Preliminary Engineering Report

Prepared for:
Village of Fredonia
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Water System Evaluation

Village of Fredonia, Chautauqua County, New York

In coordination with the Chautauqua County Department of Health, the Village has redacted the original report to create this public release version which has been determined to be appropriate for public viewing.

TABLE OF CONTENTS

Certain information that appears here has been redacted from this version of the report.

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1.0 EXECUTIVE SUMMARY

The Village of Fredonia (Village) owns and operates a Public Water System (PWS ID NY0600364) serving an estimated Village resident population of 10,700 in addition to a State University of New York (SUNY) at Fredonia student population of 4,700 and several small water districts outside the Village including the Town of Pomfret North End Water District. The Village has undertaken the present water system evaluation to assess existing conditions, determine recommended improvements, and establish an implementation plan. Furthermore, the Village seeks to determine the feasibility and cost effectiveness of available methods to provide its residents with reliable, high-quality drinking water, specifically including consideration of the following:

1. Continue using the Village water treatment plant (WTP) and surface water reservoir.
2. Decommission the Village WTP and reservoir and purchase water from the City of Dunkirk.
3. Decommission the Village WTP, drawdown the reservoir, and purchase water from the City of Dunkirk.
4. Construct groundwater wells as a primary and/or supplemental water supply.

This Preliminary Engineering Report (PER) is prepared, stamped, and dated by a New York State licensed Professional Engineer and developed in accordance with the following standards as appropriate:

- Recommended Standards for Water Works, Latest Edition - Policies for the Review, and Approval of Plans and Specifications for Public Water Supplies (commonly known as the Ten States Standards)
- New York Codes, Rules and Regulations, Title 10, Part 5, Subpart 5-1

The present engineering evaluation has identified numerous significant deficiencies in the Village's water system including but not limited to: reservoir's dam is in "unsound" condition per NYSDEC requirements, inadequate treatment plant clarification capacity, non-compliant and non-flow-paced chemical storage and feed facilities, insufficient finished water storage, insufficient fire flow capacity, inadequate system security, and an overall lack of redundancy that gives water system personnel few options to invoke to respond to unforeseen conditions and avoid a boil water notice.

This PER presents full evaluation results and an alternatives analysis, identifies recommended improvements, and presents a suggested asset investment schedule, based upon estimated life-cycle costs, to allow the Village to plan its investments and maintain water system viability.

After consideration of feasible alternatives, the Village has selected the following for implementation:

- *To be written after Village feedback*

This PER includes the elements necessary to comply with the New York Department of Health and Environmental Facilities Corporation Engineering Report Outline for New York State Assisted Drinking Water Infrastructure Projects, effective October 1, 2021, for projects receiving assistance through the Drinking Water State Revolving Fund (DWSRF) or other State assistance requiring approval by the New York State Department of Health.

2.0 PROJECT BACKGROUND AND HISTORY

The Village of Fredonia (Village) owns and operates a Public Water System (PWS ID NY0600364) serving an estimated Village resident population of 10,700 in addition to a State University of New York (SUNY) at Fredonia student population of 4,700 and several small water districts outside the Village including the Town of Pomfret North End Water District. The Village is undertaking the present water system evaluation to assess existing conditions, determine recommended improvements, and establish an implementation plan.

Certain information that appears here has been redacted from this version of the report.

The Fredonia Reservoir, a tributary of the Canadaway Brook, serves as the source water for the WTP. The original reservoir was built in 1884, while the WTP was first constructed in 1928. Over time, reservoir and WTP infrastructure has been expanded to their respective present conditions. Current WTP treatment processes include coagulation with rapid mix (addition of coagulant, polymer, clay), upflow clarification, mixed-media filtration, disinfection (trichloroisocyanurate tablets), and the addition of polyorthophosphate for corrosion control. Per available record documentation, WTP capacity is 2.1 million gallons per day (MGD), In recent years, demand has rarely (less than 1% of days) exceeded 2.00 MGD and demonstrates an average demand of 1.32 MGD.

A WTP Site Aerial Map has been provided in Appendix A, as Figure A-3.

2.1 Site Characteristics

The proposed project includes the following seven areas, site characteristics for each of the areas is identified below: Water Treatment Plant and Reservoir Outlet Site, Water Transmission Main Stabilization within Canadaway Creek, Existing Water Storage Tank Site, Existing Pump Station, Proposed Finished Water Storage Tank Site, and Proposed Interconnect with Dunkirk Site as indicated in Figure B-1. The following analysis will evaluate site characteristics on a site by site basis. The full narrative and source references for the Water Treatment Plant is provided below with associated mapping in Appendix B; the remainder of the sites are summarized in Table and Appendix B.

2.1.1 Water Treatment Plant and Reservoir Outlet Site

2.1.1.1 Land Use

The Water Treatment Plant and Reservoir Outlet Site is located within the Town of Pomfret. The Water Treatment Plant is located within Zoning District AR1: Agricultural Residential, the current land use is a permitted use by right. The reservoir area is located with the Town of Pomfret Zoning District R3: Lakeside Residential, the current land use is a permitted use by right.

2.1.1.2 Soils and Groundwater

The US Department of Agriculture (USDA) Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/) was used to obtain surficial soil conditions for the study area. The table below provides predominant soil type, depth to bedrock and groundwater, and representative slope. The Soils Report for the Water Treatment Plant study area is presented in Appendix B-2.

Table 1: USDA Soil Data

Map Symbol & Description	Depth to Bedrock (feet)	Depth to Water Table (feet)	Representative Slope
CpC Churchville silt loam	>6.5	0.5 - 1.5	8 to 15
RoF Rock outcrop-Manlius complex	1.5 – 3.0	>6.5	35 to 70
ShE Schuyler silt loam	>6.5	1.3 - 2.0	25 to 35

2.1.1.3 Surface Waterbodies

Based on review of the NYSDEC Info Locator, the project is located within the Hydrologic Unit Code (HUC) 10 Name: Canadaway Creek-Frontal Lake Erie, HUC 10 Number: 0412010102. The HUC 12 is Canadaway Creek, 041201010203. Surface Waterbodies in the vicinity of the project site include Fredonia Reservoir, Tribs to Fredonia Reservoir, and Canadaway Creek, Upper and tribs, and Lake Erie.

Table 2: Surface Waterbodies

Waterbody Name	PWL ID	Drainage Basin	Waterbody Classification
Fredonia Reservoir	PWL ID: 0105-0021	Lake Erie-Niagara River	A
Tribs to Fredonia Reservoir	PWL ID: 0105-0022	Lake Erie-Niagara River	A
Canadaway Creek, Upper and tribs	PWL ID: 0105-0020	Lake Erie-Niagara River	B
Lake Erie (Dunkirk Harbor - Shoreline)	PWL ID: 0105-0009	Lake Erie-Niagara River	B
Lake Erie (International Waters-Eastern Basin)	NHDPlusID: 904140245	Lake Erie	A-Spcl

Where NYS DEC established the following waterbody classifications that denote their best use.

- The classifications A, AA, A-S and AA-S indicate a best usage for a source of drinking water, swimming and other recreation, and fishing.
- Classification B indicates a best usage for swimming and other recreation, and fishing.

2.1.1.3.1 Fredonia Reservoir

Water quality monitoring is summarized by DEC in the DEC CALM Assessment, the Fredonia Reservoir waterbody is shown to have impaired use assessment for fishing, secondary contact recreation, primary contact recreation, and source of water supply. The reservoir is closed for recreational use. The reservoir is the primary drinking water source for the Village of Fredonia, the DEC Division of Water's Lake Monitoring and Assessment Section evaluated pollutants of concern in 2016, and identify source of water supply impairment for pollutants including Dissolved Oxygen, Iron, and Manganese.

2.1.1.3.2 Tributaries to Fredonia Reservoir

Tribs to Fredonia Reservoir are identified in the DEC Priority Waterbody List as Threatened for use as a water supply, problem documentation is suspected and states, "Water supply use of Fredonia Reservoir is thought to experience threats from pathogens due to the level of agricultural pastureland in the watershed. Current information does not indicate any impacts to water supply or other uses, but the use of the resources as a water supply and the activities in the watershed suggest additional protection efforts may be appropriate."

2.1.1.3.3 Canadaway Creek

Canadaway Creek receives the spillway outlet channel from the Fredonia Reservoir discharges. The creek conveys the discharge from the dam, approximately 7.5 miles through the Town of Pomfret, the Village of Fredonia and the Town of Dunkirk to Lake Erie. The Water Treatment Plant is located on the north side of the Creek, in close proximity. Water quality monitoring from the 2021 CALM indicates impaired use assessment for fishing, secondary contact recreation, and primary contact recreation. The creek is not a primary drinking water source. The identified pollutants include Copper and Total Dissolved Solids.

2.1.1.3.4 Lake Erie (Dunkirk Harbor Shoreline)

Lake Erie is the dominant surface water in the project area and receives waters from Tributaries to Fredonia Reservoir, Fredonia Reservoir, and Canadaway Creek. The DEC Waterbody Inventory Priority Waterbody list identifies the shoreline section from southwest of Battery Point and east of Point Gratiot. The waters of this segment are Class B and are identified as Impaired for public bathing, fish consumption, and recreation. This segment is included in the NYS 2004 Section 303(d) List of Impaired Waters due to contaminated sediment and urban runoff sources. The identified pollutants include PCB contamination.

2.1.1.3.5 Lake Erie (International Waters – Eastern Basin)

Lake Erie waterbody is an international waterbody with a volume of 119 cubic miles and is exposed to effects from urbanization and agriculture. In accordance with the 2012 Great Lakes Water Quality Agreement between Canada and the United States, State of the Great Lakes Report 2022 identifies an overall assessment of Good for treated drinking water from Lake Erie. Lake Erie is used as a source of drinking water for both Canada and the United States. Toxic chemicals monitored in Lake Erie are assessed as Fair, while overall long-term trends indicate that concentrations are Unchanging, declines in contaminant concentrations if fish filets are being observed.

Please refer to Appendix B for waterbody classifications of each of the surface waterbodies.

2.1.1.4 Wetlands

A search of the NYSDEC Environmental Resource Mapper on October 31, 2023 determined that there are no known state regulated wetlands located on or in the vicinity of the project site. Refer to Appendix B, Figure B-4, State Wetlands Map.

A search of the USFWS National Wetlands Inventory on October 31, 2023 determined that there are known federal regulated wetlands located on or in the vicinity of the project site. The wetlands include Fredonia Reservoir, 42.34 acre lake habitat classified as L1UBHh and Canadaway Creek, a 113.72 acre Riverine habitat classified as R3UBH. Refer to Appendix B, Figure B-5, Federal Wetlands Map.

2.1.1.5 Aquifer Designation

The project site is not located over a US EPA designated Sole Source aquifer; nor is it located over a Primary or Principal aquifer listed in the NYSDEC Technical and Operational Guidance Series (TOGS) 2.1.3 (1980).

2.1.1.6 Listed, Endangered, or Threatened Species

A search was performed on the NYSDEC Environmental Resource Mapper on November 9, 2023, and determined that the project site does contain threatened or endangered species, or critical habitat. The bald eagle is on the threatened species list and is protected under the Federal Bald and Golden Eagle Protection Act. An Environmental Resource Map has been provided in Appendix B, as Figure B-6.

A search was performed on the US Fish and Wildlife Service Information for Planning and Consultation (IPaC) on November 9, 2023 and determined that the project site includes Northern Long-eared Bat, Salamander Mussel, Monarch Butterfly, and migratory birds. Refer to Appendix B, as Figure B-7 USFWS IPaC Report.

2.1.1.7 Flood Plains

According to the National Flood Insurance Program Flood Insurance Rate Map (FIRM), Town of Pomfret New York, Community Panel Number 361078 0010 B, effective date December 18, 1984, the project site lies within Flood Zone C, defined as areas with minimal flooding. The FEMA Flood Map has been provided in Appendix B, as Figure B-8.

2.1.2 Site Characteristics of Remaining Project Sites

Review of site characteristics following the methodology documented in Section 2.1.1 was conducted for the remaining sites. Supporting maps are in Appendix B.

