
- Back Pressure Sustaining Improvement – $450,000.00
- Day Road Tank Mixing/THM Removal – $50,000.00
- Route 21 Watermain Replacement (Cheshire) – $300,000.00
- West Street Pump Station Improvements – $200,000
- Nott Road Watermain Replacement – $315,000.00
- Fallbrook/Sandy Beach Watermain Replacement – $490,000.00
- Canandaigua-Hopewell Interconnection (for Fallbrook) - $90,000.00
- Smith/Lucas Road Water - $627,000.00
- Woolhouse Road Water - $625,000.00
- Pierce Park Pump Station Improvements - $75,000.00
- Water Meter Replacement Project - $720,000.00 (over 6 year period)
- Annual Watermain Replacement Project - $175,000.00

XII. POTENTIAL FUNDING SOURCES

There are several funding assistance programs that can be considered by the Town to provide low interest loans and potential grants for implementation of these proposed improvement projects.

A. DRINKING WATER STATE REVOLVING FUND

The New York State Department of Health administers the Drinking Water State Revolving Fund (DWSRF) in conjunction with the NYS Environmental Facilities Corporation (NYSEFC). The DWSRF provides financing to municipalities for planning, design, and construction of eligible drinking water projects (including public water system extensions and water treatment plants). Low cost financing, in the form of low interest loans and grants, are available.

Short-term financing is available at 0% interest for up to 5-years in order to design and construct eligible sanitary facilities, with long-term financing being offered for up to 30 years. Reduced interest rate long-term financing is available as low as 0% interest for up to 30 years for municipalities meeting the financial hardship criteria.

The first step in obtaining financing through the DWSRF is to get the project listed. Based on information provided by the municipality on the DWSRF Project Listing Form, the NYSDOH will score the project and list it on the Project Priority List (PPL). To be included on the Annual PPL of the Intended Use Plan (IUP), the municipality must submit an approvable engineering report, project schedule, and Smart Growth Assessment Form.

B. COMMUNITY DEVELOPMENT BLOCK GRANTS

The Community Development Block Grant (CDBG) program gives grants directly to states, which then allocate them to small cities and non-urban counties. Grants may be used for public infrastructure projects (e.g., wastewater and drinking water facilities). Seventy (70) percent of grant funds must be used for activities that benefit low and moderate income people. HUD administers the Small Cities program in New York. Water, sewer and other public facility projects are eligible, especially those that protect public health and reduce environmental risk. Villages, small towns, and cities with population of 50,000 or less are eligible.

C. USDA – RURAL DEVELOPMENT

The U.S. Department of Agriculture – Rural Development offers a similar funding assistance program to municipalities for water and wastewater projects. Both low interest loans (covering a period of 38 years) and grants (up to 75%) are available through this program. Loan interest rates are based on the Median Household Income (MHI) of the service area. To qualify, population of the municipality must be less than 10,000 people.

D. NEW YORK STATE WATER INFRASTRUCTURE IMPROVEMENT ACT 2017 (WIIA)

At the time of this report, NYSEFC is cuurently offering $225 million in WIIA grants for clean and drinking water projects. EFC will provide $112.5 million to selected municipalities with eligible drinking water projects. This is a competitive grant that is based on the score given to the project by the NYSEFC/NYSDOH. Funding is a grant limited to the lesser of $3 million or 60% of net eligible project costs. To be considered for a WIIA grant, municipalities need to have: an Engineering Report, proof of District Formation, environmental review documentation, Smart Growth Assessment form, and established a method of finance (bond resolution).

E. NEW YORK STATE WATER INTERMUNICIPAL WATER INFRASTRUCTURE GRANT (IMG)

In addition to the WIIA grants outlined above, the IMG program authorizes NYSEFC to provide at least $150 million in grants ($30 million in 2017-18) to assist municipalities in support of intermunicipal water quality infrastructure project. IMG grants (limited to the lesser of $10 million or 40 % of net eligible project costs) are available for both clean and drinking water projects that serve multiple municipalities. IMG grants have the same requirements as the WIIA for submission to the competitive grant, but also include an executed Intermunicipal Agreement (IMA).

XIII. CONCLUSIONS

This *Water Master Plan* identified several improvements that can improve overall system performance. These improvements in general include additional water lines, relocating pressure reducing valves that feed system pressure zones, the addition of a water storage tank and addition of a new pump station. The two highest priorities for the Canandaigua Consolidated Water District are source (pumping) and storage.

The immediate need for the water system is to address the pumping deficiencies identified by the NYSDOH as a result of the high demands experienced in 2016. The West Street Pump Station no longer complies with 10 States Standards section 6.4.1 as having duplicate pumps capable of delivering peak demands with the largest pump out of service. Further the location of the station is limited by the discharge pressure delivered to the system (190 psi) and the design working pressure limit of the system facilities (200 psi). The Town should prepare a Preliminary Engineer's Report (PER) and prepare applications for funding in 2018 with plans to possibly construct in 2019.

Following the replacement of the West Street Pump Station, the Town will need to address the age/capacity of the Cramer Road Water Tank. The existing tank is due for a complete recoating project and if current population growth rates continue, the capacity will need to be increased. It is recommended the Town consider replacing the existing tank with two (2) taller tanks to eliminate the dead storage volume, increase the overall volume to at least 1.8 MG, and expand the potential service area of the Cramer Road Water Tank. The Town should prepare a PER in 2019 and submit funding applications in 2020 with plans to possibly construct by 2021/22.

The following improvements should be planned for over the next 10-15 years. The Town should develop a 10-year capital improvement plan and update annually. These improvements should improve overall system performance and serve the future needs of the Town of Canandaigua residents. The Town should establish a 10 to 15-year plan that would evaluate the funding and implementation of the following improvements.

- Install the 16” discharge line to the Cramer Road Tank(s).
- Cramer Road Extension
- Replace the existing watermain on Nott Road with 12” watermain.
- Annual Watermain Replacement Project – 1% of the distribution system.
- Duel Road Extension
- Install a tank on Smith Road to serve as an emergency backup to the Cramer Road Tank and to simplify the operation of the Pierce Park pump station and eliminate the need for the Goodale Road pump station.
- Add Back-Pressure Sustaining capabilities to the Northern PRVs.
- Install tank mixing/THM Removal system on each of the water storage tanks to improve water quality. Cramer Road Tank currently has a mixing system operating.
- Provide an interconnection with Canandaigua-Hopewell to supplement flows to the Fallbrook area.
- Extend City Supplied service area along West Lake Road and relocate pressure reducing valves to improve and create different zones.

The Town should investigate public interest (where district extensions are required) and funding alternatives regarding the construction of all of the improvements. Public interest in some cases may determine the sequence in which improvements are constructed if district formation is required for the improvement.

The Town of Canandaigua is a growing community with clear objectives (throughout its planning documents) to maintain its agrarian character and protect Canandaigua Lake. Canandaigua Lake is a resource for the entire Town and as such, access to public water should be available all its residents subject to public interest and affordability. The Town should not restrict the expansion of water, but should control the potential for development pressure by imposing lateral water restrictions where future districts could lead to unwanted development and negatively influence agricultural activities.

XIV. IMPLEMENTATION PLAN

As part of adoption of this document, the Town should consider the following implementation plan:

Action		Short Term (0-5 years)	Mid Term (5-10 years)	Long Term (>10 years)	Responsible Agency	Project Manager
Middle Cheshire Booster Station PER		X			Town Board	Town Water Superintendent / Town Engineer
Install Middle Cheshire Booster Station		X			Town Board	Town Water Superintendent / Town Engineer
Cramer Road Tank Improvements PER		X			Town Board	Town Water Superintendent / Town Engineer
Install Cramer Road Tank Improvements			X		Town Board	Town Water Superintendent / Town Engineer
Cramer Road Water Extension			X		Town Board	Town Water Superintendent / Town Engineer
Nott Road Water Replacement			X		Town Board	Town Water Superintendent / Town Engineer
Tank Mixing/THM Removal Systems		X			Town Board	Town Water Superintendent / Town Engineer
Canandaigua – Hopewell Interconnection (for Fallbrook area)			X		Town Board	Town Water Superintendent / Town Engineer
Extend City Supplied service area along West Lake Road and relocate PRVs to improve and create different zones.				X	Town Board	Town Water Superintendent / Town Engineer
Water Master Plan Annual Review		X (Yearly)			Town Board	Citizens Implementation Committee
Dev. Capital Improvement Plan (10-Year Plan)		X			Town Board	Water Superintendent
Water Master Plan Update				X	Town Board	Town Engineer

XV. REFERENCES

1. LaBella & Associates. *Agricultural Enhancement Plan*. Rep. December 2016. Print

2. MRB Group. *Sewer Master Plan for the Town of Canandaigua*. Rep. February 2016, last revised 11/16/16). Print.

3. Health Research Inc. *Recommended Standards for Waterworks*. Rep. 2012. Print.

4. MRB Group. *Hydraulic Analysis Update for the Town of Canandaigua*. Rep. January 2011. Print.

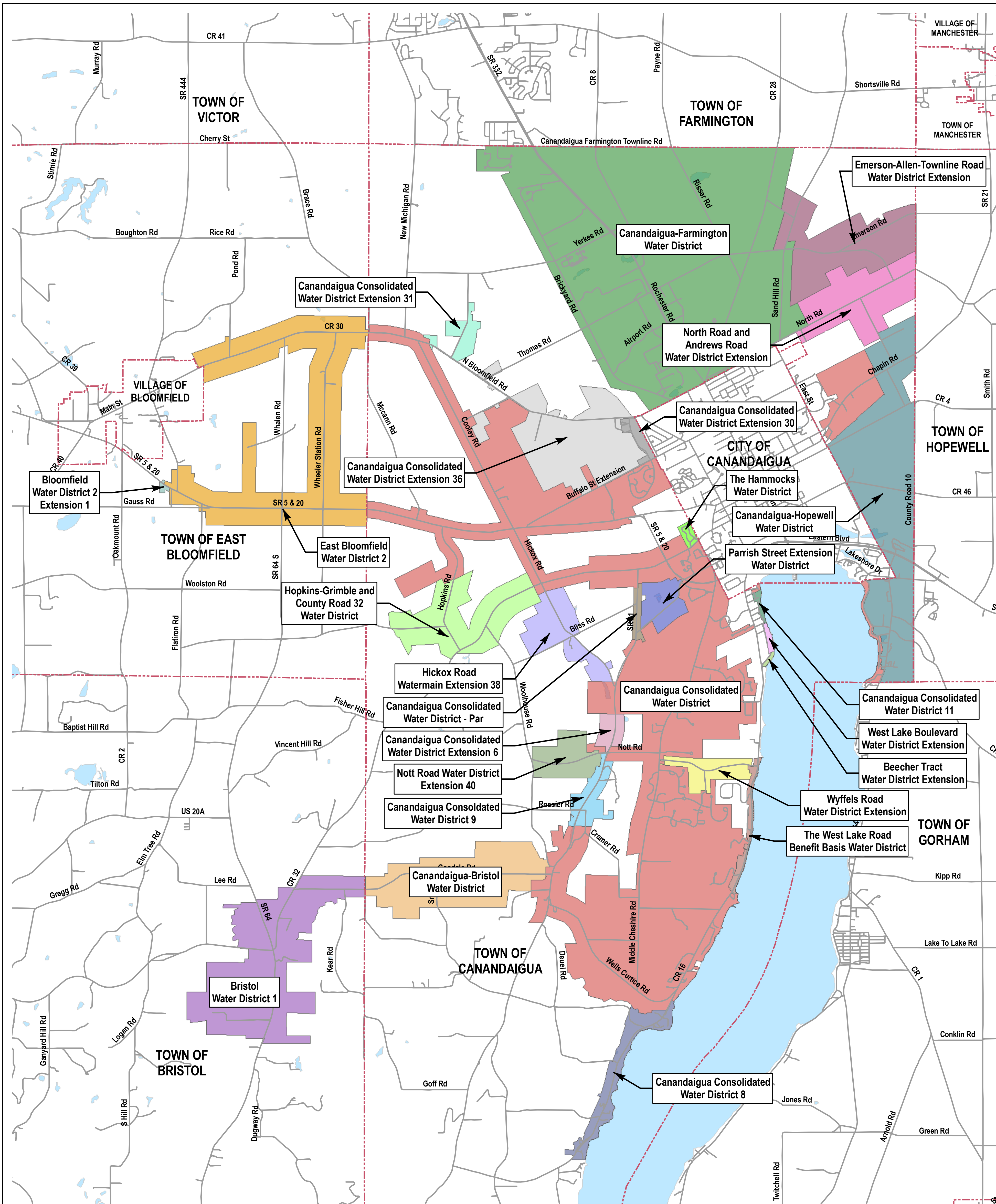
5. MRB Group. *Engineer's report for the County Road 32 Water District Extension No. 41 to the Town of Canandaigua Consolidated Water District.* Rep. September 2016. Print.