2.1.3 Environmental Justice and Disadvantaged Communities

Environmental Justice is the fair and meaningful treatment of all people, regardless of race, income, national origin or color, with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. The project area does include DEC defined Environmental Justice Areas. Please refer to Appendix B, Figure B-10 Environmental Justice Map.

Table 3: Environmental Justice Areas

Census Block Group	Percentage Below Poverty Level	Percentage Minority Population	Rural / Urban
360130359011	43.15	18.36	Rural
360130358004	27.36	5.74	Urban
360130359021	42.62	27.63	Urban
360130360004	29.19	36.75	Rural

Disadvantaged Communities are identified by New York's Climate Justice Working Group under the Climate Act. New York's Climate Act recognizes that climate change doesn't affect all communities equally, disadvantaged communities (DACs) are often overlooked in climate policy initiatives and to ensure they directly benefit from the State's historic transition to cleaner, greener sources of energy, reduced pollution and cleaner air, and economic opportunities. The project area, specifically the location of the reservoir, water treatment plant, proposed water storage tanks, and some service connections are within a NYS Disadvantaged Community Please refer to Appendix B, Figure B-11 Disadvantaged Communities Map, created with DEC InfoLocator Tool.

Table 4: Disadvantaged Community

Census Tract	Population	Environmental Burden	Population Vulnerability
36013036000	4,643	70%	56%

2.2 Ownership and Service Area

The Fredonia water system is a municipally owned public water system operated under Public Water System Number NY0600364. Public water supplies are regulated by the New York State Department of Health. The Village of Fredonia Water Department provides the vital service of furnishing safe, quality drinking water to all residents and businesses in the service area. The Village Mayor is the legally responsible party for the facility.

2.2.1 Water System Management

The Village Code, Chapter 287, was adopted by the Village Board of Trustees of the Village of Fredonia and enacted in July 1940 and as amended to date, in order that the water supply system may be properly maintained, improved and extended, primarily for the benefit of the water users and taxpayers within the service area. The water system is operated by the Village Water Department, who shall review, monitor and recommend changes deemed necessary to the rules and regulations concerning the sale of water, the collection of rents and charges, installation of services and meters, extension of mains and general rules pertaining to the water distribution system. The Village Code is available at the Municipal Office.

Table 5: Certification of Municipal Water Operators

Title	Name	Certification Level
Mayor	Doug Essek	Not Applicable
Chief Water Operator	Luis Fred	IIA
Operator	Jeffrey Lascola	IIA
Operator	Marcus Bentley	IIA
Trainee	Corbin Dissell	Trainee
Trainee	Alexander Rivera	Trainee

2.2.2 Water District Boundaries

Consistent with Village Law, the Water District includes residential, commercial, and institutional facilities within the Village boundaries. The Village also supplies water service to the Town of Pomfret as a consecutive user, SUNY Fredonia under contract, City of Dunkirk through one emergency interconnection under an Intermunicipal Agreement. The “in-district” users includes: the Village of Fredonia only and “out-district” users includes: Town of Pomfret, SUNY Fredonia, City of Dunkirk. The Village has sold water through bulk sale of water to 18 certified bulk deliverers for pools and construction.

Table 6: Water District Service

Title	In-District or Out-District	Number of Connections	Annual Water Consumption (Annual Gallons)
Village of Fredonia	In-District	3083	206,111,252
SUNY Fredonia	Contract based on In-District Use rate	Bulk Sale of Water by Contract	23,238,000
Town of Pomfret	Out-District	Village bills Town for metered use from 38 connections. Town of Pomfret bills its customers directly.	21,602,410
City of Dunkirk	Out-District	1 Emergency Interconnection	18,000
Bulk Sale of Water	Out-District	Sold by truckload	270,000

2.2.3 Water Source Nearby Land Use Activities

The Village of Fredonia’s primary source of water is the Fredonia Reservoir, PWL ID: 0105-0021. The watershed for the reservoir covers approximately 5 square miles, the watershed is unpopulated and heavily wooded. Review of EPA Waters Geo Viewer identifies the catchment area and the associated land cover as shown in Table 7: Fredonia Reservoir Watershed Land Cover.

Table 7: Fredonia Reservoir Watershed Land Cover

Land Cover	Watershed Total
Open Water	1.35%
Low Intensity Residential	2.72%
Commercial	0.05%
Deciduous Forest	67.06%
Evergreen Forest	5.89%
Mixed Forest	2.06%
Other	20.86%

The DEC CALM Assessment classifies the Fredonia Reservoir as Impaired Use, the waterbody is shown to have impaired use assessment for fishing, secondary contact recreation, primary contact recreation, and source of water supply. The reservoir is closed for recreational use. The DEC Division of Water’s Lake Monitoring and Assessment Section evaluated pollutants of concern in 2016 and identified impairment as a source of water supply for pollutants including Dissolved Oxygen, Iron, and Manganese. The DOH conducted a Source Water Assessment Plan of the reservoir, concluding a medium susceptibility rating.

2.2.4 Population Growth Trends

The Cornell Program on Applied Demographics County Projections Explorer was utilized to evaluate anticipated growth or decline in population in Chautauqua County over the next twenty years. Overall, the model predicts a decline in population from to approximately 120,000 in 2030 and 113,000 in 2040. The predicted decline is attributed to decline in births, increase in death of aging population, and net migration. It is anticipated that The Village of Fredonia will follow a similar trend as the county, with a net decrease in population in the coming twenty years.

Table 8: Population Growth Trends

Municipality	Population 2000[1]	Median Household Income 2000[2]	Population 2010[3]	Median Household Income 2010[4]	Population 2021[5]	Median Household Income 2021[5]
Village of Fredonia	9,585	$34,712	11,124	$39,838	10,018	$57,240
Town of Pomfret	13,035	$35,444	14,896	$41,930	13,409	$62,868
City of Dunkirk	12,743	$28,313	12,610	$33,849	12,651	$36,901
Chautauqua County	139,750	$33,458	135,263	$40,639	128,042	$50,408
New York	18,976,457	$43,393	19,229,752	$55,603	20,114,745	$75,157

1 DP1 Profile of General Demographic Characteristics: 2000, DEC Summary File 4 Demographic Profile
2 DP3 Profile of Selected Economic Characteristics: 2000
3 2010 American Community Survey Data
4 S1901 Income in the Past 12 Months (In 2010 Inflation-Adjusted Dollars
5 2021 American Community Survey Data

2.2.5 Historic and Projected Water Use Data

2.2.5.1 Average and Maximum Day Withdrawal – Based on Operator Daily Reports

WTP operators record operational data on daily operation records, and report recorded water quality data and sample analysis results monthly to the NYSDOH. The daily operation records include data regarding influent water quality, effluent water quality, filter effluent turbidity, and chemical use. The daily demands are recorded by the master meter recording raw water flow.

Appendix C presents a summary of the records evaluated for this project. The WTP does not record instantaneous or hourly peak flow measurements; therefore, this data is unavailable.

Table 9: Summary of Existing Demands and Water Quality Parameters

Parameter	Value			Period
WTP Demands				
Average Daily Demand (ADD), MGD	1.32			Jan. 19 – Dec. 22
99th Percentile Daily Demand (99%DD), MGD[1]	2.00			Jan. 19 – Dec. 22
Rated Production Capacity, MGD	2.50			-
Turbidity	Raw Water	Settled Water	Finished Water	Period
Average Turbidity, NTU	6.75	0.73	0.22	Jan. 21 – Dec. 22

<table>
<tr><td>Maximum Turbidity, NTU</td><td>76.7</td><td>11.4</td><td>1.77</td><td>Jan. 21 – Dec. 22</td></tr>
<tr><th>Raw Water Quality Parameter</th><th colspan="2">Raw Water</th><th>Finished Water</th><th>Period</th></tr>
<tr><td>pH Range</td><td colspan="2">7.00 – 8.82</td><td>7.0 – 8.55</td><td>Jan. 21 – Dec. 22</td></tr>
<tr><td>Temperature Range, °F</td><td colspan="2">36.8 – 82.0</td><td>37.4 – 81.8</td><td>Jan. 21 – Dec. 22</td></tr>
<tr><td>Alkalinity Range, as mg/L $CaCO_3$</td><td colspan="2">55.5 – 112.0</td><td>-</td><td>Jan. 20 – Sep. 23</td></tr>
<tr><td>Total Organic Carbon Range, mg/L</td><td colspan="2">2.0 – 5.9</td><td>1.5 – 4.5</td><td>Jan. 20 – Sep. 23</td></tr>
<tr><td>UV 254 Transmittance Range</td><td colspan="2">0.06 – 0.12</td><td>0.03 – 0.07</td><td>Jan. 21 – Sep. 23</td></tr>
<tr><td>Average Entry Point Chlorine Residual, mg/L</td><td colspan="2">-</td><td>1.28</td><td>Jan. 19 – Dec. 22</td></tr>
<tr><td>Average Entry Point Phosphate Residual, mg/L</td><td colspan="2">-</td><td>0.28</td><td>Jan. 19 – Dec. 22</td></tr>
</table>

2.2.5.2 Average and Maximum Day Demands – Based on Annual Water Withdrawal Reports

Billing Records for June 2022 to May 2023 and Annual Water Withdrawal Reports from January 2020 to December 2022, were reviewed for the project. Water is supplied to in-district Village service connections, Town of Pomfret through bulk billing to Town, SUNY Fredonia through contracted rate, City of Dunkirk through an emergency interconnection, and bulk water sale. Town of Pomfret water consumption is based on the June 2022 to May 2023 Billing Records, City of Dunkirk Emergency Connection consumption is based on annual reporting from the 2022 Water Withdrawal Report and is utilized for exercising the interconnect and is wasted. SUNY Fredonia water consumption is based on Village records of SUNY Water Utilization over time, and the Bulk Water value is based on the Billing Records form June 2022 to May 2023. The below table presents a summary of service area consumption.

Table 10: Service Area Water Consumption (2020-2022)

<table>
<tr><th></th><th>2020</th><th>2021</th><th>2022</th><th>Average</th></tr>
<tr><td>Average Day Daily Demand (ADD) (GPD)</td><td>667,452</td><td>700,131</td><td>697,401</td><td>688,328</td></tr>
<tr><td>Village of Fredonia Average Day Demand (GPD)</td><td colspan="4">564,688</td></tr>
<tr><td>Town of Pomfret (Consecutive System) (GPD)</td><td colspan="4">59,185</td></tr>
<tr><td>City of Dunkirk (Emergency Interconnect) (GPD)</td><td colspan="4">49</td></tr>
<tr><td>SUNY Fredonia (Contract)(GPD)</td><td colspan="4">63,666</td></tr>
<tr><td>Bulk Water Sold</td><td colspan="4">740</td></tr>
</table>

The Village is aware of the significant (over 40%) difference between recorded WTP average daily demand and the average daily demand recorded by service area meters.

2.2.6 Type of Use and Equivalent Dwelling Units

The water district consists of approximately, 3,139 water service connections based on the June 2022 to May 2023 Billing Records including Town connections. Subtracting the Town of Pomfret accounts results in 3,083 Village accounts, serving a population of approximately 10,018 based on the 2021

ACS Census. The number of Equivalent Dwelling Units (EDUs) that will pay debt service for the project is determined to adequately assess the project. The below table provides a breakdown of the type of use. The following definitions provide guidance:

(1) **Number of residential services** is equivalent to all Village residential hook-ups There are approximately 3,061 residential units.
(2) **Total residential flow** is based on calculated value from Average Annual Consumption metered, minus bulk accounts and minus the largest commercial users.
(3) **1 EDU** is equivalent to a typical residential household = (2)/(1).
(4) **Number of commercial/business/industrial services** includes bulk accounts from Town of Pomfret, SUNY Fredonia, City of Dunkirk, and largest commercial users in the Village.
(5) **Total commercial/business/industrial flow** is based on average values provided by the Village.
(6) **Number of commercial/business/industrial EDUs** = (5)/(3).