6. Canandaigua Development Office. *Padelford Greenway Plan*. Rep. December 2015. Print.

7. EDR. *Town of Canandaigua Comprehensive Plan 2011Update*. Rep. May 2011. Print.

APPENDIX A

TOWN OF CANANDAIGUA WATER DISTRICT MAP



Legend

EXISTING WATER DISTRICT

- BRISTOL WATER DISTRICT 1
- BEECHER TRACT WATER DISTRICT EXTENSION
- CANANDAIGUA CONSOLDATED WATER DISTRICT 9
- CANANDAIGUA CONSOLIDATED WATER DISTRICT
- CANANDAIGUA CONSOLIDATED WATER DISTRICT - PAR
- CANANDAIGUA CONSOLIDATED WATER DISTRICT 11
- CANANDAIGUA CONSOLIDATED WATER DISTRICT 8
- CANANDAIGUA CONSOLIDATED WATER DISTRICT EXTENSION 30
- CANANDAIGUA CONSOLIDATED WATER DISTRICT EXTENSION 31
- CANANDAIGUA CONSOLIDATED WATER DISTRICT EXTENSION 36
- CANANDAIGUA CONSOLIDATED WATER DISTRICT EXTENSION 6
- CANANDAIGUA-BRISTOL WATER DISTRICT
- CANANDAIGUA-HOPEWELL WATER DISTRICT
- EMERSON-ALLEN-TOWNLINE ROAD WATER DISTRICT EXTENSION
- HICKOX ROAD WATERMAIN EXTENSION 38
- HOPKINS-GRIMBLE AND COUNTY ROAD 32 WATER DISTRICT
- NORTH ROAD AND ANDREWS ROAD WATER DISTRICT EXTENSION
- NOTT ROAD WATER DISTRICT EXTENSION 40
- PARRISH STREET EXTENSION WATER DISTRICT
- RISSER ROAD EXTENSION WATER DISTRICT
- THE HAMMOCKS WATER DISTRICT
- THE WEST LAKE ROAD BENEFIT BASIS WATER DISTRICT
- WEST LAKE BOULEVARD WATER DISTRICT EXTENSION
- WYFFELS ROAD WATER DISTRICT EXTENSION
- CANANDAIGUA-FARMINGTON WATER DISTRICT
- BLOOMFIELD WATER DISTRICT 2 EXTENSION 1
- EAST BLOOMFIELD WATER DISTRICT 2
- MUNICIPAL BOUNDARY

0300.16002.000	MRB | group	Drawn By:	TJV	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C.	Scale:	1" = 6,000' @11"x17"	ONTARIO COUNTY, NEW YORK
FIG. II-1	145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Date:	SEPT 2017	EXISTING WATER DISTRICTS

N S E W

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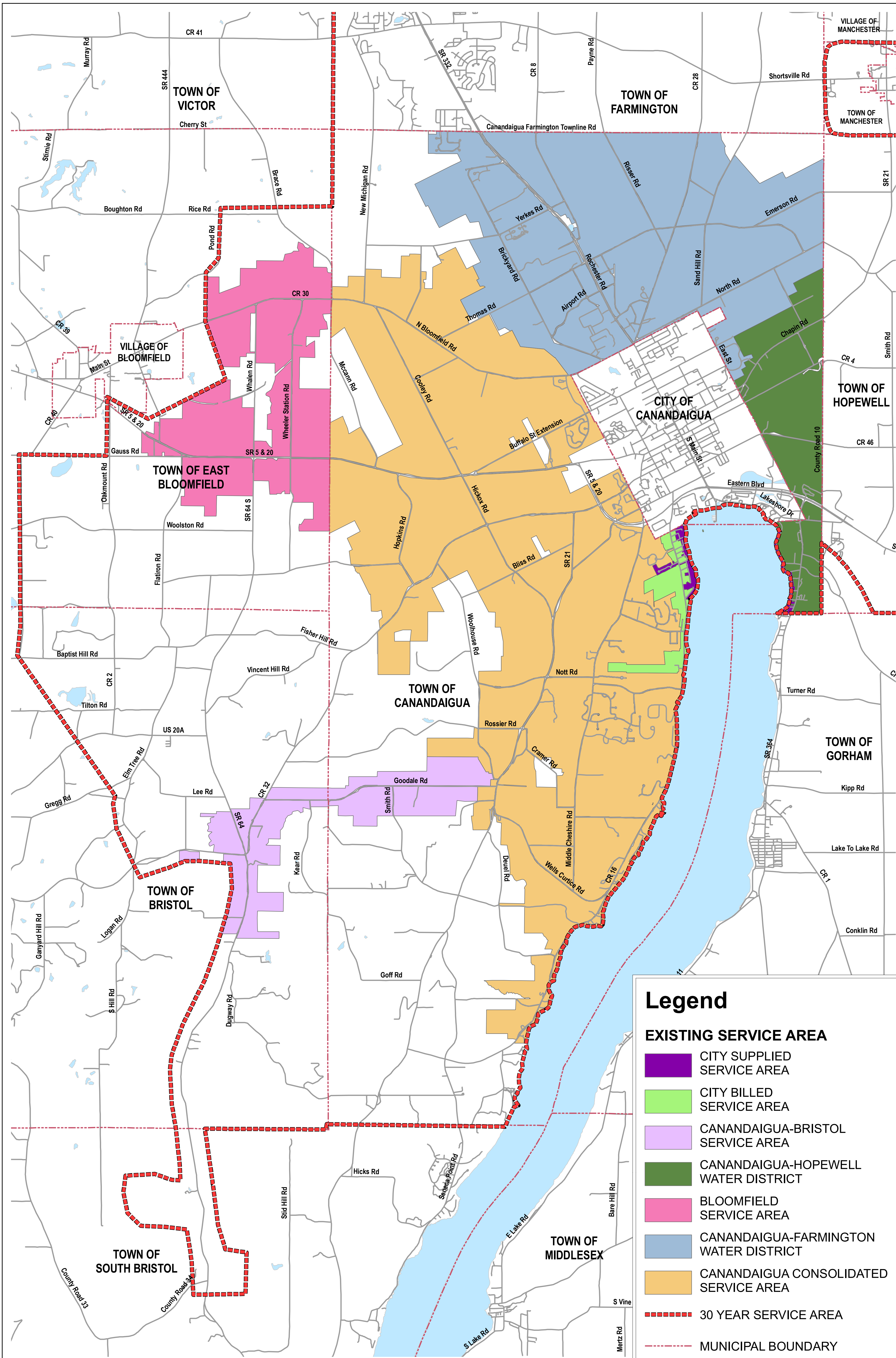
APPENDIX B

TOWN OF CANANDAIGUA SERVICE AREA MAP



0300.16002.000	MRB | group	Drawn By:	TJV	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 6,000' @11"x17"	ONTARIO COUNTY, NEW YORK
FIG. II-2		Date:	AUG 2017	EXISTING SERVICE AREAS

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APPENDIX C

WATER USE

Metered Sales

	2015-Q2	2015-Q3	2015-Q4	2016-Q1	2016-Q2	2016-Q3	2016-Q4	Total	Unit
CANANDAIGUA CONSOLIDATED SERVICE AREA									
Metered Sales	30,638,692	39,874,992	25,322,000	27,091,740	37,085,732	54,724,952	27,260,488	241,998,596	gallons
East Bloomfield	2,594,000	5,119,000	2,719,000	2,174,000	3,436,000	2,588,000	2,575,000	21,205,000	gallons
Brace Road	-	1,000	1,000	12,000	19,000	58,000	14,000	105,000	gallons
Hammocks	1,130,500	1,130,500	745,000	866,000	1,229,000	1,340,000	869,000	7,310,000	gallons
Subtotal Cramer	34,363,192	46,125,492	28,787,000	30,143,740	41,769,732	58,710,952	30,718,488	270,618,596	gallons
Days / Qtr	94	90	83	90	101	89	84	632	days
Daily Use	364,742	512,505	345,188	334,960	412,246	659,650	365,695	428,244	GPD
Daily Purchased	**401,066**	**563,546**	**379,565**	**396,562**	**488,061**	**780,964**	**432,949**	**491,527**	**GPD**
Accounts	2,029	2,032	2,046	2,056	2,065	2,085	2,091		each

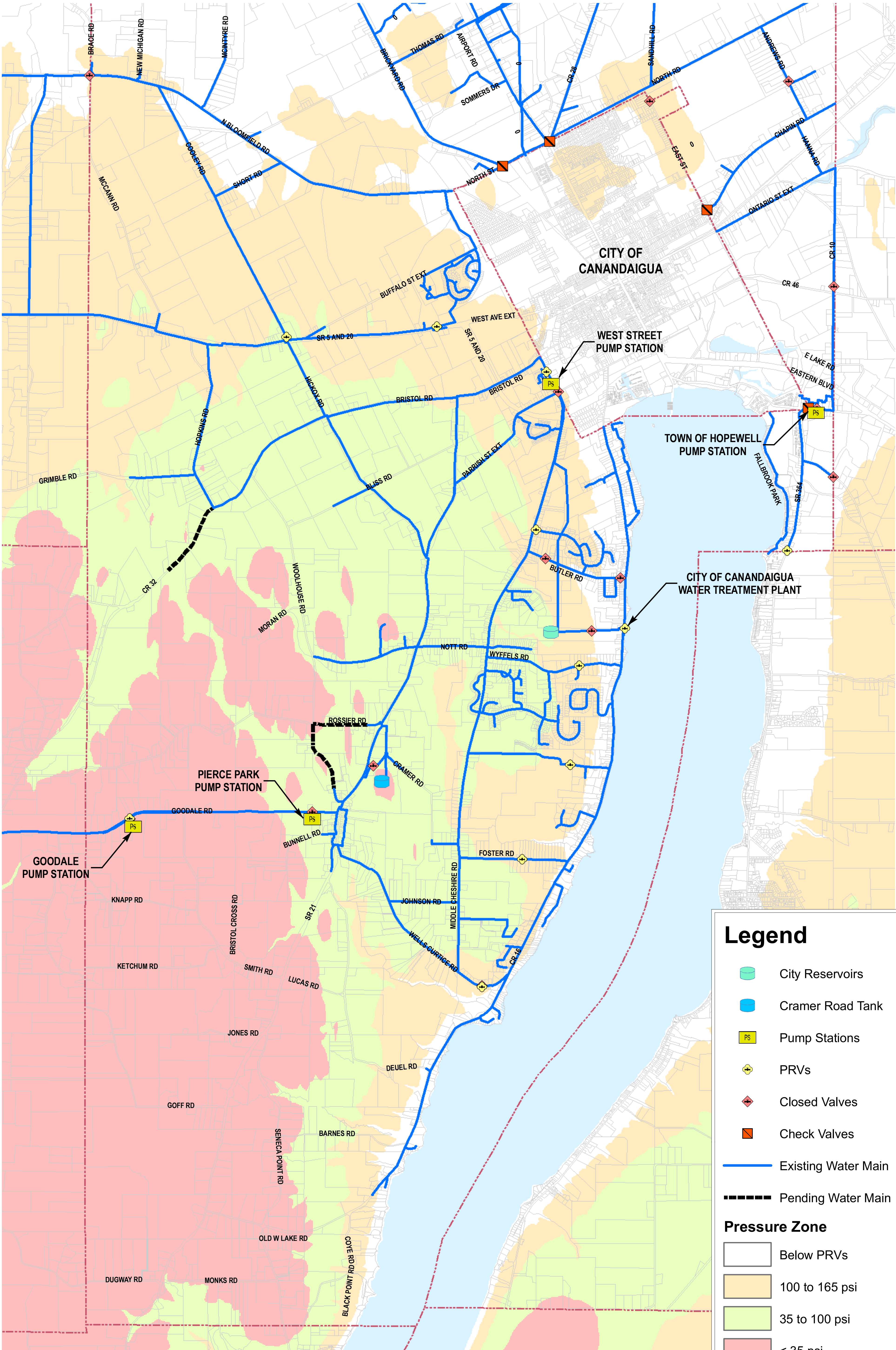
	2015-Q2	2015-Q3	2015-Q4	2016-Q1	2016-Q2	2016-Q3	2016-Q4	Total	Unit
CITY SUPPLIED SERVICE AREA									
West Lake Road	976,000	1,974,000	619,000	406,000	1,059,000	2,780,000	573,000	8,387,000	gallons
Fallbrook	1,044,000	2,137,000	643,000	408,000	1,141,000	3,096,000	659,000	9,128,000	gallons
Subtotal City	2,020,000	4,111,000	1,262,000	814,000	2,200,000	5,876,000	1,232,000	17,515,000	
Days / Qtr	94	90	83	90	101	89	84	632	days
Daily Use	21,441	45,678	15,133	9,045	21,713	66,020	14,667	27,717	GPD
Daily Purchased	**23,576**	**50,227**	**16,640**	**10,709**	**25,706**	**78,162**	**17,364**	**31,813**	**GPD**
Accounts									
West Lake Road	77	78	78	78	76	76	77		each
Fallbrook	114	113	112	112	114	114	114		each
Total Accounts	191	191	190	190	190	190	191		each

APPENDIX D

HYDRAULIC ANALYSIS

APPENDIX E

PRESSURE – CENTRAL ZONE



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SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 4,000' @11"x17"		ONTARIO COUNTY, NEW YORK
FIG. V-1		Date:	AUG 2017		PRESSURES - CENTRAL ZONE

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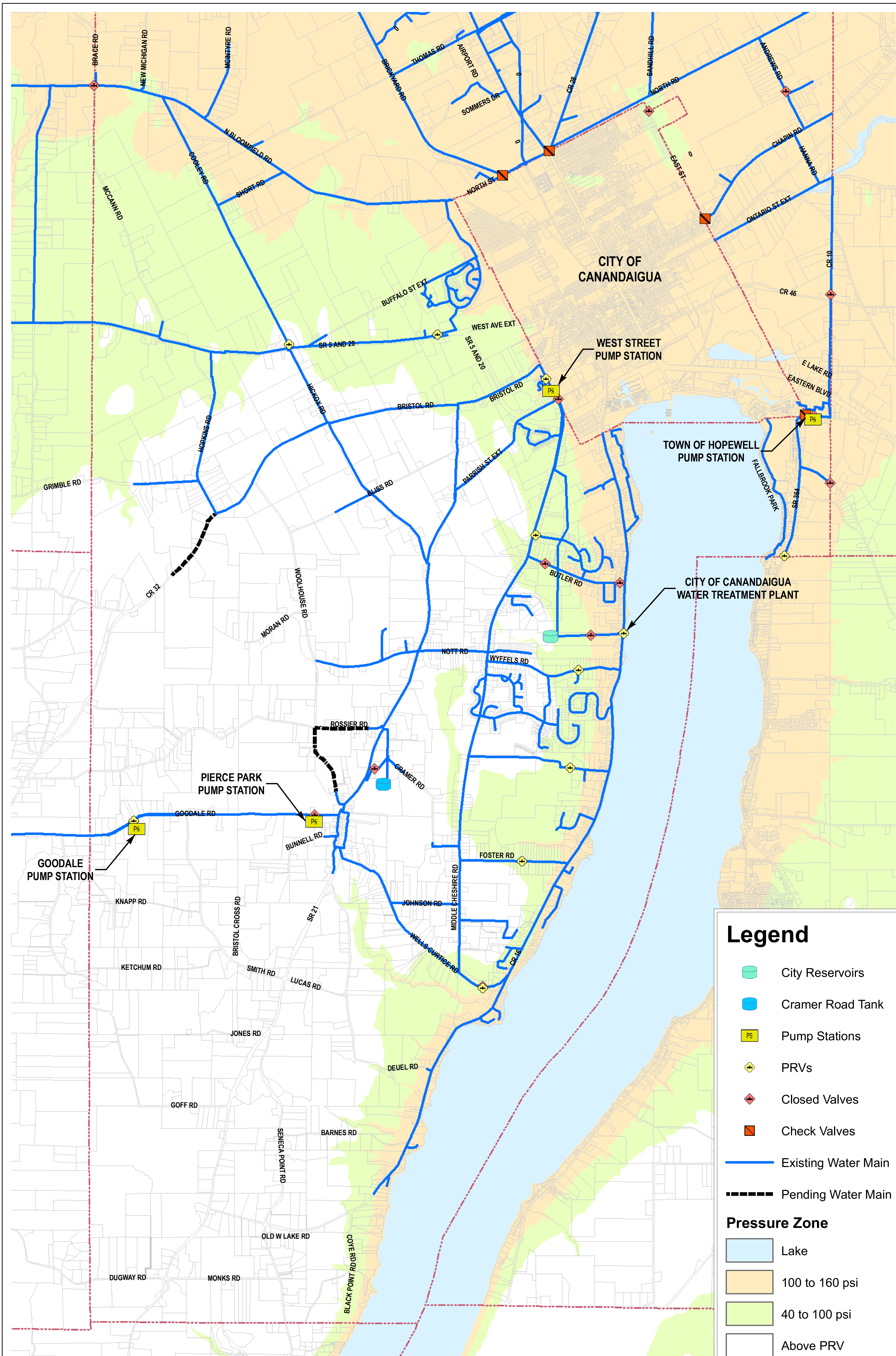
APPENDIX F

PRESSURE – LOWER ZONES



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SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 4,000' @11"x17"		ONTARIO COUNTY, NEW YORK
FIG. V-2		Date:	AUG 2017		PRESSURES - LOWER ZONE

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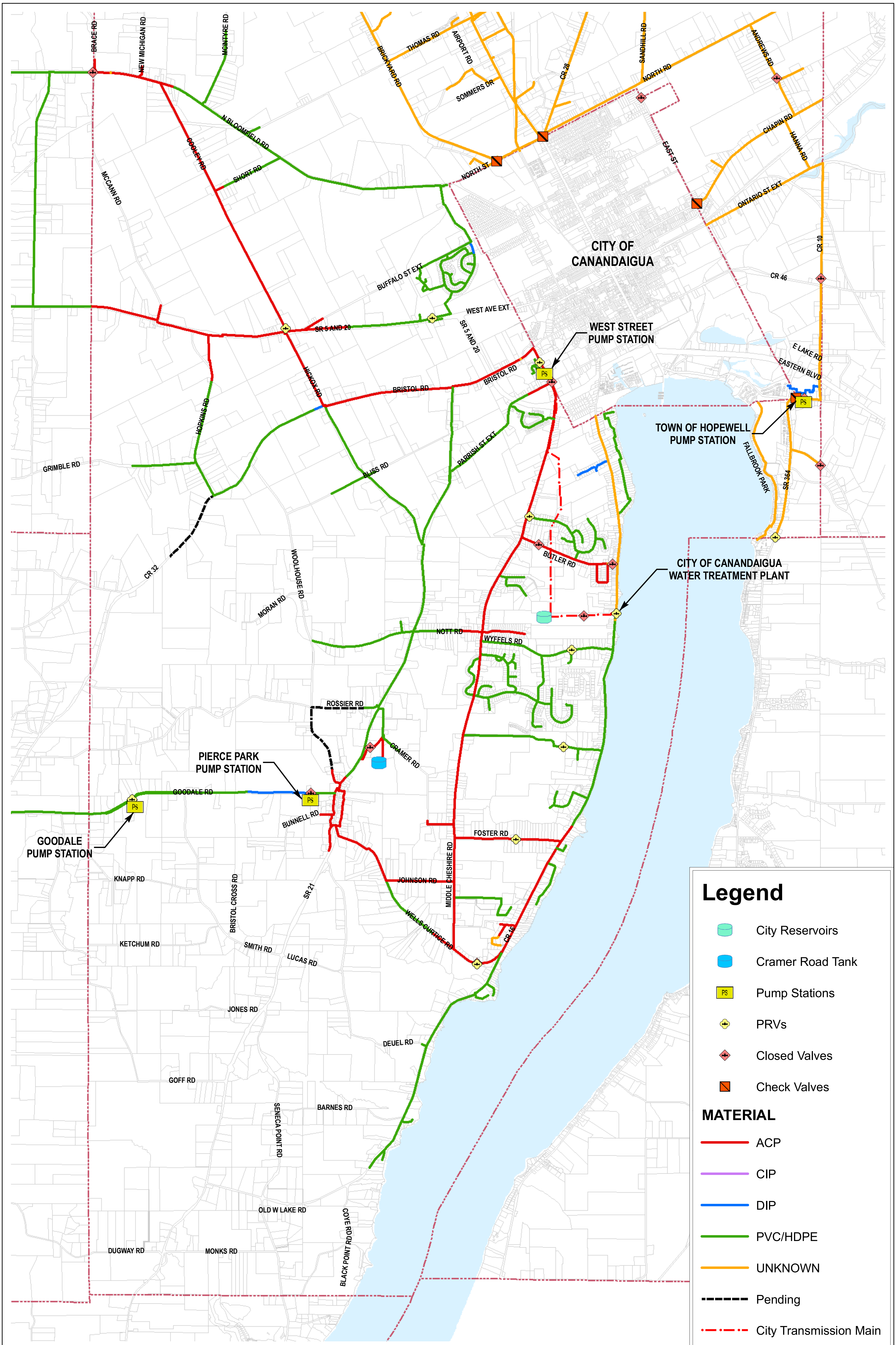
APPENDIX G

EXISTING DISTRIBUTION SYSTEM MATERIAL TYPES



0300.16002.000	MRB group	Drawn By:	TJV		TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 4,000' @11"x17"	N W E S	ONTARIO COUNTY, NEW YORK
EXHIBIT A		Date:	OCT 2017		WATER SYSTEM MATERIALS

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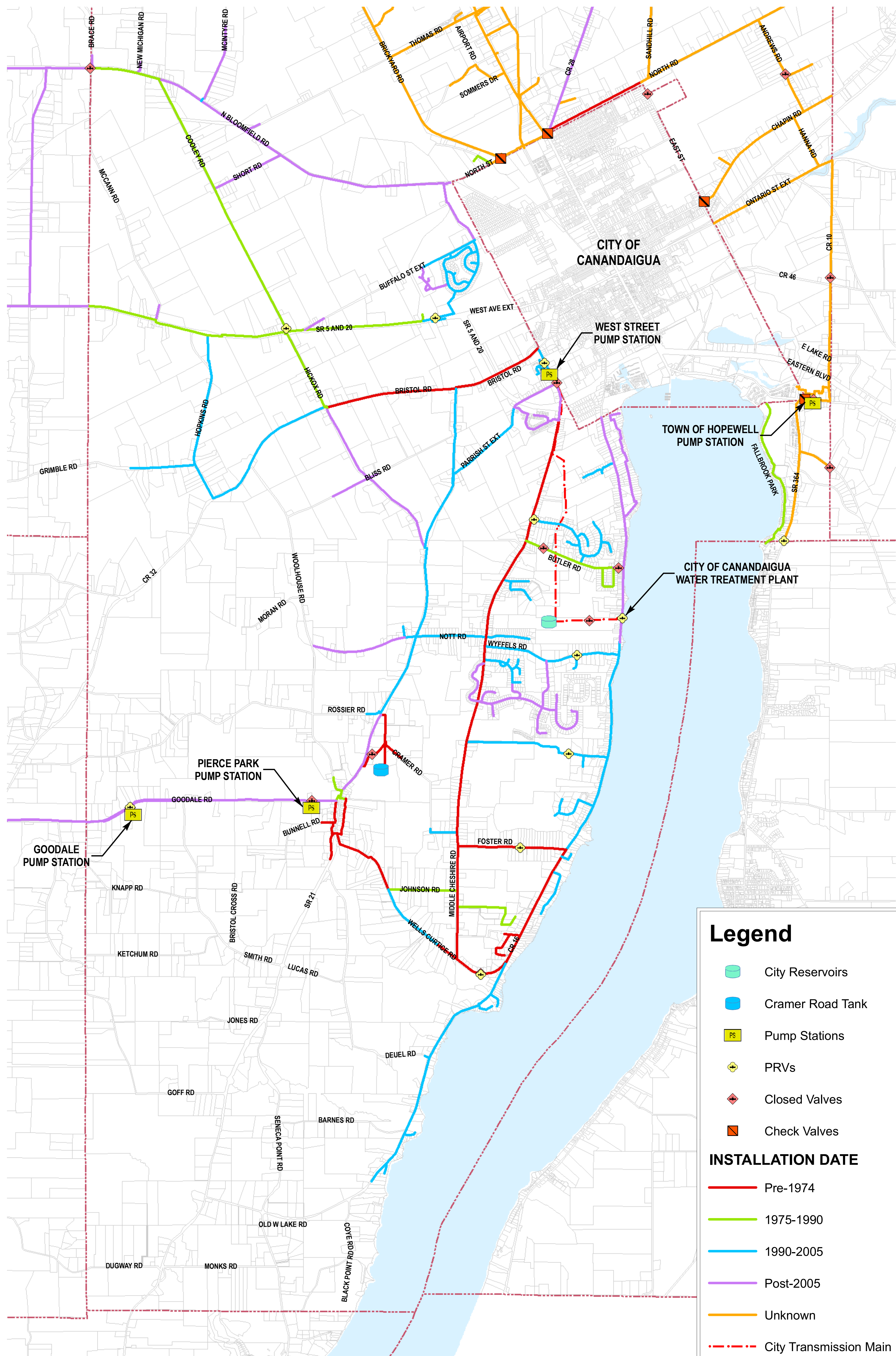
APPENDIX H

EXISTING DISTRIBUTION SYSTEM WATERMAIN AGE MAP



0300.16002.000	**MRB | group**	Drawn By:	TJV	N / W E / S	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C.	Scale:	1" = 4,000' @11"x17"		ONTARIO COUNTY, NEW YORK
EXHIBIT A	145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Date:	OCT 2017		WATER SYSTEM INSTALLATION DATES

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APPENDIX I

LIQUID ENGINEERING
CRAMER ROAD TANK
INSPECTION REPORT

APPENDIX J

STORAGE ANALYSIS

Town of Canandaigua

5440 Route 5&20 West
Canandaigua, N.Y. 14424

CRAMER ROAD TANK
AND
DAY ROAD TANK

STORAGE ANALYSIS

August 2017

MRB Group Project No. 0300.16002.000

Prepared by:

MRB group

The Culver Road Armory
145 Culver Road, Suite 160
Rochester, New York 14620
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LIST OF TABLES

LIST OF EXHIBITS

I. INTRODUCTION

This storage analysis supplements the *2017 Water Master Plan for the Town of Canandaigua Water Distribution System* (MRB Group, August 2017) *(Water Master Plan)* by providing technical details and methods utilized to evaluate water system storage and develop recommended improvements.

II. REFERENCES

Review of the tanks is based on the following references:

1. NYCRR Part 5, Sub-Part 5-1 Public Water Systems,
2. *Recommended Standards for Water Works (Recommended Standards)* (Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2012),
3. *Guide for Determination of Needed Fire Flow* (ISO Properties, Inc., 05-2008),
4. *Distribution System Requirements for Fire Protection* (American Water Works Association, Manual of Practices M-31, 3rd Edition, 1998,
5. *Water Supply Systems and Evaluation Methods, Vol. II: Water Supply Evaluation Methods* (U.S. Fire Administration, October 2008),
6. *2015 International Fire Code, Appendix B, Fire-Flow Requirements for Buildings* (ICC 2014), and
6. *Water System Design Manual, Chapter 9*, DOH 331-1223 (Washington State Department of Health, Division of Environmental Health, Office of Drinking Water, Rev. 12/09).

III. WATER DEMANDS

Existing water demands for the *Canandaigua Consolidated Water Districts* and *Town of Bristol Water District* were utilized to evaluate storage. Existing and future system demands are discussed more fully Section IV of the *Water Master Plan*.

Table III.1: Canandaigua Consolidated Service Area Demands

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	427,878	494,653	628,203	761,753	895,302	GPD
Maximum Day	932,004	1,077,453	1,368,351	1,659,250	1,950,148	GPD
Peak Hour	1,248	1,443	1,832	2,222	2,611	gpm

Table III.2: Town of Bristol Water District Demands

Water Demand	2015	2020	2030	2040	2050	Units
Average Day	10,909	32,557	68,810	105,063	141,316	gallons
Maximum Day	35,507	105,967	223,962	341,956	459,951	gallons
Peak Hour	39	118	248	379	510	gpm

IV. Review Criteria

Tank storage volume contains six volume components that include:

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS);
5. Dead Storage (DS); and
6. Headspace (HS).

A. Operating Storage

Operating Storage is the volume between pump on and off levels. Paragraph 7.3.1 of the *Recommended Standards* states that, “The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 30 feet.” Experience has found that most water system operators typically a 10-foot operating range.

The U.S. Fire Administration recommends that, "In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies." For purposes of this review this recommendation is taken as guidance for recommended operating storage.

B. EQUALIZING STORAGE

Equalizing storage is the volume between pump on level and the level needed to maintain a system pressure of 35 psi.

Needed equalizing storage for systems with a single source of supply that operates on an on-demand basis is based on the peak hour demand, less the capacity of the supply, resultant multiplied by 150 minutes.

C. STANDBY STORAGE

Standby storage is the volume needed to provide water during an emergency such as a water main break; typically the volume between the levels needed to maintain system pressures of 35 psi and 20 psi.