Table 11: Service Type and Flow

Description	Value	Units
(1) Number of residential services	3,061	EDU
(2) Total residential flow	469,846	GPD
(3) Residential flow per day from typical user	153	GPD
(4) Number of commercial/business/industrial services	26	
(5) Total commercial/business/industrial flow	218,482	GPD
(6) Number of commercial/business/industrial EDUs	1,423	EDU

Table 12: Vacant Buildable Parcels

Description	Value	Units
(7) Number of vacant buildable parcels	0	
(8) Percentage of user fee charged for debt service	0	%
(9) Number of vacant land EDUs	0	EDU

Based on the above tables, the Water system billing is comprised of residential users, business/commercial/industrial users, and vacant lots. There are 3,061 residential users, 1,423 commercial/business/industrial EDUs, and 0 vacant EDUs. **The Total System EDU is equivalent to 4,484.**

2.2.7 Bulk Sale and Commercial Users

The Village of Fredonia provides bulk sale of water to the Town of Pomfret, SUNY Fredonia, Bulk Water providers, and the City of Dunkirk through an emergency interconnection. The Bulk sale includes the following annual consumption and equivalent dwelling units.

Table 13: Bulk Sale of Water Consumption and EDU

Bulk Sale of Water	Annual Gallons	GPD	EDU

SUNY Fredonia	23,238,000	63,666	415
Town of Pomfret	21,602,410	59,185	386
City of Dunkirk	18,000	49	0.3
Bulk Water Sold	270,000	740	5
TOTAL BULK			806

The Village provided data on the thirty largest users in the water system. The large residential users such as apartment complexes were excluded from the below commercial listing and are included in the residential volume calculations in Table 11: Service Type and Flow.

Table 14: Commercial Water Consumption and EDU

Village Largest Commercial Users	Annual Gallons	GPD	EDU
AgriAmerica	5,967,852	16,350	107
AgriAmerica	4,820,640	13,207	86
Fredonia Place	1,990,100	5,452	36
Days Inn	1,989,424	5,450	35
Vineyards of Fredonia	1,865,208	5,110	33
Vineyards of Fredonia	1,792,396	4,911	32
AgriAmerica	1,582,176	4,335	28
Scudder/Laundry Mat	1,472,536	4,034	26
Fredonia Place	1,253,200	3,433	22
Lotter Enterprises	1,157,888	3,172	21
Mancuso Car Wash	1,138,884	3,120	20
Scudder/Laundry Mat	1,056,452	2,894	19
McDonalds	1,023,120	2,803	18
Fredonia School	989,036	2,710	18
Fredonia Place	951,756	2,608	17
BOCES	941,424	2,579	17
Fredonia School	801,568	2,196	14
WCA Home	783,864	2,148	14
196 Newton-Steinberg	778,420	2,133	14
Car Wash 260E Main	755,080	2,069	13
United Church Homes - 441 Temple	753,944	2,066	13
Buddy Brewsters	752,492	2,062	13
TOTAL COMMERCIAL		2,445,530	617

2.2.8 Fire Flow Demand

The Insurance Services Office, Inc (ISO) Quality management systems – Guidelines for the application of ISO 9001 in local government, 2019 acts as a guide for determination of Needed Fire Flow. The formula is as follows:

$$NFF = C * O * [1.00 + (X + P)]$$

Where:
NFF = the needed fire flow in gallons per minute (GPM)
C = a factor related to the type of construction and effective area

$$C = 18 * F * (\sqrt{A})$$

Where:
F = Coefficient related to construction (1.00 per ISO)
A = Effective Area (assumed 25,000 square feet, subject = BOCES)

Therefore:

$$C = 18 * 1.00 * (\sqrt{25{,}000})$$
$$C = 2984.96\ GPM$$
$$C = 2985\ GPM\ (rounding\ up)$$

Where:
O = a factor related to the type of occupancy (0.85; assumes limited combustibility)
X = a factor related to the exposure hazard of adjacent buildings (0.00; per ISO Table 330A)
P = a factor related to the communication hazard with adjacent buildings (0.00; per ISO Table 330B)

Therefore:

$$NFF = 2985\ GPM * 0.85 * [1.00 + (0.00 + 0.00)]$$
$$NFF = 2537.22\ GPM$$
$$NFF = 2538\ GPM\ (rounding\ up)$$

The National Fire Protection Association (NFPA) and the American Water Works Association (AWWA) define required fire flow as the "rate of water flow, at a residual pressure of 20 psi and for a specified duration that is necessary to control a major fire in a specific structure." Per AWWA Manual M31, 4th Ed., Table 1-1 (which is based upon NFPA's Fire Protection Handbook), the required fire flow duration is 180 minutes. Combining ISO's calculation of NFF at the AWWA-recommended duration, the total fire flow volume required is 457,000 gallons (*rounding up)*. However, the Village of Fredonia's most recent ISO survey denotes a flow rate of 4000 GPM for 240 minutes, meaning the total fire protection volume required would be 960,000 gallons. Adequacy of the Village's current water storage is investigated within Section 3.7.2.

2.2.9 Summary Design Parameters

As described in Section 2.2.4, service area population is in decline. For the purposes of this evaluation, it is conservatively anticipated that service area population will remain the same within the 30-year planning period.

Table 15: Summary of Design Parameters presents a summary of design parameters for the present evaluation.

Table 15: Summary of Design Parameters

Parameter	Value
Demands	
Design ADD, MGD	1.32
Design 99%DD, MGD	2.00

Design Rated Production Capacity, MGD	2.50
Design Fire Flow Rate	Rate and duration: 4000 GPM for 240 minutes Total volume: 960,000 gallons
Raw Water Quality	
Average Turbidity, NTU	6.75
Maximum Turbidity, NTU	100
pH Range	6.65 – 8.82
Temperature Range, °F	32 – 86
Alkalinity Range, as mg/L $CaCO_3$	50 – 150
Total Organic Carbon Range, mg/L	1.6 – 7.1
UV 254 Transmittance Range	0.05 – 0.15

[1] The National Fire Protection Association (NFPA) and the American Water Works Association (AWWA) define required fire flow as the "rate of water flow, at a residual pressure of 20 psi and for a specified duration that is necessary to control a major fire in a specific structure." The source of the required fire flow rate and duration values used in this project is AWWA Manual M31, 4th Ed., Table 1-1. The requirements within the AWWA manual are based upon the NFPA's Fire Protection Handbook.

2.2.10 Lost and Unaccounted Water

Certain information that appears here has been redacted from this version of the report.

Certain information that appears here has been redacted from this version of the report.

Table 17: Percent of Nonrevenue Water

	Annual Water Consumption (Gallons)
Average Annual Water Withdrawal (2020, 2021, 2022)	487,853,333
AUTHORIZED CONSUMPTION	
Average Annual Billed Metered Water (2022, 2021, 2022)	251,239,662
Average Annual Unbilled Authorized WTP Backwash	24,187,397
Average Annual Unbilled Authorized Municipal Buildings	203,900
Average Annual Unbilled Authorized Fire Department	1,460,000
Average Annual Unbilled Authorized Hydrant Flushing	250,000
UNAUTHORIZED CONSUMPTION	
Water Losses	210,512,374
Percentage of Water Losses	43%

2.2.10.1 Water Losses – Apparent Losses

Water losses are the difference between water supplied and authorized consumption. Water losses include apparent losses and real losses. Apparent losses are associated with customer metering, systematic data handling errors, and unauthorized consumption. AWWA recommends a default value of 0.25% of the total water production for system data handling errors, customer metering inaccuracies, and unauthorized consumption when considering apparent losses – resulting in approximately 1.9 million gallons per year.

A calculation of meter accuracy follows utilizing the DOH Individual Water Supply Wells – Fact Sheet #2 Water Storage, which provides that daily water usage can be estimated for typical households based on number of occupants and the typical household water use of 110 gallons of water per day per person. The 2021 ACS 5-year census documents an average household size of 2.2 persons.

$$Calculated\ Village\ Residential\ Water\ Consumption = 110\ Gallons\ per\ Day\ per\ Person\ x\ Persons\ per\ Household\ x\ Number\ of\ Households$$

$$Calculate\ Village\ Residential\ Water\ Consumption = 110\frac{GPD}{Person}\ x\ 2.2\frac{Persons}{Household}\ x\ 3061\ Households$$

$$Calculated\ Village\ Residential\ Water\ Consumption = 740{,}762\ GPD$$

The metered Village residential flow of 469,846 gallons per day is presented in Table 11: Service Type and Flow from 3,061 service connections. The metered residential water consumption is 63% of the above calculated water consumption, indicating that upgrades to residential water meters could support improved water accountability.

2.2.10.2 Water Losses – Real Losses

Water losses also includes real losses from distribution system components including pressurized distribution system, storage tanks, watermains, and customer service connections. The majority of water losses are considered to be derived from real losses. Based on the water balance calculations, 208 MG per year are calculated as real losses from leakage. The real water losses from the pressurized system, storage tanks, distribution system, and customer service lines is exacerbated by the Village's high water system pressures, 137 psi. Evaluating recent distribution system leaks, maintenance activities that would waste water, customer water leaks, and water used to flush sewer lines or other Village maintenance is outside the scope of this assessment.

2.2.11 Adjacent or Nearest Public Water Systems

The 2024 Intended Use Plan Drinking Water State Revolving Fund states, "DOH will continue to promote the regionalization and interconnections for public water systems to enhance the managerial, technical, and financial capacity for those systems. Therefore, when the possibility to interconnect to another public water system exists for a project seeking assistance, and if that interconnections will address the scope of the project with respect to its priority health ranking, the interconnection must be a carefully considered alternative." The Village of Fredonia is in proximity to the following public water systems: City of Dunkirk, the North Chautauqua County Water District, Town of Pomfret, Erie County Water Authority, Town of Hanover, Village of Westfield, and Town of Ripley. The public water systems' water provider, water source, population served, and number of service connections are provided in the table below.

Table 18: Adjacent or Nearest Public Water Systems

Public Water System	PWS ID	Water Provider	Water Source	Population Served	Number of Service Connections
VILLAGE OF FREDONIA WATER SUPPLY					
Village of Fredonia	NY 0600364	Village of Fredonia	Fredonia Reservoir	10,400	3083
SUNY Fredonia	NY 0600364	Village of Fredonia	Fredonia Reservoir	4600	NA
Town of Pomfret Berry Road WD	NY 0600369	Village of Fredonia	Fredonia Reservoir	160	65
Town of Pomfret Chestnut Road WD	NY 0600395	Village of Fredonia	Fredonia Reservoir	64	17
Town of Pomfret North End WD	NY 0630121	Village of Fredonia	Fredonia Reservoir	360	156
CITY OF DUNKIRK WATER SUPPLY					
City of Dunkirk	NY 0600360	City of Dunkirk	Lake Erie	11848	6230
North Chautauqua County Water District	NY 0630144	City of Dunkirk	Lake Erie	6200	3000
VILLAGE OF CASSADAGA WATER SUPPLY					
Vilage of Cassadaga	NY0600356	Village of Cassadaga	Groundwater	760	370
Town of Pomfret #8 Lily Dale	NY0630146	Village of Cassadaga	Groundwater	400	241
ERIE COUNTY WATER AUTHORITY WATER SUPPLY					
ECWA	NY1400443	ECWA	Lake Erie and Niagara River	335000	115486
Silver Creek Village	NY0600375	ECWA	Lake Erie and Niagara River	3100	1478
Hanover WD #1 5&20 Silver Creek	NY0600393	ECWA	Lake Erie and Niagara River	2713	908
Hanover WD # 2 - Bennett State Road	NY0600394	ECWA	Lake Erie and Niagara River	43	17
TOWN OF HANOVER WATER SUPPLY					
Hanover WD #3 - Forestville	NY0600363	Hanover	Groundwater	804	400
VILLAGE OF WESTFIELD WATER SUPPLY					
Westfield Village and Town	NY0615782	Westfield	Milton Reservoir, Chautauqua Creek	3890	1675
TOWN OF RIPLEY WATER SUPPLY					
Ripley Water District	NY0600372	Ripley	Belson Creek and Alfred Reservoir	1300	496

2.2.11.1 City of Dunkirk Water Supply

The City of Dunkirk operates a public water system from the off-shore source waters of Lake Erie. The City operates a water treatment system described in further detail in Section 3.3.1. The City produced approximately 2.71 MGD in 2022, and has a DEC Permitted Withdrawal Amount of 10 MGD. The City of Dunkirk directly serves approximately 11,848 persons through approximately 6,230 service connections. The City also supplies source water to the North Chautauqua County Water District, as outlined below.