Tank sizing guides base SB on the volume between system pressures of 30 psi and 20 psi. Paragraph 7.3.1 of the *Recommended Standards,* however states that, "The minimum working pressure in the distribution system should be 35 psi…" The sizing guides also suggest basing SB on two times the average day demand. However, Section 7.0.1, c. of the *Recommended Standards* states that, "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems." Paragraph 7.0.1.a. of the *Recommended Standards* states that, "Minimum storage for systems not providing fire protection shall be equal to the average day consumption." Therefore, based on these three criteria, SB will be based on average day demand stored between the system 35 psi and system 20 psi tank levels.

D. FIRE SUPPRESSION STORAGE

Design guides show FSS as the volume between equalization storage and the level needed to maintain 20 psi system pressure. ISO guidelines counts the volume available for fire flow as between the pump on level and the system 20 psi level. Which, by definition, includes ES. Considering the volume requirements of the *Recommended Standards* (7.0.1, c.), this evaluation bases FSS on pump on level as a means to minimize excess storage.

It is important to note that ISO does not prescribe a minimum storage volume but establishes needed fire flow based on quantity and duration needed for fire protection. When conducting a review of a system, ISO calculates the volume available in a tank and determines if it can supply the needed fire flow for the specified duration. When establishing a community rating, ISO does not consider flows greater than 3,500 gpm (3-hour duration). For this reason, it is often interpreted that the minimum amount of storage needed for fire protection is the 630,000 gallons.

The *Fire Code* provides fire flow requirements based on building type, group, and fire protection area. Associated with the flow requirements are flow durations that are similar to ISO guidelines. The *Fire Code* shows a duration of 4-hours for needed fire flows 4,000 gpm and greater. The *Fire Code* contains a provision that allows reducing the needed flow to 25% for designated automatic sprinkler systems; duration remains unchanged. The highest flow rate listed in Table B105.1(2) of Appendix B to the *Fire Code* is 8,000 gpm with a duration of 4-hours. Assuming a facility with this needed flow is protected by sprinklers, the flow is reduced to 2,000 gpm for 4-hours. The interpreted needed storage volume is therefore 480,000 gallons.

Review of the Cramer Road tank will consider FSS based on a range in volume from 480,000 gallons to 630,000 being available between the pump on elevation and system 20 psi elevation. Review of the Day Road tank will be based on a 2,500 gpm fire with a 2-hour duration, without sprinklers, due to the rural nature of the service area.

Tank sizing guides state that SB and FSS can be consolidated depending on the requirements of the local fire protection authority. Considering Section 7.0.1, c. of the Recommended Standards, this review will be based on the greater of SB of FSS.

E. Dead Storage

Dead storage is the volume between the level needed to maintain a system pressure of 20 psi and the tank outlet. Ideally, this volume should be zero in order to minimize tank volume and maintain water quality.

F. Headspace

Head space is the volume available between the pump off level and the level of the overflow. Common practice is to provide 6-inches to 1-foot of headspace to protect against overflowing the tank.

V. Tank Review

A. Cramer Road Tank

The Cramer Road tank is located approximately 1,100 feet south of the Cramer/Rosier Road Intersection. The painted steel storage tank is 1.5 million gallons in size, 85.6 feet in diameter, and the depth to overflow is approximately 35 feet. The base of the tank is at elevation 1177.8 feet, based on the NAD88 datum[1]. The tank's high water level is set to approximately 32 feet; in the summer the low level is set at 23 feet, and in the winter the low level is set to 26.5 feet.

Calculations utilized to review available and needed storage based on existing demands are attached as Exhibit A. Calculations based on future demands are attached as Exhibit C. Table V.1 summarizes the calculation results based on existing conditions.

Due to a high point in the system near 5615 Nott Road, the operating volumes of the Cramer Road tank are limited. Under peak hour conditions, the pressure at the high point drops to ~30 psi, the rest of the system is above 35 psi. Because of this, the tank does not contain ES; the pump off level equals the level needed to maintain 35 psi in the rest of the system.

[1] Town of Canandaigua, 4/25/2017.

Analysis of the tank also considered a proposed water district on Woolhouse and Rossier Roads. When completed, the intersection of the two roads becomes the high point of the system. Under peak hour demands, the projected pressure at the intersection is ~21 psi. This low pressure results in minimal SB, ~151,000 gallons.

Table V.1: Cramer Road Tank - 2015

Storage Volume	Existing	Needed Minimum	Needed Maximum
Operating Storage (OS)	236,788	171,303	228,404
Fire Suppression Storage (FSS)	150,683	428,185	676,301
Fire Suppression Storage (FSS) as ES+SB			
Equalizing Storage (ES)	-	128,700	128,700
Standby Storage (SB)	150,683	442,309	442,309
Fire Suppression Storage (FSS)	150,683	571,009	571,009
Dead Storage (DS)	990,205	-	-
Head Space (HS)	129,157	21,526	43,052
Total Volume = OS + FSS + DS + HS	**1,506,833**	**621,014**	**947,757**
Total Volume = OS + ES + SB + DS + HS	**1,506,833**	**763,838**	**842,465**

Table V.1 lists maximum and minimum needed storage volumes with a total needed storage ranging from 622,000 gallons to 843,000 gallons. These volumes do not include dead storage since excess storage is discouraged. The needed volumes can be provided by an elevated storage tank. Utilizing a standpipe introduces dead storage resulting in a tank with total volume ranging from 1.61 million gallons to over 1.83 million gallons. These volumes are greater than the existing 1.5 million gallon tank. Therefore, the existing tank is undersized for existing system demands.

Normally the pressure on Nott Road is ~42 psi, trending toward 35 psi during maximum day demands. A hydraulic analysis of the distribution system found that pressure losses due to flow in the supply line to the Cramer Road tank can be significant with losses over 30-feet (~13.2 psi) during peak demands. Tank volumes shown in Table V.1 account for this loss. The hydraulic analysis also found that providing a 12-inch supply line from the tank to the system reduces line losses to 8.2-feet (~3.6 psi) during peak demands. Table

V.2 compares Cramer Road tank storage volume under existing conditions to the tank with a 12-inch supply line. As the table shows, the increased supply line increases FSS, ES and SB; it also decreases DSl

Table V.2: Cramer Tank with 12-inch Supply

Storage Volume	Existing w/8"	Existing w/12"
Operating Storage (OS)	236,788	236,788
Fire Suppression Storage (FSS)	150,683	1,118,501
Fire Suppression Storage (FSS) as ES + SB		
Equalizing Storage (ES)	-	3,014
Standby Storage (SB)	150,683	1,115,487
Fire Suppression Storage (FSS)	150,683	1,118,501
Dead Storage (DS)	990,205	22,387
Head Space (HS)	129,157	129,157
Total Volume = OS + FSS + DS + HS	**1,506,833**	**1,506,833**
Total Volume = OS + ES + SB + DS + HS	**1,506,833**	**1,506,833**

Table V.3: Cramer Road Tank - 2050

Storage Volume	Needed Minimum	Needed Maximum
Operating Storage (OS)	357,394	476,525
Fire Suppression Storage (FSS)	185,113	462,101
Fire Suppression Storage (FSS) as ES+SB		
Equalizing Storage (ES)	154,695	54,195
Standby Storage (SB)	1,036,618	1,036,618
Fire Suppression Storage (FSS)	1,091,313	1,091,313
Dead Storage (DS)	0	0
Head Space (HS)	21,526	43,052
Total Volume = OS + FSS + DS + HS	**564,033**	**98,678**
Total Volume = OS + ES + SB + DS + HS	**1,570,233**	**1,710,890**

Table V.3 summarizes the estimated storage volume needed in the Canandaigua Consolidated service area by year 2050. Comparing the table to Table V.1, shows that as system demand increases that needed SB storage becomes more significant than FSS. Listed volumes in Table V.3 are based on additional flow from a future supply pump station designed to provide year 2050 maximum day demands and increased demand at the Pierce park pump station. The larger pumps help reduce storage volumes. Total future storage can be provided in an elevated storage tank.

B. DAY ROAD TANK

The Day Road tank is located on Day Road approximately 700 feet east of Bristol Road. The glass lined storage tank is 125,000 gallons in size, 28 feet in diameter, and the depth to overflow is approximately 27 feet. The base of the tank is at elevation 1144.5 feet, based on the NAD88 datum. The tank's high water level is set to approximately 25 feet, and the low level is set at 23 feet.

Calculations utilized to review available storage in the Day Road tank and to determine needed storage are attached as Exhibits D and E. Table V.4 summarizes the calculation results based on existing demands.

Table V.4: Day Road Tank - 2015

		Needed	
Storage Volume	**Existing**	**Minimum**	**Maximum**
Operating Storage (OS)	9,259	3,273	4,364
Fire Suppression Storage (FSS)	106,432	280,509	282,559
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	106,386	0	0
Standby Storage (SB)	46	10,909	10,909
Fire Suppression Storage (FSS)	106,432	10,909	10,909
Dead Storage (DS)	46	-	-
Head Space (HS)	9,259	2,315	4,630
Total Volume = OS + FSS + DS + HS	**124,997**	**286,097**	**291,552**
Total Volume = OS + ES + SB + DS + HS	**124,997**	**16,496**	**19,902**

The table indicates that FSS is the preponderance of the needed storage for the Day Road tank making it appear that the tank is potentially under sized. FSS is based on an assumed needed fire flow of 2,500 gpm. An ISO evaluation of the service area is needed to determine the actual, needed fire flow. If the ISO review determines that the needed fire flow is something less, such as 1,000 gpm for 1 hour, then the tank has adequate FSS.

The table also indicates that no ES storage is needed. This is because the supply rate from the control valve that fills the tank is greater than existing system demands.

Review of the tank based on anticipated year 2050 demands (Table V.5) indicates that as system demands increase that additional storage may be need in the service area, potentially as a parallel tank to the existing.

Table V.5: Day Road Tank - 2050

Storage Volume	Existing	Needed Minimum	Needed Maximum
Operating Storage (OS)	9,259	43,745	58,326
Fire Suppression Storage (FSS)	106,432	254,176	280,729
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	106,386	4,500	4,500
Standby Storage (SB)	46	141,316	141,316
Fire Suppression Storage (FSS)	106,432	145,816	145,816
Dead Storage (DS)	46	-	-
Head Space (HS)	9,259	2,315	4,630
Total Volume = OS + FSS + DS + HS	**124,997**	**300,236**	**343,685**
Total Volume = OS + ES + SB + DS + HS	**124,997**	**191,876**	**208,772**

VI. RECOMMENDATIONS

Review of the Cramer Road tank determined that it does not provide the needed storage for the service area based on current demands. Storage volume is limited by existing and proposed high points in the system. Volume is further limited by head loss due to flow in the tank's supply line. It is recommended that tank be replaced with a 1.8 million gallon elevated tank with minimal dead storage. It is also recommended to add a 12-inch diameter main that runs parallel to the existing 8-inch line. The new line will improve system pressure during high demands and increases design fire flow in the service area.

Review of the Day Road tank determined that it is adequately sized for existing demands. The Day Road tank service area would benefit from an ISO review to determine the actual, needed fire flow and duration for the service area. A second, 200,000 gallon tank may be necessary by year 2050 as the service area expands.

EXHIBIT A

CRAMER ROAD TANK STORAGE VOLUME ANALYSIS – EXISTING

CRAMER ROAD TANK

STORAGE ESTIMATE BASED ON EXISTING SYSTEM DEMANDS

Reference: *Water System Design Manual* , Washington State Department of Health, December 2009.

System Demands

Canandaigua Consolidated Service Area

Demand	2016	Units
Average Day	427,878	GPD
Maximum Day	932,004	GPD
Peak Hour	1,248	gpm

Pierce Park Pump Station

Demand	2016	Units
Average Day	14,431	GPD
Maximum Day	31,434	GPD
Peak Hour	42	gpm
Pump Capacity	195	gpm

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.

9.0.1 Total Storage

Total tank volume between overflow and tank outlet elevations.

		Level	
Existing Tank	Overflow	35.00	ft
	Base	-	ft
	Depth	35	ft
	Unit Volume	43,052	gallon / foot
Total Storage		1,506,833	gallons

9.0.2 Operating Storage (OS)

Volume between pump ON and OFF set points.

		Level	
Existing Tank	Pump OFF	32.00	ft
	Pump ON	26.50	ft
	Depth	5.5	ft
	Unit Volume	43,052	gallon / foot
Operating Storage (OS) =		236,788	gallons

9.0.3 Equalizing Storage (ES)

For Call-On-Demand Pumping:
Equalizing Storage, ES = (PHD - Qs)(150 min)

PHD = Peak Hour Demand (gpm)
Qs = Sum of Supply Capacities (gpm)

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
7.0.1.a. - Reduce if source has capacity to supplement peak demands. (Needs emergency power.)

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	427,878	14,431	442,309	gallons
	297.14	10.02	307	gpm
	0.43	0.01	0.44	MGD

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	297	10	307	gpm
Peak Hour Factor =	4.20	NA		
Peak Hour Flow =	1,248	195	1,443	gpm
		Typical pump flow rate.		

Total Peak Hour Demand on Tank (PHD) = 1,443 gpm

Estimated Available West Street Flow with one pump, Qs = 585 gpm

Estimated Flow From Storage, PHD - QS = 858 gpm

Equalizing Storage, ES = (PHD - Qs)(150 min) = 128,700 gpm

Interpreted to mean the volume between Pump ON and System 35 psi.
Reference: Water System Design Manual, Washington State Department of Health, December 2009.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 35 psi	26.50	ft
	Depth	0	ft
	Unit Volume	43,052	gallon / foot
Equalizing Storage (ES) =		-	gallons

9.0.4 Standby Storage (SB)

Volume that provides 20 psi at all points in the system.
Recommended for systems with a single source, SB = 2 x Average Day Demand

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
Section 7.0.1, c. "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems."
For New York, this is interpreted to mean that SB can be reduced to 1 x Average Day Demand

Average Day Demand = 442,309 gallons
Standby Storage, SB = 442,309 gallons

Reference: National Drinking Water Clearinghouse Tech Brief: *Reservoirs, Towers, and Tanks, Drinking water Storage Facilities*, Fall 2001.
Interpreted to mean the volume between system 35 psi and system 20 psi.

		Level	
Existing Tank	System 35 psi	26.50	ft
	System 20 psi	23.00	ft
	Depth	3.5	ft
	Unit Volume	43,052	gallon / foot
Standby Storage (SB) =		150,683	gallons

9.0.5 Fire Suppression Storage (FSS)

Reference: Recommended Standards for Water Works (2012 Ed)
7.0.1.c. - Satisfy ISO fire flow requirements for systems with fire protection.

ISO fire flow credit.
Fire Suppression Rating Schedule (2013, ISO)
- Credit no more than average daily minimum storage maintained (MSM) expressed in gpm at required residual and duration.
- Limit pumped storage to capacity of pumping facility.
- Evaluate minimum storage maintained based on average minimum storage maintained for maximum population.

ISO Needed Fire flow in WD #2 is unknown, use 3,500 gpm, which is ISO maximum for a community rating.
Required fire duration is therefore 3-hours.

Estimate fire storage needed based on average day demands.

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	297	195	492	gpm
		Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	88,584.75	88,585	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	568,585	718,585	gallons
Estimated Available West Street Pump Station Flow (min 20 psi sys) =	585	585	gpm
4-Hour & 3-Hour Volume	140,400	105,300	gal

Average Day Fire Suppression Storage (FSS) with reliance on Pumps =	428,185	613,285	gal

Estimate fire storage needed based on maximum day demands.

		CCSA	Pierce Park PS	Combined	
Maximum Day Demand =		932,004.00	31,433.84	963,438	GPD
	Calculated	647	22	669	
	USE	647	195	842	gpm
			Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	151,600.50	151,601	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	631,601	781,601	gallons
Estimated Available West Street Pump Station Flow (min 20 psi sys) =	585	585	gpm
4-Hour & 3-Hour Volume	140,400	105,300	gal
Maximum Day Fire Suppression Storage (FSS) with reliance on Pumps =	491,201	676,301	gal
Fire Suppression Storage (FSS) with reliance on Pumps =	428,185	676,301	gallons

ISO interprets to mean the volume between Pump ON and System 20 psi.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 20 psi	23.00	ft
	Depth	3.5	ft
	Unit Volume	43,052	gallon / foot
Fire Suppression Storage (FSS) =		150,683	gallons

9.0.6 Dead Storage (DS)

Volume between System 20 psi and tank outlet.

		Level		Needed Minimum	Needed Maximum
Existing Tank	System 20 psi	23.00	ft		
	Tank Outlet	-	ft		
	Depth	23	ft		
	Unit Volume	43,052	gallon / foot		
Dead Storage (DS) =		990,205	gallons	Not Recommended	

9.0.7 Headspace (HS)

Volume Between Pump Off and Tank Overflow
(Typically 6 to 12 inches.)

		Level		Needed Minimum	Needed Maximum	
Existing Tank	Overflow	35.00	ft	0.5	1	ft
	Pump OFF	32.00	ft			
	Depth	3	ft			
	Unit Volume	43,052	gallon / foot			
Head Space (HS) =		129,157	gallons	21,526	43,052	gallons

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.
6. Head Space (HS), if any.

"In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies."
Reference: U.S. Fire Administration, *Water Supply Systems and Evaluation Methods* , Vol II: Water Supply Evaluation Methods, October 2008.

This is interpreted to mean that Operating Storage is the storage available for equalizing water production.

Fire Administration Operating Storage (FAOS) = 30% to 40% x (ES + SB)

		Needed		
	Existing	Minimum	Maximum	
Equalizing Storage (ES) =		128,700	128,700	
Standby Storage (SB) =		442,309	442,309	
Total =		571,009	571,009	
Fire Administration Operating Storage (FAOS) =		171,303	171,302.73	gallons
		to	to	
		228,404	228,404	gallons
Existing FAOS = OS =	236,788 gallons			

ESTIMATE TANK SIZE

		Needed	
	Existing	Minimum	Maximum
Operating Storage (OS)	236,788	171,303	228,404
Fire Suppression Storage (FSS)	150,683	428,185	676,301
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	-	128,700	128,700
Standby Storage (SB)	150,683	442,309	442,309
Fire Suppression Storage (FSS)	150,683	571,009	571,009
Fire Suppresion Storage (FSS), USE max	150,683	571,009	676,301
Dead Storage (DS)	990,205	0	0
Head Space (HS)	129,157	21,526	43,052

EXHIBIT B

CRAMER ROAD TANK STORAGE VOLUME ANALYSIS – 12-INCH SUPPLY

CRAMER ROAD TANK

STORAGE ESTIMATE BASED ON EXISTING SYSTEM DEMANDS
Increase Supply Line to Tank to 12-inches

Reference: *Water System Design Manual* , Washington State Department of Health, December 2009.

System Demands

Canandaigua Consolidated Service Area

Demand	2016	Units
Average Day	427,878	GPD
Maximum Day	932,004	GPD
Peak Hour	1,248	gpm

Pierce Park Pump Station

Demand	2016	Units
Average Day	14,431	GPD
Maximum Day	31,434	GPD
Peak Hour	42	gpm
Pump Capacity	195	gpm

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.

9.0.1 Total Storage

Total tank volume between overflow and tank outlet elevations.

		Level	
Existing Tank	Overflow	35.00	ft
	Base	-	ft
	Depth	35	ft
	Unit Volume	43,052	gallon / foot
Total Storage		1,506,833	gallons

9.0.2 Operating Storage (OS)

Volume between pump ON and OFF set points.

		Level	
Existing Tank	Pump OFF	32.00	ft
	Pump ON	26.50	ft
	Depth	5.5	ft
	Unit Volume	43,052	gallon / foot
Operating Storage (OS) =		236,788	gallons

9.0.3 Equalizing Storage (ES)

For Call-On-Demand Pumping:
Equalizing Storage, ES = (PHD - Qs)(150 min)

PHD = Peak Hour Demand (gpm)
Qs = Sum of Supply Capacities (gpm)

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
7.0.1.a. - Reduce if source has capacity to supplement peak demands. (Needs emergency power.)

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	427,878	14,431	442,309	gallons
	297.14	10.02	307	gpm
	0.43	0.01	0.44	MGD

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	297	10	307	gpm
Peak Hour Factor =	4.20	NA		
Peak Hour Flow =	1,248	195	1,443	gpm
		Typical pump flow rate.		

Total Peak Hour Demand on Tank (PHD) =	1,443	gpm
Estimated Available West Street Flow with one pump, Qs =	585	gpm
Estimated Flow From Storage, PHD - QS =	858	gpm
Equalizing Storage, ES = (PHD - Qs)(150 min) =	128,700	gpm

Interpreted to mean the volume between Pump ON and System 35 psi.
Reference: Water System Design Manual, Washington State Department of Health, December 2009.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 35 psi	26.43	ft
	Depth	0.07	ft
	Unit Volume	43,052	gallon / foot

Equalizing Storage (ES) = 3,014 gallons

9.0.4 Standby Storage (SB)

Volume that provides 20 psi at all points in the system.
Recommended for systems with a single source, SB = 2 x Average Day Demand

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
Section 7.0.1, c. "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems."
For New York, this is interpreted to mean that SB can be reduced to 1 x Average Day Demand

Average Day Demand = 442,309 gallons
Standby Storage, SB = 442,309 gallons

Reference: National Drinking Water Clearinghouse Tech Brief: *Reservoirs, Towers, and Tanks, Drinking water Storage Facilities* , Fall 2001.
Interpreted to mean the volume between system 35 psi and system 20 psi.

		Level	
Existing Tank	System 35 psi	26.43	ft
	System 20 psi	0.52	ft
	Depth	25.91	ft
	Unit Volume	43,052	gallon / foot

Standby Storage (SB) = 1,115,487 gallons

9.0.5 Fire Suppression Storage (FSS)

Reference: Recommended Standards for Water Works (2012 Ed)
7.0.1.c. - Satisfy ISO fire flow requirements for systems with fire protection.

ISO fire flow credit.
Fire Suppression Rating Schedule (2013, ISO)
- Credit no more than average daily minimum storage maintained (MSM) expressed in gpm at required residual and duration.
- Limit pumped storage to capacity of pumping facility.
- Evaluate minimum storage maintained based on average minimum storage maintained for maximum population.

ISO Needed Fire flow in WD #2 is unknown, use 3,500 gpm, which is ISO maximum for a community rating.
Required fire duration is therefore 3-hours.

Estimate fire storage needed based on average day demands.

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	297	195	492	gpm
		Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	88,584.75	88,585	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	568,585	718,585	gallons
Estimated Available West Street Pump Station Flow (min 20 psi sys) =	585	585	gpm
4-Hour & 3-Hour Volume	140,400	105,300	gal
Average Day Fire Suppression Storage (FSS) with reliance on Pumps =	428,185	613,285	gal

Estimate fire storage needed based on maximum day demands.

		CCSA	Pierce Park PS	Combined	
Maximum Day Demand =		932,004.00	31,433.84	963,438	GPD
	Calculated	647	22	669	
	USE	647	195	842	gpm
			Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	151,600.50	151,601	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	631,601	781,601	gallons
Estimated Available West Street Pump Station Flow (min 20 psi sys) =	585	585	gpm
4-Hour & 3-Hour Volume	140,400	105,300	gal
Maximum Day Fire Suppression Storage (FSS) with reliance on Pumps =	491,201	676,301	gal
Fire Suppression Storage (FSS) with reliance on Pumps =	428,185	676,301	gallons

ISO interprets to mean the volume between Pump ON and System 20 psi.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 20 psi	0.52	ft
	Depth	25.98	ft
	Unit Volume	43,052	gallon / foot
Fire Suppression Storage (FSS) =		1,118,501	gallons

9.0.6 Dead Storage (DS)

Volume between System 20 psi and tank outlet.

		Level		Needed Minimum	Needed Maximum
Existing Tank	System 20 psi	0.52	ft		
	Tank Outlet	-	ft		
	Depth	0.52	ft		
	Unit Volume	43,052	gallon / foot		
Dead Storage (DS) =		22,387	gallons	Not Recommended	

9.0.7 Headspace (HS)

Volume Between Pump Off and Tank Overflow
(Typically 6 to 12 inches.)

		Level		Needed Minimum	Needed Maximum	
Existing Tank	Overflow	35.00	ft	0.5	1	ft
	Pump OFF	32.00	ft			
	Depth	3	ft			
	Unit Volume	43,052	gallon / foot			
Head Space (HS) =		129,157	gallons	21,526	43,052	gallons

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.
6. Head Space (HS), if any.

"In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies."
Reference: U.S. Fire Administration, *Water Supply Systems and Evaluation Methods* , Vol II: Water Supply Evaluation Methods, October 2008.

This is interpreted to mean that Operating Storage is the storage available for equalizing water production.

Fire Administration Operating Storage (FAOS) = 30% to 40% x (ES + SB)

	Existing	Needed Minimum	Needed Maximum	
Equalizing Storage (ES) =		128,700	128,700	
Standby Storage (SB) =		442,309	442,309	
Total =		571,009	571,009	
Fire Administration Operating Storage (FAOS) =		171,303	171,302.73	gallons
		to	to	
		228,404	228,404	gallons
Existing FAOS = OS =	236,788 gallons			

ESTIMATE TANK SIZE

	Existing	Needed Minimum	Needed Maximum
Operating Storage (OS)	236,788	171,303	228,404
Fire Suppression Storage (FSS)	1,118,501	428,185	676,301
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	3,014	128,700	128,700
Standby Storage (SB)	1,115,487	442,309	442,309
Fire Suppression Storage (FSS)	1,118,501	571,009	571,009
Fire Suppresion Storage (FSS), USE max	1,118,501	571,009	676,301
Dead Storage (DS)	22,387	0	0
Head Space (HS)	129,157	21,526	43,052

EXHIBIT C

CRAMER ROAD TANK STORAGE VOLUME ANALYSIS – YEAR 2050

EXHIBIT C

CRAMER ROAD TANK

STORAGE ESTIMATE BASED ON YEAR 2050 SYSTEM DEMANDS

Reference: *Water System Design Manual* , Washington State Department of Health, December 2009.

System Demands

Canandaigua Consolidated Service Area

Demand	2050	Units
Average Day	895,302	GPD
Maximum Day	1,950,148	GPD
Peak Hour	2,611	gpm

Pierce Park Pump Station

Demand	2050	Units
Average Day	141,316	GPD
Maximum Day	307,814	GPD
Peak Hour	412	gpm
Pump Capacity	460	gpm

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.

9.0.1 Total Storage

Total tank volume between overflow and tank outlet elevations.

		Level	
Existing Tank	Overflow	35.00	ft
	Base	-	ft
	Depth	35	ft
	Unit Volume	43,052	gallon / foot
Total Storage		1,506,833	gallons

9.0.2 Operating Storage (OS)

Volume between pump ON and OFF set points.

		Level	
Existing Tank	Pump OFF	32.00	ft
	Pump ON	26.50	ft
	Depth	5.5	ft
	Unit Volume	43,052	gallon / foot
Operating Storage (OS) =		236,788	gallons

9.0.3 Equalizing Storage (ES)

For Call-On-Demand Pumping:
Equalizing Storage, ES = (PHD - Qs)(150 min)

PHD = Peak Hour Demand (gpm)
Qs = Sum of Supply Capacities (gpm)

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
7.0.1.a. - Reduce if source has capacity to supplement peak demands. (Needs emergency power.)

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	895,302	141,316	1,036,618	gallons
	621.74	98.14	720	gpm
	0.90	0.14	1.04	MGD

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	622	98	720	gpm
Peak Hour Factor =	4.20	NA		
Peak Hour Flow =	2,611	460	3,071	gpm
		Typical pump flow rate.		