The Village of Fredonia and the City of Dunkirk currently have an emergency interconnection at the Existing Water Pumping Station which is exercised and operated under the Intermunicipal Agreement executed July 14, 2011. The interconnection is reserved for emergency use, at times of exercising the water is wasted by both communities. Please refer to Section 3.3 City of Dunkirk Water System – Evaluation of Existing Interconnection.

The North Chautauqua County Water District (NCCWD) was formed by the Chautauqua County Legislature in 2016 and became operational in 2018. The water system serves municipalities to the east and west of the Village of Fredonia through the NCCWD East Tank in Sheridan and the NCCWD West Tank in Brocton. The NCCWD serves the North County Industrial Water District, Village of Brocton, Town of Dunkirk, Town of Portland, Town of Pomfret, and Town of Sheridan. NCCWD purchases water from the City of Dunkirk through the Intermunicipal Water Purchase / Supply Agreement executed in 2015 and amended. The NCCWD serves approximately 6,200 persons through 3,000 service connections.

The Village of Fredonia and NCCWD have an emergency interconnection. NCCWD is in the process of constructing new mains, pumps and water storage facilities to create a new regional water distribution district to serve the Village of Brocton, Town of Portland, Town of Pomfret, Town of Dunkirk, Town of Sheridan and to provide emergency water service to the Village of Fredonia and Town of Pomfret. NCCWD, Village of Fredonia, and Town of Pomfret signed an Intermunicipal Agreement for Emergency Water Supply in December 2022. The emergency purchase of water was invoked by NCCWD in August 2022 to purchase approximately 200,000 gallons of water from the Village of Fredonia.

2.2.11.2 Village of Cassadaga Water Supply

The Village of Cassadaga is located approximately 5 miles south of the Village of Fredonia. Cassadaga owns and operates a municipal water supply from three active groundwater wells, the average day withdrawal is 195,000 GPD (2021) and maximum permitted withdrawal is 590,400 GPD (2021). There are currently no existing and no planned interconnections with the Village of Fredonia.

2.2.11.3 Erie County Water Authority Water Supply

Erie County Water Authority (ECWA) operates a water supply with an intake in Lake Erie at Sturgeon Point, located approximately 20 miles northeast of the Village of Fredonia. ECWA average day withdrawal from Sturgeon Point is 54.2 MGD (2021) and maximum permitted withdrawal is 90 MGD (2021). ECWA has a second water supply source further north from the Niagara River. ECWA serves 36 municipalities including the nearby Village of Silver Creek and Town of Hanover. There are currently no existing and no planned interconnections with the Village of Fredonia.

2.2.11.4 Town of Hanover Water Supply

The Town of Hanover is approximately six miles west of the Village of Fredonia. The Town of Hanover purchases water from ECWA and owns and operates the two Town of Hanover groundwater wells serving 800 people in District #3 Forestville. The wells were put into service in 2014 and the water is treated with poly orthophosphate to reduce iron and chlorination. There are currently no existing and no planned interconnections with the Village of Fredonia.

2.2.11.5 Village of Westfield Water Supply

The Village of Westfield is approximately 12 miles south west of the Village of Fredonia and is the nearest public water supply west of the Village of Fredonia. The Village of Brocton stopped its own water supply when they began purchasing water from NCCWD. The Village of Westfield's water supply sources are the [redacted] Reservoir and [redacted] Creek. The average day withdrawal is 491,503 GPD (2021) and the maximum permitted withdrawal is 200,000 GPD (2021). There are currently no existing and no planned interconnections with the Village of Fredonia.

2.2.11.6 Town of Ripley Water Supply

The Town of Ripley is approximately 18 miles southwest of the Village of Fredonia. The Town of Ripley owns and operates water supplies from [redacted] Creek and [redacted] Reservoir. The average day withdrawal is 91,964 GPD (2021) and the maximum permitted withdrawal is 350,000 GPD (2021). There are currently no existing and no planned interconnections with the Village of Fredonia.

2.2.12 Community Involvement

To comply with State regulations, the Village of Fredonia annually issues a report describing the quality of the drinking water, Annual Drinking Water Quality Report. The purpose of the report is to raise the public's understanding of drinking water and awareness of the need to protect drinking water sources. Included are results or regular monitoring to indicate whether water meets health standards. The public is welcome to attend regularly scheduled Village Board meetings on the first and third Monday of the month at 6:30 pm to learn more about the water system.

The proposed project was and will be discussed at Board meetings to approve of proposal to write this Preliminary Engineering Report, receive draft report for comments, approve report for submission to DEC, conduct State Environmental Quality Review (SEQR) for the proposed project area, and in later stages, to approve of financing and funding awards.

3.0 EXISTING FACILITIES

The major components that comprise the Village Public Water System include the [redacted] Reservoir, the WTP, the existing finished water storage tank and pump station, the existing pump station interconnection with the City of Dunkirk water system, and the distribution system that, per recent Chautauqua County Department of Health (CCDOH) documentation, includes approximately 56 miles of water mains and all necessary fittings, valves, hydrants, and other appurtenances necessary to serve its service area.

Four interconnections exist between the Village system and neighboring water system infrastructure:

Certain information that appears here has been redacted from this version of the report.

This section of the report details the evaluation and condition assessment completed on major pieces of water system infrastructure.

3.1 CCDOH 2023 Public Water System Sanitary Survey

In May 2023, the CCDOH completed a water system inspection to determine compliance with Part 5 of the NYS Sanitary Code. CCDOH issued an inspection report dated July 10, 2023, that included a table listing “significant deficiencies” and a compliance schedule for addressing them, and a progress letter dated October 2, 2023, that outlines actions completed by the Village since inspection report issuance. CCDOH’s documentation is summarized in Table 19 and presented in full in Appendix C.

Table 19: Compliance with Part 5 of NYS Sanitary Code

Subpart Cited	Location	Description of Requirement or Recommendation
Violations		
5-1.71(b)	WTP	Repair or replace inoperable backwash pump.
5-1.71(b)	WTP	Repair or replace the inoperable chlorinator.
5-1.71(b)	WTP	Provide redundancy for coagulant and polymer feed pumps.
5-1.71(b)	WTP	Clean and/or replace clarifier sludge blowoff valves.
5-1 App. 5-A2.21	WTP	Change to a bentonite clay that complies with ANSI/NSF 60 or 61.
5-1.319(e)	WTP	Implement cross connection control in backwash system.
5-1 App. A-7.0.1(a)	Existing Tank/PS	Return existing tank to service and increase total system finished water storage capacity.
Significant Deficiencies		
-	Reservoir	Secure intake structure and ensure all lines exiting access tunnel are buried.
-	WTP	Calculate and verify where CT is met and conduct sampling at that location.
-	WTP	Label, color code, and add arrows to process piping.
-	WTP	Conduct jar testing to optimize chemical addition based on raw water quality.
-	WTP	Reconfigure chemical storage area to implement secondary containment.
-	WTP	Modify dry chemical storage handling facilities and isolate in a dedicated room.
-	WTP	Repair chlorine room vent fan.
-	WTP	Install non-corrodible mesh screens to clearwell vents.
-	WTP	Remove brush and weeds from top of clearwell and near the wall to sludge well.
-	WTP	Install locks on all clearwell hatches.
-	Existing. Tank/PS	Install non-corrodible mesh screen on tank overflow.
-	Existing PS	Implement a procedure to routinely exercise and test this facility.
Recommendations		
-	Reservoir	Evaluate moving the intake structure to a deeper location to minimize impact from drought or surface contamination.
-	Reservoir	Create a protocol that relates water level to water conservation including an enforcement mechanism.
-	Reservoir	Monitor erosion and sedimentation and consider if dredging is necessary.
-	Reservoir	Address any issues identified during a recent NYSDEC inspection.
-	WTP	Investigate how to stabilize stream bank next to WTP.

-	WTP	Develop a comprehensive standard operating procedure (SOP) for all WTP operations.
-	WTP	Investigate alternatives to bentonite clay to allow for discontinuance.
-	WTP	Complete general outdoor cleanup at WTP.
-	WTP	Review, and if necessary improve, the filter backwash procedure.
-	WTP	Implement turbidity monitoring to determine when a filter may be returned to service after a backwash.
-	WTP	Review all SCADA alarm set points to ensure proper operator notification.
-	WTP	Install meter to monitor outflow from sludge well to creek.
-	WTP	Determine if a raw water bypass exists and, if so, its condition.
-	Distribution System	Install meters on all Village-owned buildings.
-	Existing Tank/PS	Install fencing to improve tank and pump station security.
-	Existing PS	Provide water system operators the resources necessary to learn proper operation of this facility and develop a comprehensive SOP.

The violations, significant deficiencies, and recommendations outlined by CCDOH were taken into account during the evaluation and condition assessment presented in the following sections.

3.2 Current Water Source – Fredonia Reservoir

3.2.1 Location and Layout

The Fredonia Reservoir is located south of the Village in the Town of Pomfret. Figure A-1 displays the reservoir location and serves as a reference to its position relative to other major water system infrastructure.

3.2.2 Fredonia Reservoir Description and History

Fredonia's Reservoir is owned and operated by the Village of Fredonia Water Bureau. The reservoir was placed in service in 1938 to provide potable water to the Village of Fredonia. The current dam and spillway supersede an 1896 constructed spillway located upstream and indicated by the remaining intake structure. The intake structure was constructed within the embankment of the 1896 spillway and remains in the original location.

The reservoir watershed is approximately 5.7 square miles. The reservoir is created by a natural basin contained and controlled by a dam (State ID 003-1102). The dam is comprised of two earthen embankments (East and West) and a concrete spillway. The concrete spillway contains 3 distinct sections; an ogee-shaped dam approximately 75 wide is the main control structure, a gradual sloping spillway contained by training walls that narrows the spillway, and a stepped outfall portion. The spillway discharges to the Canadaway Creek.

The Fredonia Reservoir has been classified as a Class C High Hazard dam because a dam failure may result in widespread or serious damage to homes, main highways, industrial or commercial buildings, or loss of human life.

Engineering Assessments completed for the dam in 2012 and 2022 indicate that the dam is deficient of the New York State Compilation of Codes, Rules, and Regulations Part 673.13. Upon review of the

2022 Engineering Assessment prepared by LaBella Associates (presented in Appendix E), the New York State Department of Conservation requested a schedule and plan to address the deficiencies and render the dam safe.

3.2.3 Present Condition and Limitations

The dam serving Fredonia's Reservoir was found to be deficient in the following categories:

- Spillway Stability
- Spillway Capacity
- Drawdown Rate and Elevation

Certain information that appears here has been redacted from this version of the report.

Spillway Capacity

- New York State Regulation requires a dam's spillway be capable of passing 50% of the Probable Maximum Flood (PMF).
- The PMF for Fredonia's Reservoir is calculated to be 10,500 cfs.
- Fredonia's Dam, in current condition is capable of passing 30% (3,150 cfs) before overtopping.
- The PMF flow would overtop the dam by a calculated 1.5 feet.
- The Capacity deficiencies noted above would be addressed by constructing a new spillway with greater capacity or increasing the dam crest.

Drawdown Rate and Elevation

- New York State Regulation requires a reservoir to capable of reducing the impoundment by 90 percent (below dam crest) within 14 days using a low-level outlet (LLO).
- The Fredonia Dam utilizes a 12" pipe at an elevation of 1,015' as the facilities LLO.
- Under current condition the facility can release 31% of the reservoir capacity within 14 days.
- It would require 36 days for the reservoir to reach its maximum discharge allowable of 76% capacity.
- Based on the current elevation and flow capacity of the LLO neither parameter can be achieved.