Total Peak Hour Demand on Tank (PHD) = 3,071 gpm

Estimated Available West Street Flow with one pump, Qs = (Future Pump, 1.5xMax Day) 2,040 gpm

Estimated Flow From Storage, PHD - QS =	1,031	gpm
Equalizing Storage, ES = (PHD - Qs)(150 min) =	154,695	gpm

Interpreted to mean the volume between Pump ON and System 35 psi.
Reference: Water System Design Manual, Washington State Department of Health, December 2009.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 35 psi	26.50	ft
	Depth	0	ft
	Unit Volume	43,052	gallon / foot
Equalizing Storage (ES) =		-	gallons

9.0.4 Standby Storage (SB)

Volume that provides 20 psi at all points in the system.
Recommended for systems with a single source, SB = 2 x Average Day Demand

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
Section 7.0.1, c. "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems."
For New York, this is interpreted to mean that SB can be reduced to 1 x Average Day Demand

Average Day Demand =	1,036,618	gallons
Standby Storage, SB =	1,036,618	gallons

Reference: National Drinking Water Clearinghouse Tech Brief: *Reservoirs, Towers, and Tanks, Drinking water Storage Facilities* , Fall 2001.
Interpreted to mean the volume between system 35 psi and system 20 psi.

		Level	
Existing Tank	System 35 psi	26.50	ft
	System 20 psi	23.00	ft
	Depth	3.5	ft
	Unit Volume	43,052	gallon / foot
Standby Storage (SB) =		150,683	gallons

9.0.5 Fire Suppression Storage (FSS)

Reference: Recommended Standards for Water Works (2012 Ed)
7.0.1.c. - Satisfy ISO fire flow requirements for systems with fire protection.

ISO fire flow credit.
Fire Suppression Rating Schedule (2013, ISO)
- Credit no more than average daily minimum storage maintained (MSM) expressed in gpm at required residual and duration.
- Limit pumped storage to capacity of pumping facility.
- Evaluate minimum storage maintained based on average minimum storage maintained for maximum population.

ISO Needed Fire flow in WD #2 is unknown, use 3,500 gpm, which is ISO maximum for a community rating.
Required fire duration is therefore 3-hours.

<u>Estimate fire storage needed based on average day demands.</u>

	CCSA	Pierce Park PS	Combined	
Average Day Demand =	622	460	1,082	gpm
		Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	194,712.79	194,713	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	674,713	824,713	gallons

Estimated Available West Street Pump Station Flow (min 20 psi sys) =	2,040	2,040	gpm
4-Hour & 3-Hour Volume	489,600	367,200	gal
Average Day Fire Suppression Storage (FSS) with reliance on Pumps =	185,113	457,513	gal

Estimate fire storage needed based on maximum day demands.

		CCSA	Pierce Park PS	Combined	
Maximum Day Demand =		1,950,147.80	307,813.58	2,257,961	GPD
	Calculated	1,354	214	1,568	
	USE	1,354	460	1,814	gpm
			Typical pump flow rate.		

	Minimum	Maximum	
Maximum Day Volume, 3-hour =	326,568.47	326,568	gallons
Fire Code with Sprinkler based: (8,000 gpm * 4-hour * 25%) =	480,000.00		gallons
ISO Based on 3-Hour, 3,500 gpm Fire =		630,000	gallons
Max day + Fire Volume =	806,568	956,568	gallons
Estimated Available West Street Pump Station Flow (min 20 psi sys) =	2,040	2,040	gpm
4-Hour & 3-Hour Volume	489,600	367,200	gal
Maximum Day Fire Suppression Storage (FSS) with reliance on Pumps =	316,968	589,368	gal
Fire Suppression Storage (FSS) with reliance on Pumps =	185,113	589,368	gallons

ISO interprets to mean the volume between Pump ON and System 20 psi.

		Level	
Existing Tank	Pump ON	26.50	ft
	System 20 psi	23.00	ft
	Depth	3.5	ft
	Unit Volume	43,052	gallon / foot
Fire Suppression Storage (FSS) =		150,683	gallons

9.0.6 Dead Storage (DS)
Volume between System 20 psi and tank outlet.

		Level		Needed Minimum	Needed Maximum
Existing Tank	System 20 psi	23.00	ft		
	Tank Outlet	-	ft		
	Depth	23	ft		
	Unit Volume	43,052	gallon / foot		
Dead Storage (DS) =		990,205	gallons	Not Recommended	

9.0.7 Headspace (HS)
Volume Between Pump Off and Tank Overflow
(Typically 6 to 12 inches.)

		Level		Needed Minimum	Needed Maximum	
Existing Tank	Overflow	35.00	ft	0.5	1	ft
	Pump OFF	32.00	ft			
	Depth	3	ft			
	Unit Volume	43,052	gallon / foot			
Head Space (HS) =		129,157	gallons	21,526	43,052	gallons

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.
6. Head Space (HS), if any.

"In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies."
Reference: U.S. Fire Administration, *Water Supply Systems and Evaluation Methods* , Vol II: Water Supply Evaluation Methods, October 2008.

This is interpreted to mean that Operating Storage is the storage available for equalizing water production.

Fire Administration Operating Storage (FAOS) = 30% to 40% x (ES + SB)

		Needed		
	Existing	Minimum	Maximum	
Equalizing Storage (ES) =		154,695	154,695	
Standby Storage (SB) =		1,036,618	1,036,618	
Total =		1,191,313	1,191,313	
Fire Administration Operating Storage (FAOS) =		357,394	357,394	gallons
		to	to	
		476,525	476,525	gallons
Existing FAOS = OS =	236,788 gallons			

ESTIMATE TANK SIZE

		Needed	
	Existing	Minimum	Maximum
Operating Storage (OS)	236,788	357,394	476,525
Fire Suppression Storage (FSS)	150,683	185,113	589,368
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	-	154,695	154,695
Standby Storage (SB)	150,683	1,036,618	1,036,618
Fire Suppression Storage (FSS)	150,683	1,191,313	1,191,313
Fire Suppresion Storage (FSS), USE max	150,683	1,191,313	1,191,313
Dead Storage (DS)	990,205	0	0
Head Space (HS)	129,157	21,526	43,052

EXHIBIT D

DAY ROAD TANK STORAGE VOLUME ANALYSIS – EXISTING

DAY ROAD TANK

STORAGE ESTIMATE BASED ON EXISTING SYSTEM DEMANDS

Reference: *Water System Design Manual* , Washington State Department of Health, December 2009.

System Demands

Town of Bristol Water District

Demand	2016	Units
Average Day	10,909	GPD
Maximum Day	35,507	GPD
Peak Hour	39	gpm

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.

9.0.1 Total Storage

Total tank volume between overflow and tank outlet elevations.

		Level	
Existing Tank	Overflow	27.00	ft
	Base	-	ft
	Depth	27	ft
	Unit Volume	4,630	gallon / foot
Total Storage		124,997	gallons

9.0.2 Operating Storage (OS)

Volume between pump ON and OFF set points.

		Level	
Existing Tank	Pump OFF	25.00	ft
	Pump ON	23.00	ft
	Depth	2	ft
	Unit Volume	4,630	gallon / foot
Operating Storage (OS) =		9,259	gallons

9.0.3 Equalizing Storage (ES)

For Call-On-Demand Pumping:
Equalizing Storage, ES = (PHD - Qs)(150 min)

PHD = Peak Hour Demand (gpm)
Qs = Sum of Supply Capacities (gpm)

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
7.0.1.a. - Reduce if source has capacity to supplement peak demands. (Needs emergency power.)

	TBWD		Combined	
Average Day Demand =	10,909	-	10,909	gallons
	7.58	-	8	gpm
	0.01	-	0.01	MGD

	TBWD		Combined	
Average Day Demand =	8	-	8	gpm
Peak Hour Factor =	5.15	NA		
Peak Hour Flow =	39	-	39	gpm
		Typical pump flow rate.		

Total Peak Hour Demand on Tank (PHD) = 39 gpm

Estimated Available Valve Supply Flow, Qs = 170 gpm

Estimated Flow From Storage, PHD - QS =		(131)	gpm
Equalizing Storage, ES = (PHD - Qs)(150 min) =	ES = 0 Since Qs > PHD	-	gpm

Interpreted to mean the volume between Pump ON and System 35 psi.
Reference: Water System Design Manual, Washington State Department of Health, December 2009.

		Level	
Existing Tank	Pump ON	23.00	ft
	System 35 psi	0.02	ft
	Depth	22.98	ft
	Unit Volume	4,630	gallon / foot
Equalizing Storage (ES) =		106,386	gallons

9.0.4 Standby Storage (SB)

Volume that provides 20 psi at all points in the system.
Recommended for systems with a single source, SB = 2 x Average Day Demand

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
Section 7.0.1, c. "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems."
For New York, this is interpreted to mean that SB can be reduced to 1 x Average Day Demand

Average Day Demand =	10,909	gallons
Standby Storage, SB =	10,909	gallons

Reference: National Drinking Water Clearinghouse Tech Brief: *Reservoirs, Towers, and Tanks, Drinking water Storage Facilities* , Fall 2001.
Interpreted to mean the volume between system 35 psi and system 20 psi.

		Level	
Existing Tank	System 35 psi	0.02	ft
	System 20 psi	0.01	ft
	Depth	0.01	ft
	Unit Volume	4,630	gallon / foot
Standby Storage (SB) =		46	gallons

9.0.5 Fire Suppression Storage (FSS)

Reference: Recommended Standards for Water Works (2012 Ed)
7.0.1.c. - Satisfy ISO fire flow requirements for systems with fire protection.

ISO fire flow credit.
Fire Suppression Rating Schedule (2013, ISO)
- Credit no more than average daily minimum storage maintained (MSM) expressed in gpm at required residual and duration.
- Limit pumped storage to capacity of pumping facility.
- Evaluate minimum storage maintained based on average minimum storage maintained for maximum population.

ISO Needed Fire flow in WD #2 is unknown, use 3,500 gpm, which is ISO maximum for a community rating.
Required fire duration is therefore 3-hours.

<u>Estimate fire storage needed based on average day demands.</u>

	TBWD		Combined	
Average Day Demand =	8	-	8	gpm

	Minimum	Maximum	
Average Day Volume, 2-hour =	909	909	gallons
Fire Code w/o Sprinkler: (2,500 gpm * 2-hour) =	300,000		gallons
ISO Based on 2-Hour, 2,500 gpm Fire =		300,000	gallons
Avg Dday + Fire Volume =	300,909	300,909	gallons

Estimated Available Flow from Valve (min 20 psi sys) =	170	170	gpm
2-Hour Volume	20,400	20,400	gal
Average Day Fire Suppression Storage (FSS) with reliance on Valve =	280,509	280,509	gal

Estimate fire storage needed based on maximum day demands.

		TBWD		Combined	
Maximum Day Demand =		35,507.00		35,507	GPD
	Calculated	25	-	25	
	USE	25	-	25	gpm
		Typical pump flow rate.			

	Minimum	Maximum	
Maximum Day Volume, 2-hour =	2,959	2,959	gallons
Fire Code w/o Sprinkler: (2,500 gpm * 2-hour) =	300,000		gallons
ISO Based on 2-Hour, 2,500 gpm Fire =		300,000	gallons
Max Day + Fire Volume =	302,959	302,959	gallons
Estimated Available Flow from Fill Valve (min 20 psi sys) =	170	170	gpm
2-Hour Volume	20,400	20,400	gal
Maximum Day Fire Suppression Storage (FSS) with reliance on Pumps =	282,559	282,559	gal
Fire Suppression Storage (FSS) with reliance on Pumps =	280,509	282,559	gallons

ISO interprets to mean the volume between Pump ON and System 20 psi.

		Level	
Existing Tank	Pump ON	23.00	ft
	System 20 psi	0.01	ft
	Depth	22.99	ft
	Unit Volume	4,630	gallon / foot
Fire Suppression Storage (FSS) =		106,432	gallons

9.0.6 Dead Storage (DS)

Volume between System 20 psi and tank outlet.

		Level		Needed Minimum	Needed Maximum
Existing Tank	System 20 psi	0.01	ft		
	Tank Outlet	-	ft		
	Depth	0.01	ft		
	Unit Volume	4,630	gallon / foot		
Dead Storage (DS) =		46	gallons	Not Recommended	

9.0.7 Headspace (HS)

Volume Between Pump Off and Tank Overflow
(Typically 6 to 12 inches.)

		Level		Needed Minimum	Needed Maximum	
Existing Tank	Overflow	27.00	ft	0.5	1	ft
	Pump OFF	25.00	ft			
	Depth	2	ft			
	Unit Volume	4,630	gallon / foot			
Head Space (HS) =		9,259	gallons	2,315	4,630	gallons

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.
6. Head Space (HS), if any.

"In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies."

Reference: U.S. Fire Administration, *Water Supply Systems and Evaluation Methods* , Vol II: Water Supply Evaluation Methods, October 2008.

This is interpreted to mean that Operating Storage is the storage available for equalizing water production.

Fire Administration Operating Storage (FAOS) = 30% to 40% x (ES + SB)

	Existing	Needed Minimum	Needed Maximum	
Equalizing Storage (ES) =		-	-	
Standby Storage (SB) =		10,909	10,909	
Total =		10,909	10,909	
Fire Administration Operating Storage (FAOS) =		3,273	3,272.70	gallons
		to	to	
		4,364	4,364	gallons
Existing FAOS = OS =	9,259 gallons			

ESTIMATE TANK SIZE

	Existing	Needed Minimum	Needed Maximum
Operating Storage (OS)	9,259	3,273	4,364
Fire Suppression Storage (FSS)	106,432	280,509	282,559
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	106,386	-	-
Standby Storage (SB)	46	10,909	10,909
Fire Suppression Storage (FSS)	106,432	10,909	10,909
Fire Suppresion Storage (FSS), USE max	106,432	280,509	282,559
Dead Storage (DS)	46	0	0
Head Space (HS)	9,259	2,315	4,630

EXHIBIT E

DAY ROAD TANK STORAGE VOLUME ANALYSIS – YEAR 2050

DAY ROAD TANK

STORAGE ESTIMATE BASED ON YEAR 2050 SYSTEM DEMANDS

Reference: *Water System Design Manual* , Washington State Department of Health, December 2009.

System Demands

Town of Bristol Water District

Demand	2016	Units
Average Day	141,316	GPD
Maximum Day	459,951	GPD
Peak Hour	510	gpm

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.

9.0.1 Total Storage

Total tank volume between overflow and tank outlet elevations.

		Level	
Existing Tank	Overflow	27.00	ft
	Base	-	ft
	Depth	27	ft
	Unit Volume	4,630	gallon / foot
Total Storage		124,997	gallons

9.0.2 Operating Storage (OS)

Volume between pump ON and OFF set points.