Section 5.1 presents an evaluation of the following alternatives that would address the concerns associated with Fredonia's Dam and Reservoir.

- Abandon Reservoir Usage – Drawdown
- Maintain Reservoir – Construct New Spillway
- Abandon Reservoir Usage – Decommission

3.2.4 Source Capacity

Table 20 presents reservoir storage capacity.

Table 20: Fredonia Reservoir Storage Capacities

Condition	Elevation	Storage Capacity
Spillway Crest	1037’	899 acre-ft
Embankment Crest	1044.8’	1325 acre-ft
Low Level Outlet Pipe	1015’	199.48 acre-ft

A review of weekly U.S. Drought Monitor drought maps for Chautauqua County between January 2000 and October 2023 indicates severe drought conditions only 1.2% of weeks. Data specific to the PWS reservoir or the Village is unavailable. Despite the low level outlet elevation and historic occurrence which present a mild concern, Village and WTP officials note no history of drought leading to a significant water supply shortage decrease in reservoir level during dry conditions; therefore, it is believed the reservoir system has adequate capacity for continued PWS use.

3.2.5 Water Quality

Section 2.1.1.3 establishes:

- DEC has classified the reservoir as Class A.
- DEC has documented the reservoir as having an impaired use assessment for fishing, secondary contact recreation, primary contact recreation, and source of water supply.
- The DEC Division of Water’s Lake Monitoring and Assessment Section evaluated pollutants of concern in 2016, and identified Dissolved Oxygen, Iron, and Manganese, as the pollutants that cause the “impaired” assessment for use as a source of water supply.
- Tribs to Fredonia Reservoir are identified in the DEC Priority Waterbody List as Threatened for use as a water supply, noting “Water supply use of Fredonia Reservoir is thought to experience threats from pathogens due to the level of agricultural pastureland in the watershed. Current information does not indicate any impacts to water supply or other uses, but the use of the resources as a water supply and the activities in the watershed suggest additional protection efforts may be appropriate.”
- The DOH conducted a Source Water Assessment Plan of the reservoir, concluding a medium susceptibility rating.

In addition, the DEC Lake Classification and Inventory (LCI) report produced in 2016 presents the following:

- Reservoir trophic state: Mesoligotrophic
- Susceptibility to harmful algal blooms: low (none reported)
- Invasive vulnerability: high (invasives present)
- Deep manganese average concentration (4 samples): 2.01 mg/L
- Deep iron average concentration (3 samples): 0.45 mg/L
- Deep arsenic average concentration (4 samples): 1.01 mg/L
- A rating of “stressed/poor” for use as a potable water source.

WTP officials and CCDOH have not cited nor provided any data that indicates the presence of elevated levels of E. coli, cryptosporidium, or giardia that would cause CCDOH to require additional treatment (log removal).

Section 2.2.5.1 presents raw water quality data per sampling and analysis completed by WTP operators of the raw water flowing into the WTP from the reservoir.

3.3 City of Dunkirk Water System – Evaluation of Existing Interconnection

3.3.1 City of Dunkirk Water Supply Description, Present Condition, and Limitations

The City owns and operates a Public Water System (PWS ID NY0600360) that serves residents in the City and supplies finished water to the North Chautauqua County Water District. Section 2.2.11.1 discusses the City water system and service area in further detail.

3.3.1.1 Raw Water Source and Quality

The City of Dunkirk (City) water system draws its raw water through a submerged 36-inch intake pipe from the Eastern Basin of Lake Erie. Per the United States Environmental Protection Agency (USEPA) Lake Erie's volume is approximately 116 cubic miles and is a source of drinking water for over ten million people. Its Eastern Basin generally includes the portion of the Lake east of Erie, Pennsylvania, and is reported by USEPA to be the deepest of the Lake's three basins with an average depth of 80 feet and a maximum depth of 210 feet.

USEPA's 2018 "U.S. Action Plan for Lake Erie" highlights that controlling phosphorous loading to the Lake is the key factor to limiting harmful algal blooms (HABs). USEPA notes that although the Eastern Basin typically only receives approximately 11% of the total phosphorous loading to the Lake and thus is the least susceptible of the three basins to harmful algal blooms (HABs), "conditions [more frequently observed on the northern shore of the basin] are adequate to promote the excessive growth of algae," particularly benthic types. Per the City, HABs have not been observed near the intake nor has the water system's raw water been impacted.

At present, raw water quality data documenting observed values for common parameters including but not limited to turbidity, pH, temperature, alkalinity, and total organic carbon is unavailable, and its detailed consideration is outside the scope of the present evaluation. Section 2.1.1.3 presents further information.

3.3.1.2 Water Treatment Plant

The City owns and operates a WTP [redacted] in the City originally constructed in 1927 with significant improvements implemented in the early 1990s and between 2011 and the present. WTP treatment processes presently include pre-chlorination, coagulation (polyaluminum chloride) with rapid mix, flocculation, sedimentation, mixed-media filtration (granular activated carbon, sand), and disinfection (chlorine gas). The WTP does not fluoridate the finished water nor add a chemical for distribution system corrosion control. Per the City's 2022 Annual Water Quality Report, average daily demand in 2022 was 2.71 MGD. City public works officials report peak demand is approximately 4.0 MGD and the WTP rated capacity is 10.0 MGD. The City pumps solids removed during the treatment process to its wastewater treatment plant for treatment and disposal.

A WTP Site Aerial Map has been provided in Appendix F, as Figure F-1.

3.3.1.3 Distribution System

The City distribution system includes a backwash/emergency storage tank with an approximate capacity of 75,000 gallons adjacent to the WTP, the 2 MG [redacted] Tank (constructed 2014) near the southern border of the City, the 2 MG [redacted] (constructed 1935) near the eastern border of the City, and a distribution system primarily comprised of ductile and cast iron mains more than 60 years old. Per the May 2015 North Chautauqua County Regional Water Supply System Implementation Plan, the two 2-MG tanks provide finished water storage to satisfy service area demand include fire flows. City officials report distribution system pressures ranging from approximately 40 to 80 psi. A Site Location Map has been provided in Appendix F, as Figure F-2.

3.3.2 Existing Interconnection Location and Layout

The Existing Interconnection to the City of Dunkirk water system was constructed in approximately 1994 and includes a duplex 50 HP booster pump station (the Station) to provide sufficient pressure to the Village system. [redacted]

Certain information that appears here has been redacted from this version of the report.

Record documents show that the Station was most recently upgraded in the period between 2019 and 2021 in an attempt to restore its capacity to the design capacity of 800 gpm. Improvements implemented in an attempt to achieve this goal included:

- Replace exterior 6-inch suction piping to 8-inch between the City of Dunkirk existing 8-inch transmission main tie-in and pumping station.
- Upsize suction piping within the pump station from 6-inch to 8-inch where possible.
- Install a new 12-inch transmission pipe.
- Replace several 4-inch components (turbine flow meter, strainer, pressure sustaining valves) with 6-inch components to reduce head loss.

Despite the improvements constructed, City of Dunkirk officials contend the Station cannot provide 800 gpm to the Village system for any extended duration, as further discussed below.

3.3.3 Suitability for Use as Interconnection

The Existing Interconnection in its current condition cannot supply its intended design flow of 800 gpm to the Village Public Water System. It was determined that the 8-inch Dunkirk water main the Station is currently connected to has severe capacity limitations and can negatively impact Dunkirk water system customers within this area when operating as designed. The City has informed the Village that, to avoid negative impacts to City customers, it can provide up to 300 gpm for long durations, but can only provide 800 gpm in a true emergency.

Per City officials, this interconnect was not intended/designed to be a fully redundant source of flow to satisfy the entire Village distribution system demand. It was primarily designed to be a supplemental and emergency water source, including during times of drought due to Dunkirk's water source being Lake Erie, which is not affected by drought like the Village's Reservoir may be.

LaBella's recommendations for the Existing Pump Station are as follows:

- The Station be maintained in service no matter which Overall Alternative, per the present evaluation, is selected to be implemented.
- Dunkirk's distribution system should be upgraded to allow 800 gpm or greater flow to be re-established.
- Hydraulic modeling of Dunkirk's water system using different flow scenarios is needed to confidently determine the required minimum diameter and length of water main that needs upgrade. It is recommended the Village commission a detailed analysis to determine the required upgrades and implement the results promptly.

3.4 Groundwater Supply Source

3.4.1 Area Groundwater Wells

The Village does not currently rely upon groundwater well supplies. However, individual, private supply wells have been drilled in the Town of Pomfret to the east, west, and south of the Village. These have been for residential, commercial, and industrial properties. In addition, the Village of Fredonia is in proximity to the following public water systems relying upon groundwater wells: the Village of Cassadaga, and the Town of Hanover Water District #3, as described in Section 2.2.11. The largest community in Chautauqua County, the City of Jamestown, utilizes wells.

3.4.2 Area Hydrogeology

The Village of Fredonia is underlain by glacial lake sediments predominately of silt, sand, and clay. These deposits were deposited into proglacial lakes known as Lake Warren and Lake Whittlesey. The shorelines of these ancient lakes are marked by distinctive, parallel beach ridges that are oriented northeast-southwest across the Village. Deposits of sand and gravel are associated with these ridges. Further to the south, in the vicinity of the Fredonia Reservoir, deposits of dense silt, sand, clay, and gravel known as glacial till cover the surrounding hillsides. Till was deposited beneath the glacial ice sheets. The thickness of till is quite variable, with bedrock exposed in many locales, including the Village of Fredonia Water Treatment Plant. Local bedrock consists of shale and siltstone. Further discussion of the area hydrogeology is found in Appendix G.

3.4.3 Suitability for Development of Groundwater Wells

In order to determine the potential for the Village of Fredonia to develop a well supply, LaBella conducted a hydrogeological evaluation and feasibility study. The results of this study are located in Appendix G. This preliminary study completed by LaBella relied upon the compilation and interpretation of available hydrogeologic data for the area. Please refer to Appendix G.

3.5 Water Treatment Plant

The WTP and its components were evaluated based on their capacity to meet the design parameters presented in Section 2.2.9, as well as their ability to be operated and maintained during the design planning period without significant risk of failure or efficiency loss. Ten States Standards have been used to compare baseline performance of the unit processes.

3.5.1 Location and Layout

The water treatment plant major system components include rapid chemical mixing, upflow clarifiers, mixed media filtration, and a clearwell. Figures A-1, A-2, and A-3 present aerial views upon which major Village of Fredonia PWS components, including the WTP, are identified. Figure H-1 presents a historic representation of WTP site plan with major facilities identified. Appendix H includes an existing flow schematic.

Certain information that appears here has been redacted from this version of the report.

The Village WTP was first constructed in 1928. Since originally constructed, the Village has completed several major WTP expansion and improvement projects to maintain WTP performance, as summarized below.

Table 21: Summary of WTP Design Demand Parameters

Date	Description
1928	Construction of original WTP with capacity of 1.0 MGD. Treatment processes included 2 filters and chlorination.

1938	WTP expanded to achieve 1.5 MGD capacity. Treatment processes included rapid mix, coagulation, settling, filtration (3 filters), and chlorination.
1965	WTP expanded to achieve 2.0 MDG capacity. Project included new “accelerator tanks,” a 4th filter, new chemical storage areas, and a new wash water settling tank.
2003	WTP improvements implemented included clarifiers to replace accelerator tanks, chemical storage and feed improvements, process piping system improvements, construction of baffles in the clearwell, and process control and monitoring improvements.
2021	WTP improvements implemented included new solids contact clarifiers to replace existing clarifiers, filtration improvements (media and underdrain replacement, piping and pump improvements), and finished water flow meter additions.

Certain information that appears here has been redacted from this version of the report.

3.5.2 Regulatory Requirements

The WTP is required to comply with the following regulations:

- The New York State Sanitary Code (Title 10, Subpart 5-1 of the New York Codes, Rules, and Regulations (NYCRR)). The Recommended Standards for Water Works, commonly referred to as Ten States Standards (Ten States), has been adopted as the basis for design standards in NYS.
- The National Primary Drinking Water regulations (NPDWR) in the United States Code of Federal Regulations (40 CFR Part 141), including the following Surface Water Treatment Rules, as applicable:
  - Surface Water Treatment Rule (SWTR) – 40 CFR 141.70 through 75
  - Interim Enhanced Surface Water Treatment Rule (IESWTR) – 40 CFR 141.170 through 175
  - Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) – 40 CFR 141.500 through 571
  - Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) – 40 CFR 141.700 through 722

Table 22 presents relevant regulations applicable to the present evaluation. Specific requirements are detailed in Section 4.7. Note that under the NPDWR, the PWS is considered a “subpart H” PWS because it uses a surface water source.

Table 22: Applicable Regulations

Regulation	Subject
NYCRR 5-1.22	Approval of plans and completed work
Ten States	Unit process capacity and other requirements

Surface Water Treatment Rules (40 CFR 141)	Level of treatment and contaminant removal
LT2ESWTR (40 CFR 141.700 thru 722)	Source water monitoring, Cryptosporidium inactivation
Stage 2 Disinfection Byproducts Requirements (40 CFR 141 Subpart V)	DBP limits and monitoring
Enhanced Coagulation for Control of DBP Precursors (40 CFR 141.135)	Total Organic Carbon (TOC) removal

3.5.3 Present Condition and Unit Process Evaluation

The WTP and its components were evaluated based on their capacity to meet the design parameters presented in Section 2.2.9, as well as their ability to be operated and maintained during the design planning period without significant risk of failure or efficiency loss. Ten States Standards have been used to compare baseline performance of the unit processes.

Detailed unit process calculations are presented in Appendix H. All calculations are preliminary, and any sizing of proposed facilities or equipment presented in this report will need to be reviewed during design to meet actual conditions.

3.5.3.1 Raw Water Conveyance

The Village of Fredonia is reliant on surface water conveyed from its 5.7-acre watershed reservoir, which was originally constructed in 1938. A detailed evaluation of the Village reservoir is presented in Appendix E and summarized within Section 3.2.

Certain information that appears here has been redacted from this version of the report.

Certain information that appears here has been redacted from this version of the report.

It is recommended to:

- Perform improvements to these intakes as indicated within Appendix E, Fredonia Reservoir Engineering evaluation.
- Evaluate moving the reservoir intake to a lower elevation.
- Inspect both reservoir intakes and refurbish or replace as necessary.
- Inspect tunnel and piping within tunnel and refurbish as necessary.
- Replace valving near daylight of tunnel with new, below grade valving.
- Inspect concrete encasement crossing stream and refurbish as necessary.
- Investigate potential water treatment plant bypass, and if present, cut and cap as necessary to ensure no water is capable of bypassing water treatment plant.

3.5.3.2 Chemical Addition and Rapid Mix

Certain information that appears here has been redacted from this version of the report.

It is recommended to:

- Alter the injection points of PACL, Polymer, and bentonite to near the base of the first mixing basin or on the influent point prior to entering this mixing basin,
- Install an automatically modulating weir plate, which may be programmed to rise and fall according to raw water influent flow rates, to meet detention times,
- Replace the existing rapid mixer with a mixer capable of meeting the specified velocity gradient, such as a mixer with additional propellers or which utilizes the existing number of propellers but with larger diameters.
- Investigate alternatives to the use of bentonite clay with a more conventional treatment chemical such as aluminum sulfate, aluminum chloride, sodium aluminate, aluminum chlorohydrate, and polyaluminum chloride by conducting jar testing. Note that polyaluminum chloride is already

being utilized, and the dosages of which may be able to be increased as a replacement to bentonite addition.

- Flow pacing should be investigated based on raw water influent flow rate for PACL, Polymer and bentonite to ensure that dosing is as efficient as possible. Jar testing should be conducted at low, medium, and high flow rates through the WTP, to develop an optimum dosing curve for each chemical. Flow metering pumps must be integrated into the WTP SCADA system to achieve this.
- Adequate secondary containment should be provided for PACL and Polymer day tanks. The containment volume should be equal to 110% of the maximum volume within each day tanks. Separate secondary containment should be provided for each chemical.
- Bentonite clay storage should be housed within a separate room than any other chemicals. The separate room should have adequate ventilation and must be housed within a gas-tight partition.
- Remove deteriorated equipment within chemical area and replace with metering pump skids. Supply a duplex pump skid for PACL, and for Polymer to provide redundancy, the ability to adequately calibrate, air relief capabilities, and to ensure adequate and permanent wall mounting.

3.5.3.3 Clarification

The Village of Fredonia utilizes two (2) upflow clarifiers which provide flocculation and sedimentation of influent water post rapid mixing, as analyzed within the previous section. Calculations to determine adequacy of each clarifier is provided in Appendix H. The following summarizes design parameters which these clarifiers are to be designed to and their calculations to determine sufficiency:

- "Clarifiers should be designed for the maximum day demand and should be adjustable to changes inflow which are less than the design rate and for changes in water characteristics, 10 State Standards", 2018 – thereby, the two (2) existing clarifiers should be capable of treating the maximum day demand incurred by the WTP.

Certain information that appears here has been redacted from this version of the report.

- Total Detention Time, 10 State Standards, 2018 - minimum 2 hours with both clarifiers online,
    - Adequate at all design flowrates
- Flocculation Zone Detention Time, 10 State Standards, 2018 - minimum 30 minutes.
    - Adequate at the design average day demand and 99th percentile day demand,
    - Inadequate at the peak day demand.
- Upflow Rate at Sludge Separation Line, 10 State Standards, 2018 – maximum 1 gpm/ft^2.
    - Adequate at all design flowrates
- Launder Loading Rate, 10 State Standards, 2018 – maximum 1 gpm/ft^2.
    - Adequate at all design flowrates

Given that the design standards are reasonably met, as shown in the above bullets, the only standard which is not currently incorporated at the Village is clarifier redundancy.

It is recommended to:

- Install an additional clarifier, equivalent to the existing two clarifiers, to provide system redundancy and enhance contaminant removal.

3.5.3.4 Mixed Media Filtration

The Village of Fredonia utilizes four (4) mixed media filters, which provide filtration of unsettled flocs and finished water polishing by use of anthracite and sand. Calculations to determine adequacy of each filter are provided in Appendix H. The following summarizes design parameters which these filters are to be designed to and the findings of the Appendix H calculations to determine sufficiency.

According to 10 State Standards, 2018, "the rate of filtration shall be determined through consideration of such factors as raw water quality, degree of pretreatment provided, filter media, water quality control parameters, competency of operating personnel, and other factors as required by the reviewing authority. Typical filtration rates are from 2 to 4 gpm/ft^2. In any case, the filter rate must be proposed and justified by the design engineer to the satisfaction of the reviewing authority prior to the preparation of final plans and specifications." According to calculations presented within Appendix H, filter loading rates are generally between 2 and 4 gpm/ft^2. However, there is no verbal or written record documenting consideration or study of other factors such as raw water quality, degree of pretreatment provided, and other factors as stated above, which may influence filter loading rate.

Additionally, the number of filtration units is sufficient to provide redundancy to the system in the instance where one (1) of the filters is not operational.

Filter material within the filtration beds consists of a layer of anthracite and a layer of sand with a media retention cap and filter underdrain, below. The total depth of anthracite is 18-inches, and the total depth of sand is 12-inches, measuring a total depth of 30-inches.

The filters utilize direct pumped backwash from two (2) backwash pumps, which are capable of pumping variable flow rates generally between 3000 and 7000 GPM. 10 State Standards requires that backwashing of filters shall be at minimum 15 gallons per minute per square foot and backwash of 20 gallons per minute per square foot is recommended. The calculations presented in Appendix H demonstrate that adequate backwashing is achieved. Record information indicates that each filter unit is 154.72 ft^2. According to operator testimony, each filter generally utilizes between 35,000 and 40,000 gallons per backwash at a duration of between 15 minutes. Thereby, a 35,000-gallon backwash for 15 minutes would equate to 15.08 gallons per minute per square foot. Therefore, operators may choose to increase the duration or flowrate their backwashes to ensure a value of 20 gallons per minute per square foot, but it is not necessary to meet design standards. Backwash pumps are not located in a space where operation and maintenance is easily performed.

Cross-connection control is not currently implemented between the filter-to-waste inlet to the filters nor between the backwash inlet to filters. Furthermore, there is extremely limited usable space for installation of a suitable cross-connection control device such as a double check valve or reduced pressure zone valve.

It is recommended to:

- Implement cross-connection control by use of a backwash and filter-to-waste water storage tank of approximately 100,000-gallons, located nearby to the WTP. Cross-connection could be achieved by utilization of a water tank by ensuring that the tank overflow elevation is located below its influent standpipe outlet. Existing backwash pumps could then be replaced with low flow, high pressure pumps which could be utilized to convey water to the new water storage tank. The new water storage tank could be designed to supply fire flows and pressures to the WTP.
- Ensure that 20 gallons per minute per square foot is met for backwash of filters.
- Ensure that filter-to-waste volumes are minimized based upon live influent and effluent turbidities through filters by implementation of automatic filter-to-waste cycles or an adequate SOP.

3.5.3.5 Disinfection

Certain information that appears here has been redacted from this version of the report.

The PWS relies upon residence time in the clearwell to ensure sufficient chlorine contact time (CT). If the tank is bypassed, CT will be inadequate. For all CT calculations, the following parameters were used for conservatism:

- Clearwell operates at its high-water level of 12'-0" from its finished floor elevation.
- Finished water storage tank baffling factor is 0.75 to reflect that it has in place two, nearly full-length baffle curtains. The baffling factor was selected from Table 4-2 of the 2003 USEPA LT1ESWTR Disinfection Profiling and Benchmarking Technical Guidance Manual.

The most conservative manner to determine required CT is to use the maximum observed pH (8.55) and minimum observed temperature (3.00 °C). Under these conditions, required CT is 275 min*mg/L (per NYCRR Subpart 5-1, Tables 14A-14F).

Assuming WTP flow is equal to design ADD and chlorine residual is at its average level (1.28 mg/L), CT provided is 321.86 min*mg/L and exceeds the requirement.

Assuming WTP flow is equal to the WTP rated production capacity, and chorine residual is at its average level (1.28 mg/L), CT provided is 169.94 min*mg/L and is insufficient. Under this scenario, any one of the following water quality characteristics or operational adjustments would ensure CT provided exceeds the requirement:

- Increase chlorine dose to approximately 2.07 mg/L. It is believed the chlorination system has capacity to deliver this dose.
- Reduce WTP flow to approximately 1.55 MGD.
- Effluent water pH is equal to its average value (7.71).

It is recommended to:

- Integrate the chlorination system equipment into the SCADA system and control logic be established to ensure that chlorine dosing be adjusted to automatically based upon live influent flow readings and upon a water temperature gauge located at the chlorine injection point for additional flow pacing of the chlorination system.
- Due to health and safety hazards associated with a pelleted chlorine system, Village officials and WTP operators seek to consider discontinuing its use at the WTP by changing to a different type of chlorine, such as an on-site chlorine generation system.
- Replace ventilation within the chlorine room which should be designed to pass 12 air changes per hour through the space, by utilization of a permanent wall or ceiling exhaust fan and

louver. These ventilation devices would be sized at approximately 250 cubic feet / minute. Furthermore, additional heating within the space is recommended due to the increased level of ventilation associated with a large exhaust fan and louver, though it is not a design standard as the water piping within this space is heating by a point of use water heater.
- Remove all deteriorated equipment and miscellaneous storage from the space such that a new eyewash/shower combination fixture may be installed. Additionally secondary containment should be installed for each day tank that is equal to 110% volume of each day tank.
- The clearwell should be emptied and cleaned on a regular basis to ensure that settled solids do not build up past the inverts of any clearwell effluent piping. Operators could utilize some form of a level sensor to check solids level in the clearwell on a weekly or biweekly period, and thus understand the rate of buildup within the tank. Once this understanding is reached, a timeline for cleaning out the clearwell could be implemented.