		Level	
Existing Tank	Pump OFF	25.00	ft
	Pump ON	23.00	ft
	Depth	2	ft
	Unit Volume	4,630	gallon / foot
Operating Storage (OS) =		9,259	gallons

9.0.3 Equalizing Storage (ES)

For Call-On-Demand Pumping:
Equalizing Storage, ES = (PHD - Qs)(150 min)

PHD = Peak Hour Demand (gpm)
Qs = Sum of Supply Capacities (gpm)

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
7.0.1.a. - Reduce if source has capacity to supplement peak demands. (Needs emergency power.)

	TBWD			Combined	
Average Day Demand =	141,316		-	141,316	gallons
	98.14		-	98	gpm
	0.14		-	0.14	MGD

	TBWD			Combined	
Average Day Demand =	98		-	98	gpm
Peak Hour Factor =	5.20	NA			
Peak Hour Flow =	510		-	510	gpm
		Typical pump flow rate.			

Total Peak Hour Demand on Tank (PHD) = 510 gpm

Estimated Available Valve Supply Flow, Qs =	Modified Valve, Max Day x 1.5.	480	gpm
Estimated Flow From Storage, PHD - QS =		30	gpm
Equalizing Storage, ES = (PHD - Qs)(150 min) =		4,500	gpm

Interpreted to mean the volume between Pump ON and System 35 psi.
Reference: Water System Design Manual, Washington State Department of Health, December 2009.

		Level	
Existing Tank	Pump ON	23.00	ft
	System 35 psi	0.02	ft
	Depth	22.98	ft
	Unit Volume	4,630	gallon / foot
Equalizing Storage (ES) =		106,386	gallons

9.0.4 Standby Storage (SB)

Volume that provides 20 psi at all points in the system.
Recommended for systems with a single source, SB = 2 x Average Day Demand

Reference: *Recommended Standards for Water Works* (2012 Ed)
7.0.1.a. - Minimum storage for systems ***not*** providing fire protection = Average Day Consumption (Demand)
Section 7.0.1, c. "Excessive storage capacity should be avoided to prevent potential water quality deterioration problems."
For New York, this is interpreted to mean that SB can be reduced to 1 x Average Day Demand

Average Day Demand =	141,316	gallons
Standby Storage, SB =	141,316	gallons

Reference: National Drinking Water Clearinghouse Tech Brief: *Reservoirs, Towers, and Tanks, Drinking water Storage Facilities*, Fall 2001.
Interpreted to mean the volume between system 35 psi and system 20 psi.

		Level	
Existing Tank	System 35 psi	0.02	ft
	System 20 psi	0.01	ft
	Depth	0.01	ft
	Unit Volume	4,630	gallon / foot
Standby Storage (SB) =		46	gallons

9.0.5 Fire Suppression Storage (FSS)

Reference: Recommended Standards for Water Works (2012 Ed)
7.0.1.c. - Satisfy ISO fire flow requirements for systems with fire protection.

ISO fire flow credit.
Fire Suppression Rating Schedule (2013, ISO)
- Credit no more than average daily minimum storage maintained (MSM) expressed in gpm at required residual and duration.
- Limit pumped storage to capacity of pumping facility.
- Evaluate minimum storage maintained based on average minimum storage maintained for maximum population.

ISO Needed Fire flow in WD #2 is unknown, use 3,500 gpm, which is ISO maximum for a community rating.
Required fire duration is therefore 3-hours.

Estimate fire storage needed based on average day demands.

	TBWD		Combined	
Average Day Demand =	98	-	98	gpm

	Minimum	Maximum	
Average Day Volume, 2-hour =	11,776	11,776	gallons
Fire Code w/o Sprinkler: (2,500 gpm * 2-hour) =	300,000		gallons
ISO Based on 2-Hour, 2,500 gpm Fire =		300,000	gallons
Avg Dday + Fire Volume =	311,776	311,776	gallons

Estimated Available Flow from Valve (min 20 psi sys) =	480	480	gpm
2-Hour Volume	57,600	57,600	gal
Average Day Fire Suppression Storage (FSS) with reliance on Valve =	254,176	254,176	gal

Estimate fire storage needed based on maximum day demands.

		TBWD		Combined	
Maximum Day Demand =		459,951.00		459,951	GPD
	Calculated	319	-	319	
	USE	319	-	319	gpm

Typical pump flow rate.

	Minimum	Maximum	
Maximum Day Volume, 2-hour =	38,329	38,329	gallons
Fire Code w/o Sprinkler: (2,500 gpm * 2-hour) =	300,000		gallons
ISO Based on 2-Hour, 2,500 gpm Fire =		300,000	gallons
Max Day + Fire Volume =	338,329	338,329	gallons
Estimated Available Flow from Fill Valve (min 20 psi sys) =	480	480	gpm
2-Hour Volume	57,600	57,600	gal
Maximum Day Fire Suppression Storage (FSS) with reliance on Pumps =	280,729	280,729	gal
Fire Suppression Storage (FSS) with reliance on Pumps =	254,176	280,729	gallons

ISO interprets to mean the volume between Pump ON and System 20 psi.

		Level	
Existing Tank	Pump ON	23.00	ft
	System 20 psi	0.01	ft
	Depth	22.99	ft
	Unit Volume	4,630	gallon / foot
Fire Suppression Storage (FSS) =		106,432	gallons

9.0.6 Dead Storage (DS)

Volume between System 20 psi and tank outlet.

		Level		Needed Minimum	Needed Maximum
Existing Tank	System 20 psi	0.01	ft		
	Tank Outlet	-	ft		
	Depth	0.01	ft		
	Unit Volume	4,630	gallon / foot		
Dead Storage (DS) =		46	gallons	Not Recommended	

9.0.7 Headspace (HS)

Volume Between Pump Off and Tank Overflow
(Typically 6 to 12 inches.)

		Level		Needed Minimum	Needed Maximum	
Existing Tank	Overflow	27.00	ft	0.5	1	ft
	Pump OFF	25.00	ft			
	Depth	2	ft			
	Unit Volume	4,630	gallon / foot			
Head Space (HS) =		9,259	gallons	2,315	4,630	gallons

9.0 Storage Volume Components

1. Operating Storage (OS);
2. Equalizing Storage (ES);
3. Standby Storage (SB);
4. Fire Suppression Storage (FSS); and
5. Dead Storage (DS), if any.
6. Head Space (HS), if any.

"In systems of moderate size, the amount of water storage available for equalizing water production is 30 to 40 percent of the total storage available for water-pressure equalization purposes and emergency water supplies."
Reference: U.S. Fire Administration, *Water Supply Systems and Evaluation Methods* , Vol II: Water Supply Evaluation Methods, October 2008.

This is interpreted to mean that Operating Storage is the storage available for equalizing water production.

Fire Administration Operating Storage (FAOS) = 30% to 40% x (ES + SB)

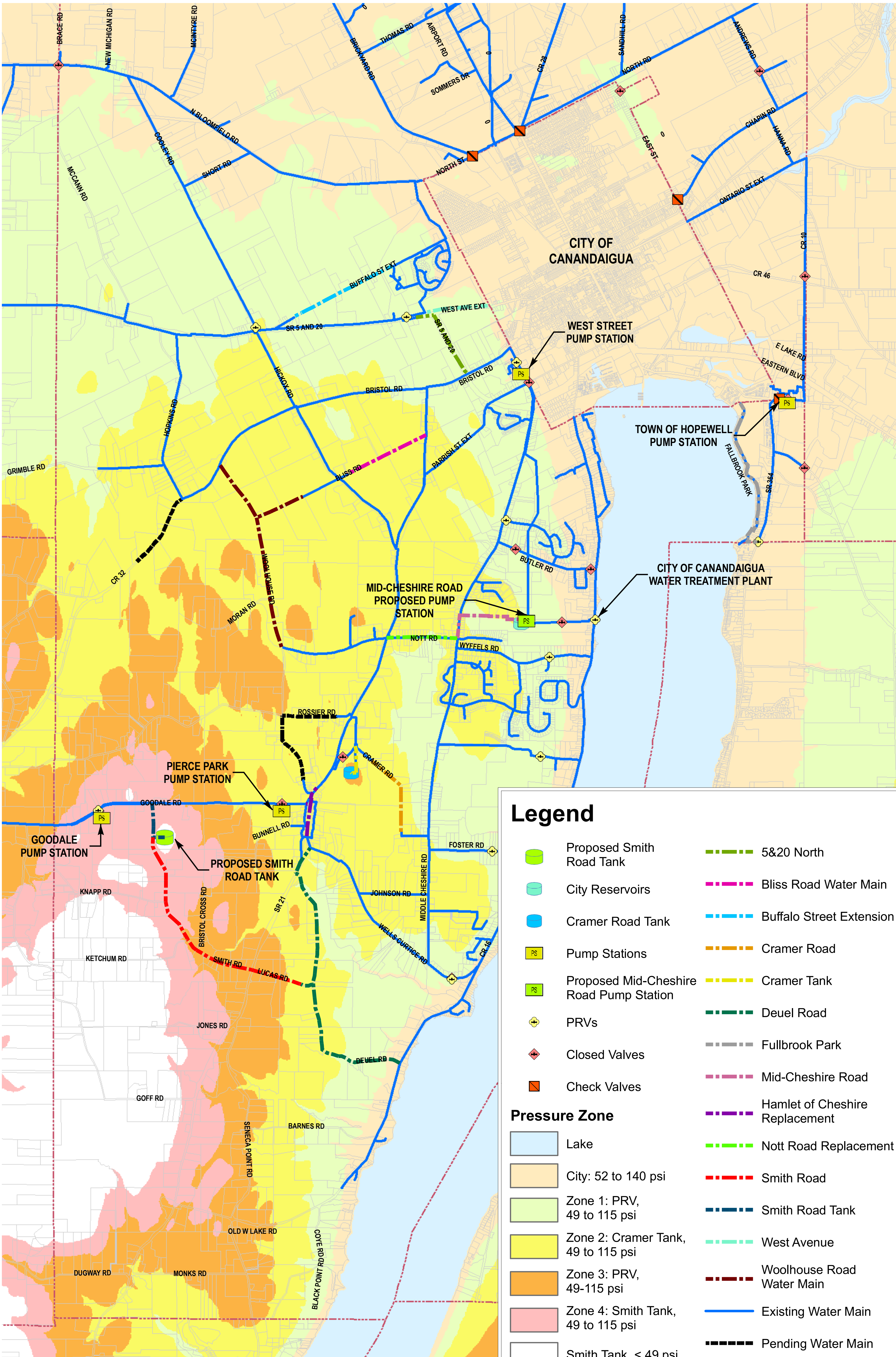
		Needed		
	Existing	Minimum	Maximum	
Equalizing Storage (ES) =		4,500	4,500	
Standby Storage (SB) =		141,316	141,316	
Total =		145,816	145,816	
Fire Administration Operating Storage (FAOS) =		43,745	43,744.80	gallons
		to	to	
		58,326	58,326	gallons
Existing FAOS = OS =	9,259 gallons			

ESTIMATE TANK SIZE

		Needed	
	Existing	Minimum	Maximum
Operating Storage (OS)	9,259	43,745	58,326
Fire Suppression Storage (FSS)	106,432	254,176	280,729
Fire Suppression Storage (FSS) as ES + SB			
Equalizing Storage (ES)	106,386	4,500	4,500
Standby Storage (SB)	46	141,316	141,316
Fire Suppression Storage (FSS)	106,432	145,816	145,816
Fire Suppresion Storage (FSS), USE max	106,432	254,176	280,729
Dead Storage (DS)	46	0	0
Head Space (HS)	9,259	2,315	4,630

APPENDIX K

PRESSURE – MODIFIED ZONES

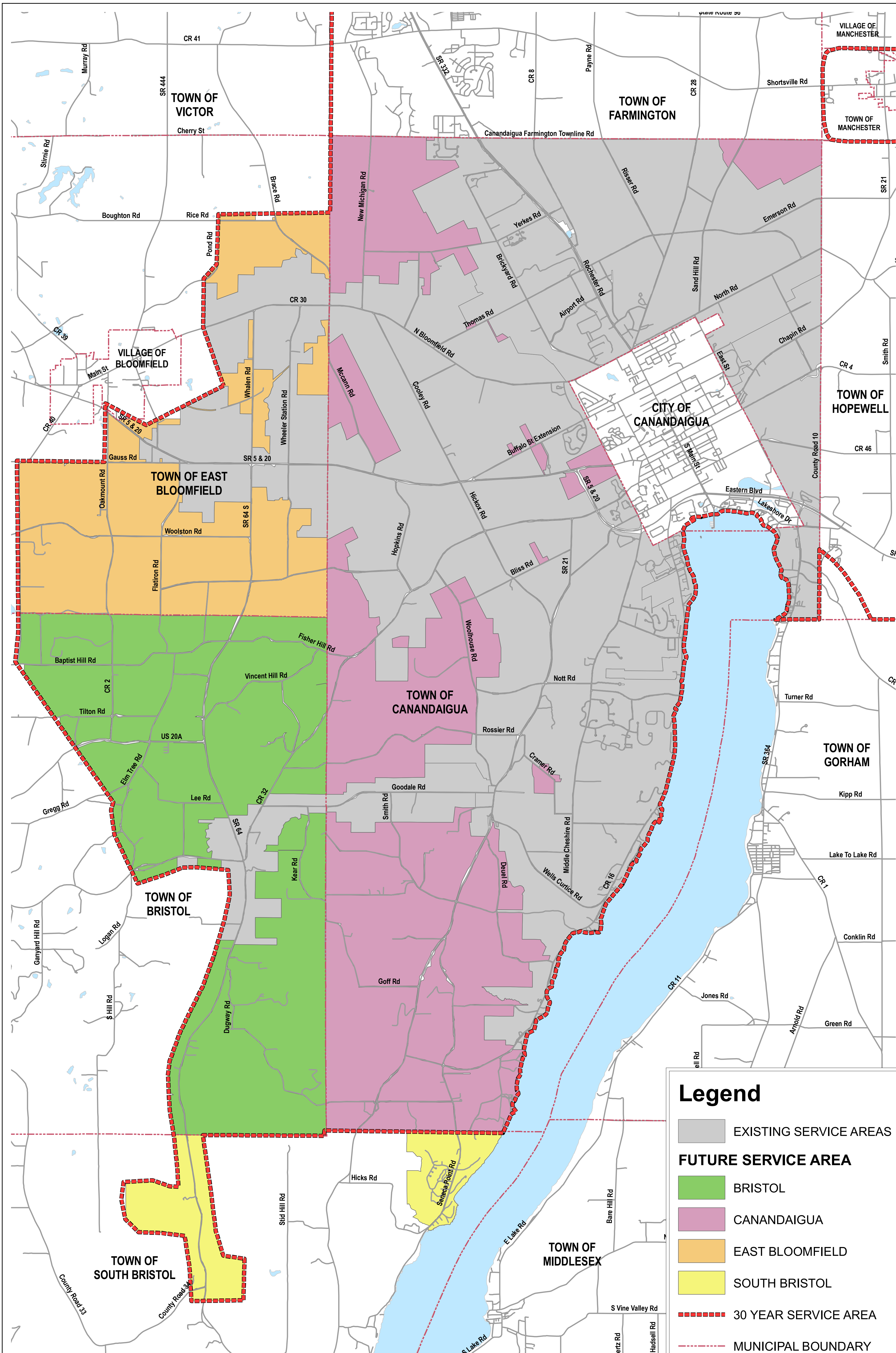


0300.16002.000	**MRB** group	Drawn By:	TJV	N / W E / S	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 4,000' @11"x17"		ONTARIO COUNTY, NEW YORK
FIG. V1-1		Date:	AUG 2017		PRESSURES - MODIFIED ZONES

Document Path: N:\0300.16002.000\dwg\Pressures_Modified_Zone.mxd

APPENDIX L

FUTURE SERVICE AREA



0300.16002.000	MRB | group	Drawn By:	TJV		TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 6,000' @11"x17"	N / W E / S	ONTARIO COUNTY, NEW YORK
FIG. VI-2		Date:	AUG 2017		FUTURE SERVICE AREAS

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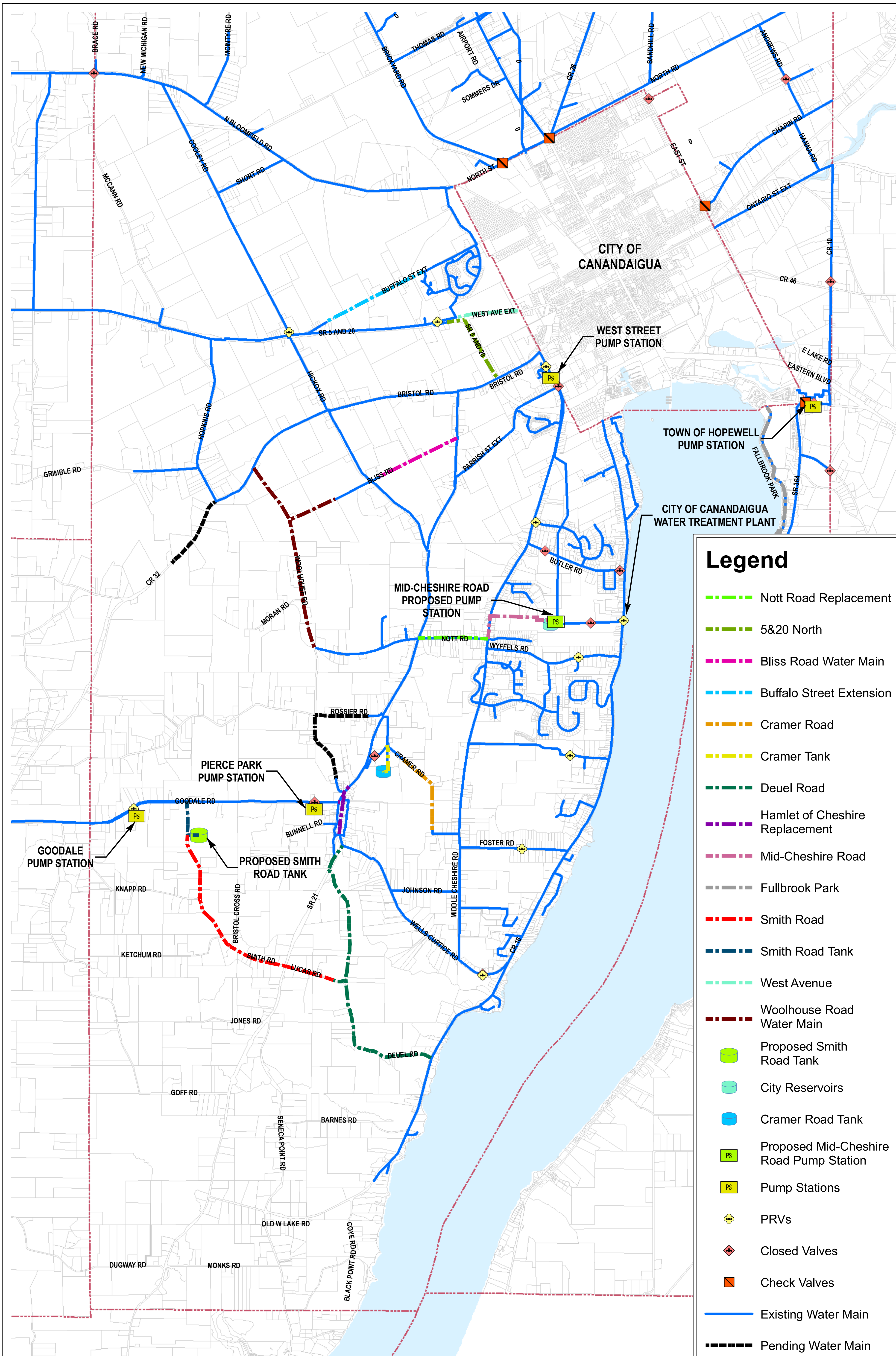
APPENDIX M

PROPOSED IMPROVEMENTS

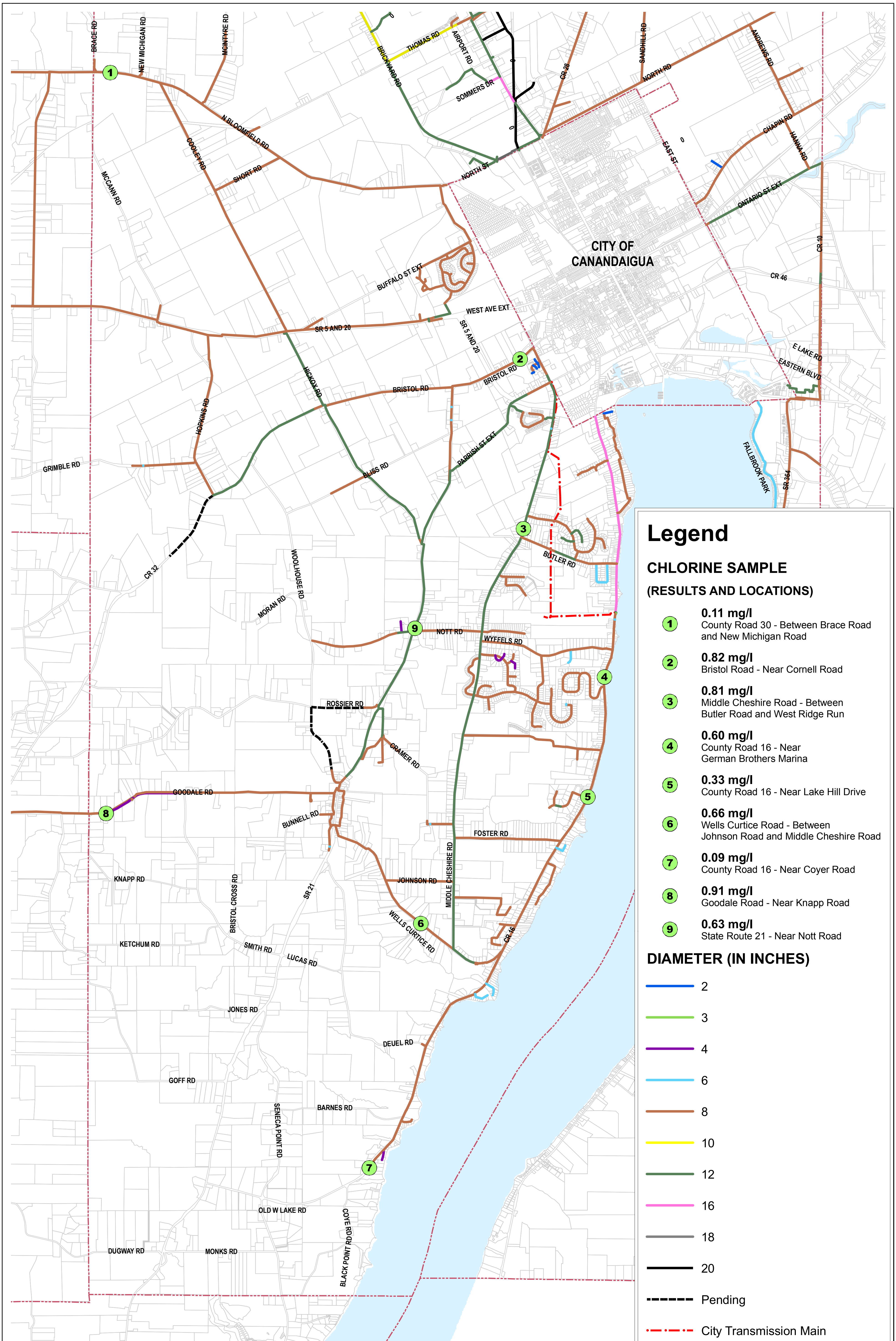


0300.16002.000	**MRB** | *group*	Drawn By:	TJV	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C. 145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Scale:	1" = 4,000' @11"x17"	ONTARIO COUNTY, NEW YORK
FIG. VII-1		Date:	SEPT 2017	PROPOSED IMPROVEMENTS

Document Path: N:\0300.16002.000\dwg\Improvements.mxd

APPENDIX N

WATER QUALITY TEST LOCATION MAP



0300.16002.000	**MRB** | *group*	Drawn By:	TJV	TOWN OF CANANDAIGUA
SHEET NO.	Engineering, Architecture, Surveying, D.P.C.	Scale:	1" = 4,000' @11"x17"	ONTARIO COUNTY, NEW YORK
EXHIBIT D	145 Culver Road, Suite 160, Rochester, New York 14620 Tel. 585-381-9250 Fax 585-381-1008 www.mrbgroup.com	Date:	SEPT 2017	CHLORINE SAMPLING LOCATIONS

N W E S

Document Path: N:\0300.16002.000\dwg\ChlorineSampling.mxd

APPENDIX O

TTHM/HAA5 SUMMARY WORKSHEET

	Canandaigua Consolidated Sample Location 1 Ononda Park TTHM	Sample Location 1 Ononda Park HAA	Sample Location 2 Cooley Road TTHM	Sample Location 2 Cooley Road HAA	Bristol Water Sample Location 3 4280 Route 64 TTHM	Sample Location 3 4280 Route 64 HAA
2014						
January						
Feburary						
March						
April						
May	58	52	56	37		
June						
July						
August						
September						
October						
November						
December						
2015						
January						
Feburary	62	24	52	48		
March						
April						
May	54	40	46	36		
June						
July						
August	39	36	41	6.2	37	3.1
September						
October						
November	93	39	87	5		
December						
2016						
January						
Feburary	46	36	47	14		
March						
April						
May	79	29	57	29		
June						
July						
August	95	35	96	30		
September					103	35
October						
November	70	33	68	29	92	38
December						
2017						
January						
Feburary	42	28	47	28	63	40
March						

		Canandaigua Consolidated Quarter Average 1 Ononda Park TTHM ug/l	Quarter Average 1 Ononda Park HAA ug/l	LRAA 1 TTHM ug/l	RAA 1 HAA ug/l	Quarter Average 2 Cooley Road TTHM ug/l	Quarter Average 2 Cooley Road HAA ug/l	LRAA 1 TTHM ug/l	RAA 1 HAA ug/l	Bristol Water Quarter Average 2 Cooley Road TTHM ug/l	Quarter Average 2 Cooley Road HAA ug/l	LRAA 1 TTHM ug/l	RAA 1 HAA ug/l
2014 March		#DIV/0!	#DIV/0!			#DIV/0!	#DIV/0!			#DIV/0!	#DIV/0!		
2014 June		58	52			56	37			#DIV/0!	#DIV/0!		
2014 September		#DIV/0!	#DIV/0!			#DIV/0!	#DIV/0!			#DIV/0!	#DIV/0!		
2014 December		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	MIN	58	52		MIN	56	37		MIN	0	0		
	MAX	58	52		MAX	56	37		MAX	0	0		
2015 March		62	24	#DIV/0!	#DIV/0!	52	48	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2015 June		54	40	#DIV/0!	#DIV/0!	46	36	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2015 September		39	36	#DIV/0!	#DIV/0!	41	6.2	#DIV/0!	#DIV/0!	37	3.1	#DIV/0!	#DIV/0!
2015 December		93	39	62	34.75	87	5	56.5	23.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	MIN	39	24		MIN	41	5		MIN	37	3.1		
	MAX	93	40		MAX	87	48		MAX	37	3.1		
2016 March		46	36	58	37.75	47	14	55.25	15.3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2016 June		79	29	64.25	35	57	29	58	13.55	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2016 September		95	35	78.25	34.75	96	30	71.75	19.5	103	35	#DIV/0!	#DIV/0!
2016 December		70	33	72.5	33.25	68	29	67	25.5	92	38	#DIV/0!	#DIV/0!
	MIN	46	29		MIN	47	14		MIN	92	35		
	MAX	95	36		MAX	96	30		MAX	103	38		
2017 March		42	28	71.5	31.25	47	28	67	29	63	40	#DIV/0!	#DIV/0!

April						
May	49	32	57	35	72	41
June						

49	32	64	32	57	35	67	30.5	72	41	82.5	38.5

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