3.5.3.6 Corrosion Control

Polyorthophosphate is currently injected into the clearwell to inhibit corrosion within the distribution system. This practice is adequate, but corrosion inhibition dosing rates can vary on a yearly basis dependent upon the level of tuberculation within distribution system pipes which can form or fail to form depending on several factors that may vary. Additionally, polyorthophosphate could be injected near the “back” of the clearwell, closer to its effluent piping to mitigate the amount of time that the polyorthophosphate has to dissolute and adhere to non-distribution piping as well as to ensure adequate spacing between chlorine injection and polyorthophosphate injection.

Dilution of polyorthophosphate is performed manually by adding dry polyorthophosphate powder into a day tank at undefined amounts. This practice creates inconsistent dilutions of polyorthophosphate solution. Furthermore, polyorthophosphate injection is performed by a singular pump, without redundancy.

It is recommended to:
- Alter the injection point of polyorthophophate to a location closer to the “back” of the clearwell, where water enters the distribution system.
- Consider implementation of a corrosion inhibition study, performed biyearly to analyze the dilution and amounts of chemical added to the distribution system and its effectivity.
- Purchase pre-diluted drums of polyorthophosphate or develop an SOP to more accurately dilute the polyorthophosphate.
- Purchase an additional polyorthophosphate injection pump or purchase a duplex metering pump skid, to provide redundancy to the system.
- Flow pace polyorthophosphate upon the flow rate of filter effluent readings to ensure consistent solution of polyorthophosphate within the distribution system.

3.5.3.7 Finished Water Storage

As demonstrated within Section 2.2.8, the Village of Fredonia requires a total fire protection capacity of 0.96 MG per their most recent ISO Survey. To calculate the total necessary water storage capacity of the Village, the following formula is utilized:

$$Total\ Storage\ Required = (ADD, MG) + \big((PDD, MG) * 15\%\big) + (Fire\ Protection\ Capacity, MG)$$
$$Where{:}\ ADD = 1.32\ MG$$
$$PDD = 2.50\ MG$$
$$Fire\ Protection\ Capacity = 0.96\ MG$$

$$Total\ Storage\ Required = (1.32\ MG) + (2.50\ MG * 15\%) + (0.96\ MG)$$
$$= 2.65\ MG$$

Additionally, the Village of Fredonia currently utilizes a 1.008 MG water storage tank and a 0.304 MG clearwell near the WTP. Therefore, the Village currently holds a total of 1.312 MG of water storage capacity. To determine the amount of water storage that the Village should consider implementing, the following equations were utilized:

$$(Total\ Storage\ Required, MG) - (Total\ Existing\ Storage\ Capacity, MG)$$
$$= Additional\ Storage\ Required, MG$$
$$= (2.655\ MG) - (1.312\ MG)$$
$$= 1.35\ MG$$

The Village's Existing Water Storage Tank has been emptied of water since February 2023, and is projected to be filled and put back into commission before the end of 2023. The Village does not anticipate the water tank to have any violations once returned to service. It employs air stripping and mixing within to mitigate formation of TTHMs. These systems are expected to work adequately once the tank is brought back online, but testing of these systems relies on water held within the tank to operate. Therefore, their adequacy should be investigated once the tank has been disinfected and filled.

Therefore, it is recommended to:

- Install additional water storage totaling at least 1.35 MG. Air stripping and mixing systems should be considered within the new water tank(s) to ensure mitigation of TTHM formation.
- Install fencing around the Existing Tank site.
- Air stripping and mixing systems should be considered within the existing clearwell to ensure mitigation of TTHM formation.
- Install a drop pipe as needed within the existing clearwell to ensure that all effluent piping from it is drawing water from a location at least one foot above its finished floor elevation.

3.5.3.8 Solids Handling and Disposal

The Village of Fredonia disposes of sludge from their two (2) existing clarifiers, as well as filter-to-waste water and backwash water from their four (4) existing mixed media filters. Sludge produced currently flows to a concrete sludge holding basin where the sludge and water separate by gravity. Water then flows from the sludge holding basin and exits through a disposal pipe to the adjacent stream, which the Village's SPDES permit allows (see Appendix H).

Clarifier Sludge

The two (2) existing clarifiers employ a sludge blanket with a depth of approximately 4 to 6 feet from their finished floor elevations. This sludge must be kept at a relatively consistent depth to ensure adequate sedimentation zone, so much of the sludge must be disposed of into the WTP's sludge holding basin. Sludge is piped sludge sump from the clarifiers' low level effluent piping to a pit, where sludge sump pumps are utilized to transfer sludge into the sludge holding basin. No flow meters are provided to measure the quantities of sludge disposed of within the sludge holding basin. Presently, this practice is challenging as sludge piping is clogged and/or valves are inoperable. WTP operators employ small diameter sampling taps to remove sludge.

It is recommended to:

- Replace inoperable clarifier sludge draw-down valves and ensure that piping is unclogged before placing each respective clarifier back into service.

Mixed Media Filter Backwash Waste Water
Backwash waste water is disposed of by gravity from the WTP's four (4) mixed media filters to the sludge holding basin. Flow meters are utilized to measure the quantity of flow from the backwash pumps to the filters, and concurrently to the sludge holding basin.

Mixed Media Filter, Filter-to-Waste Water
Mixed media filter, filter-to-waste water is disposed of by gravity from the WTP's four (4) mixed media filters to the sludge holding basin. Flow meters are not employed to measure the quantity of flow from the filters to the sludge holding basin.

It is recommended to:

- Implement a cleanout procedure for disposal of built-up sludge within the sludge holding basin.
- Employ flow meter(s) to accurately measure filter-to-waste flow from the mixed media filters to the sludge holding basin.
- Employ a flow meter to accurately measure flow from the sludge holding basin to the adjacent stream.

3.5.4 Finished Water Quality

Because the Village of Fredonia PWS is considered a subpart H facility, its average influent TOC is 3.30 mg/L, and its influent alkalinity is 83.21 mg/L as CaCO3, the WTP is required per the Enhanced Coagulation for Control of DBP Precursors (40 CFR 141.135) regulation to remove at least 25% of TOC. Testing results between 2019 and 2022 indicate the WTP average TOC removal is 27.34% and is sufficient to remove at least 25% of TOC 60% of the time. Appendix C presents TOC removal data reviewed as part of the present evaluation.

As presented in Table 23, quarterly finished water measurements of two notable disinfection byproducts, total trihalomethanes (TTHM) and haloacetic acids (HAA5), intermittently exceed the regulatory maximum contaminant level (MCL) (per NYCRR SubPart 5-1 - Public Water Supplies 5-1.52 Table 3).

- TTHM MCL: 80 µg/L
- HAA5 MCL: 60 µg/L

Table 23: TTHM and HAA5 Finished Water Sampling Measurements

	251 Chestnut St	**278 Chestnut St**	**Gregory Hall**	**33 Temple St**	**176 Eagle St**	**WTP Clearwell**	**Existing Tank – Influent Side**	**Existing Tank – Effluent Side**	**Existing Tank – Side not Noted**
Samples	1	12	13	13	14	3	1	1	2
TTHM Avg. (µg/L)	32	55	55	46	62	33	61	53	48
TTHM Max (µg/L)	32	95	98	78	89	43	61	53	49
TTHM % of Samples Above MCL	0%	25%	15%	0%	21%	0%	0%	0%	0%
HAA5 Avg. (µg/L)	29	28	39	36	14	29	21	24	29
HAA5 Max (µg/L)	29	76	93	69	35	42	21	24	40

HAA5 % of Samples Above MCL	0%	8%	15%	15%	0%	0%	0%	0%	0%

[1] Per data between quarter 1 of 2020 through quarter 3 of 2023.

Appropriate chemical addition and the use of unit treatment processes with sufficient capacity for design flows is essential to ensure proper removal of contaminants, such as total and dissolved organic carbon and disinfection byproduct precursors, such that finished water sampling reveals water quality that consistently meets regulatory requirements.

The Village of Fredonia is responsible for completion of the monitoring requirements set forth in DOH Public Water Supplies Subpart 5-1. The following sampling and reporting protocols are implemented:

Monthly Water System Operation Reports

- Daily treated water volumes (1,000 gallons/day), daily chlorine usage (lbs), daily free chlorine residual at entry point (average, mg/L), total polymer usage (gallons), total PACL usage (gallons), total bentonite usage (pounds), EP average phosphate recorded.
- Microbiological samples and free chlorine residual in distribution system – Total Coliform (positive/negative), E. Coli (positive/negative), Free Chlorine Residual (mg/L).
- Filtration Component – entry point chlorine residual every 4 hours (mg/L), Distribution Turbidity Results (NTU).
- Composite Filter Effluent Monitoring – Turbidity Results every 4 hours (NTU).
- Water Treatment Plant Raw and Finished Water – Total Organic Carbon (TOC), Alkalinity (mg/L $CaCO_3$), SUVA Absorbance.

Quarterly Monitoring

- State Pollutant Discharge Elimination System (SPDES) (2/month) – Flow (GPD), Total Suspended Solids (mg/L), Settleable Solids (mL/L), Total Chlorine Residual (mg/L), pH (SU).
- Disinfection By-Products (DBPs) (quarterly, monthly) – TTHMs and HAA5 sampling within distribution system.

Yearly Monitoring

- Lead and Copper Sampling Results within distribution system

Irregular Monitoring

- 1, 4 – Dioxane, PFOAs – Monitoring and Sampling within distribution system, as required by the NYSDOH.

The Village provided copies of sampling results and Annual Water Quality Reports which includes finished water quality reporting, LaBella also reviewed the EPA Safe Drinking Water Information System for record of previous violations.

The daily logs documented or monitor reports of the raw and finished water quality found that several violations were present for DBPs within the distribution system. Additionally, the WTP SPDES permit dictates an outfall limit of between 20 and 40 mg/L. The Village failed to regularly send sampling reports for SPDES TSS to the NYSDEC in 2022 and 2023. Furthermore, reporting of any contaminants other than TSS were not reported on, and samples taken on 07/28/21 for TSS were much higher than the SPDES limit.

Review of the EPA Safe Drinking Water Information System Violation Report shows that the Village has had health-based violations. These results are based on data extracted on November 9, 2023.

Numerous violations have been documented by the EPA through this database, most of which refer to monitoring and reporting violations. The full report is available within Appendix H.

The Village develops an Annual Drinking Water Report which includes reporting of required testing. Review of the reports from years shows several violations, 2022 results are provided in the below Table 24.

In 2022, the Village cited violations for failing to submit the following reports or results to the Health Department on time:

1. Lead and copper results
2. Microbiological monitoring results for October, November, and December.
3. DBP monitoring results for second third and fourth quarters.
4. DBP monitoring results for July, August, September, October, November, and December.
5. Monthly operation reports for October, November, and December.
6. Notification of Designated Operator in Responsible Charge.

Table 24: Table of Regulated, Detected Contaminants, 2022

Contaminant	Violation Yes/No	Level Detected	Units	Regulatory Limit (MCL)	Likely Source of Contamination
Inorganic Contaminants					
Turbidity(1) Max	No	0.39	NTU	TT=<1.0 NTU	Soil Run-off.
Turbidity(1)	Yes	93.75% <0.3	NTU	TT=95% of samples<0.3 NTU	Soil Run-off.
Distribution Turbidity(2) Max	No	0.37	NTU	MCL>5 NTU	Soil Run-off, water main breaks, flushing hydrants.
Inorganic Contaminants					
Lead(3)	No	7.8; Range=ND-25	µg/L	15 (AL)	Corrosion of household plumbing systems; Erosion of natural deposits.
Copper(4)	No	0.224; Range=0.0098-0.427	mg/L	1.3 (AL)	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives.
Barium	No	0.0545	mg/L	2.0 (MCL)	Discharge of drilling wastes; discharge from metal refineries; erosion or natural deposits.
Nickel	No	0.23	µg/L	NA	Nickel enters groundwater and surface water by dissolution of rocks and soils, from atmospheric fallout, from biological decays and from waste disposal.
Chromium	No	0.56	µg/L	100 (MCL)	Discharge from steel and pulp mill; Erosion of natural deposits
Nitrate	No	0.23	mg/L	10 (MCL)	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.
Manganese	No	23	mg/L	300 (MCL)	Naturally occurring; Indicative of landfill contamination.

Copper (EP)	No	0.00057	mg/L	1.3 (AL)	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives
Iron	No	20	µg/L	300 (MCL)	Naturally occurring.
Sodium	No	9.4	mg/L	(see health effects) (5)	Naturally occurring; Road salt; Water softeners; Animal waste.
Thallium	No	0.023	µg/L	2 (MCL)	Leaching from ore processing sites; Discharge from electronics, glass, and drug factories.
Chloride	No	16.3	mg/L	250 (MCL)	Naturally occurring or indicative of road salt contamination.
Sulfate	No	13.7	mg/L	250 (MCL)	Erosion of natural deposits.
Radiologicals					
Gross Alpha	No	0.691	pCi/L	15 (MCL)	Erosion of natural deposits.
Gross Beta	No	0.641	pCi/L	50 (MCL)	Decay of natural deposits and man-made emissions.
Radium 226	No	0.0896	pCi/L	5 (MCL)	Erosion of natural deposits.
Radium 228	No	0.168	pCi/L	5 (MCL)	Erosion of natural deposits.
Stage 2 Disinfection Byproducts (Chestnut St)					
Haloacetic Acids	No	Avg.=14.3 Range= 5.0–39.7	µg/L	60 (MCL)	By-products of drinking water chlorination.
Total Trihalomethanes	No	Avg.=37.4 Range=20 .1–60.4	µg/L	80 (MCL)	By-products of drinking water chlorination. TTHM's are formed when source water contains large amounts of organic matter.
Stage 2 Disinfection Byproducts (Eagle St)					
Haloacetic Acids	No	Avg.=19.2 Range=9. 9-25.0	µg/L	60 (MCL)	By-products of drinking water chlorination.
Total Trihalomethanes	No	Avg.=62. Range=38 .8-81.3	µg/L	80 (MCL)	By-products of drinking water chlorination. TTHM's are formed when source water contains large amounts of organic matter.
Stage 2 Disinfection Byproducts (Gregory Hall)					
Haloacetic Acids	No	Avg.=20.7 Range=16 .7-34.0	µg/L	60 (MCL)	By-products of drinking water chlorination.
Total Trihalomethanes	No	Avg.=46.0 Range=53 .0-76.1	µg/L	80 (MCL)	By-products of drinking water chlorination. TTHM's are formed when source water contains large amounts of organic matter.
Stage 2 Disinfection Byproducts (Temple)					
Haloacetic Acids	No	Avg.=25.2 Range=18 .0-34.0	µg/L	60 (MCL)	By-products of drinking water chlorination.
Total Trihalomethanes	No	Avg.=41.9 Range=27 .5-64.0	µg/L	80 (MCL)	By-products of drinking water chlorination. TTHM's are formed when source water contains large amounts of organic matter.
Disinfectant					

Chlorine Residual	No		mg/L	4.0 (MCL)	Water additive used to control microbes.

“Notes:

(1) Turbidity is a measure of the cloudiness of the water. We monitor it because it is a good indicator of the effectiveness of our filtration system. Our highest turbidity measurement for the year (0.39 NTU) occurred on November 14. State regulations require that turbidity must always be less than or equal to 1.0 NTU. The regulations also require that 95% of the turbidity samples collected every month must be below 0.3 NTU. In November, 93.75% of our samples measured below 0.3 NTU.

(2) Distribution Turbidity is a measure of the cloudiness of the water found in the distribution system. We monitor it because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants. Our highest average monthly distribution turbidity measurement detected during the year (0.37 NTU) occurred in March 2022. This value is below the State’s maximum contaminant level (5 NTU).

(3) The level presented represents the 90^{th} percentile of the 24 sites tested. A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it. The 90^{th} percentile is equal to or greater than 90% of the Lead values detected in your water system. In this case, 24 samples were collected at your water system and the 90th percentile value was calculated to be the 22nd highest value at 7.8 µg/L. The action level for lead was exceeded at two of the 24 sampling locations.

(4) The level presented represents the 90^{th} percentile of the 24 sites tested. A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal or below it. The 90^{th} percentile is equal to or greater than 90% of the Copper values detected in your water system. In this case, 24 samples were collected at your water system and the 90^{th} percentile value was calculated to be the 22^{nd} highest value at 0.224 µg/L. The action level for copper was not exceeded at any of the 24 sampling locations.

(5) Water containing more than 20 mg/L of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing more than 270 mg/L of sodium should not be used for drinking by people on moderately restricted sodium diets.”

3.5.5 Structural, Electrical, HVAC, and Plumbing Deficiencies

A review of HVAC, plumbing, electrical, and structural conditions at the WTP was performed. Reports from site visits are included in Appendix H.

3.5.6 Process Control System

Certain information that appears here has been redacted from this version of the report.

Certain information that appears here has been redacted from this version of the report.

Although a detailed review of the SCADA system was outside the scope of the present evaluation, it is recommended to make the following improvements while also making any necessary improvements to system security.

- Establish the ability to automatically control influent flow control based on the appropriate finished water storage tank water level by integrating the new influent control valve, new influent flow meter, new finished water storage tank level monitoring instrumentation into the SCADA system.
- Integrate all chemical feed pumps to allow flow-pacing and the establishment of malfunction alarms.

3.5.7 Site Features and Security

Physical security measures in place at the WTP site include the following:

- WTP site: External lighting
- Reservoir: Lockable gate on access road.
- Existing Pump Station: External lighting
- Existing Water Tank: Padlocks on valve pits within site limits.
- Existing Pump Station: Fence with lockable access gate.

WTP operators note that helpful security improvements at the would include:

- A motorized chain-link fence gate that can be opened/closed either by a keypad or badge reader at the gate or by an operator from the WTP building.
- Several strategically placed security cameras, tied into the SCADA system.
- Fencing and gate around the Existing Pump Station and Water Tank.

It is recommended to implement these features to improve site security.

3.5.8 Suitability for Continued Use

The suitability for continued use of WTP unit processes and associated equipment has been discussed in each of the prior sections in detail. Please refer to those sections and to Section 4.7 for a list of compliance with accepted standards.

3.6 Existing Water Storage Tank and Pump Station

See Section 3.5.3.7 above for a description of water quality considerations with respect to TTHMs, overall required Village Public Water System finished water storage, and associated recommended upgrades.

3.6.1 Location and Layout

Certain information that appears here has been redacted from this version of the report.

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3.6.2 *Existing Storage Tank and Pump Station Description and History*

The Existing pump station was initially designed in 1965 to have one 250 hp high service pump and one 50 hp standard duty pump but were replaced at some later time with two 75 hp pumps.

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The tank and pump station were not in service during LaBella's inspections and thus limited our scope to visual inspection only. The tank and pump station are showing their age based on being nearly 60 years old.

The weld steel tank appears to be in serviceable condition; however, an interior inspection was not performed by LaBella. Exterior painting is patchy where rust areas were repaired and repainted. No areas or significant rust or deterioration were observed on the exterior of the tank walls during LaBella's visual inspection.

The tank is under a service contract with Corrpro Waterworks out of Conyers, Georgia (Corrpro). Corrpro's 2019 15-point Tank Inspection Review for the Existing Tank to evaluate its condition prior to the start of their contract has been provided in Appendix I, as Figure I-1.

The cathodic protection for the tank was recently replaced, and the Town is currently implementing safety and security upgrades to the tank/site and replacing the tank's outdated cellular modem to reestablish controls communication between the tank and WTP.

The pump station is known to cause water main breaks and other issues when in operation due to the age of the Village's water distribution system, despite the pump motor starters having been upgraded to VFDs in the recent past.

The pump casing and frame for Pump #1 are highly oxidized, as is the frame for Pump #2.

LaBella's recommendations for the Existing Pump Station are as follows:

- Once the station is fully operational again, an assessment of the pump startup and ramp down procedures, VFD setpoints, and other controls related design should be completed as part of a surge analysis to determine if changes to the existing control set points can minimize pump impacts on the distribution system or if additional surge suppression measures are warranted.
- Development and calibration of a complete hydraulic water model of the Village's water distribution system to assist in pressure surge analysis.
- Once the surge analysis has been completed, replacement of both pumps and implementation of other recommended upgrades should be considered.
- Repaint the tank exterior within the next 5 to 10 years.

3.7 Water System Present Condition

3.7.1 Recommendations from Other Recently Completed Engineering Reports

Consideration of certain Village water system components was outside of the scope of the present evaluation; nonetheless, to advance a comprehensive approach, LaBella read five (5) engineering reports prepared by other consulting firms over the last 16 years, summarized technical recommendations, and asked Village officials if any action had been taken to satisfy the recommendation. Table 26 summarizes, relevant, recommended improvements that remain incomplete. Please note LaBella did not perform any independent assessment or evaluation of these recommendations; they are solely brought forward from previous work completed by others. Please refer to Section 7.0 for a presentation of costs associated with these upgrades.

Table 26: Incomplete Historical Report Recommendations

Year	Document Title	Recommendation
2007	Corrosion Control Study	Review (at least every other year if not more often) corrosion inhibitor selection.
2013	Disinfection By-Products Evaluation	Evaluate moving the reservoir intake to a lower elevation.
2013	Disinfection By-Products Evaluation	Evaluate clearwell DBP formation and install air stripping if needed.
2017	Additional Water Quality Evaluation	Move corrosion control chemical addition location to a drip feed in Clearwell for more consistent dosing.
2017	Additional Water Quality Evaluation	Replace 4” unlined cast iron pipe with 6” cement-lined DIP in area east of SUNY Fredonia (area of highest concern).
2017	Additional Water Quality Evaluation	Evaluate lining options for pipes ≥ 8”. Prioritize lining in areas where issues have been reported.
2017	Water System Evaluation	Extend lower reservoir intake pipe approx.. 100 ft to a water depth of 30 ft. Design grating to avoid sediment introduction.
2017	Water System Evaluation	Complete a detailed evaluation of the Existing PS.
2017	Water System Evaluation	Flow-pace coagulant and coagulant aid feeds at recommended doses based on raw water flow for more consistent dosing & TOC removal.
2017	Water System Evaluation	Implement an additional 0.19 MG of finished water storage, minimum, to satisfy equalization and fire flow demands.
2017	Water System Evaluation	Install flow meters on two 12" finished water transmission mains (and stop the practice of calculating water production as equal to raw water minus backwash water).
2017	Water System Evaluation	Decrease Existing PS pump centerline elevation so that full volume of tank is use-able (previously the bottom 8 feet of water (0.23 MG) were too low relative to pumps to use).
2017	Water System Evaluation	Construct a second tank (0.25 MG to 0.50 MG) at Existing site to reduce reliability on the Dunkirk interconnection.
2017	Water System Evaluation	Replace 4” unlined cast iron pipe with 6” cement-lined DIP to support fire protection.
2017	Water System Evaluation	Replace unlined cast iron pipe (pre-1970). Prioritize areas based on frequency of water quality complaints/issues.
2018	Water System Improvements	Complete piping improvements to allow filter-to-waste system to work correctly.
2018	Water System Improvements	Clearwell: secure submerged pipe in Clearwell that suctions for WTP domestic water and as entry point sampling point
2018	Water System Improvements	Clearwell: secure chlorine dosing pipe by replacing wall brackets
2018	Water System Improvements	Clearwell: remove sediment

2018	Water System Improvements	Install insertion-style flow meter and doghouse manhole for finished water flow metering as two 12" finished water transmission mains leave clearwell (or find a better location)
2018	Water System Improvements	Electrical: Inspect and repair grounding system
2018	Water System Improvements	Electrical: Add circuits, motor controls, disconnects, etc. to support treatment-related improvements
2018	Water System Improvements	Electrical: Provide backup power for clarifier equipment, sludge valves & pumps, filter-to-waste valves, and new instruments.
2018	Water System Improvements	I&C: Add facilities as needed to support treatment-related improvements
2018	Water System Improvements	Replace raw water turbidimeter
2018	Water System Improvements	VDPS: Replace City of Dunkirk 4-inch turbine flow meter and strainer with 6-inch versions (saves 10 psi head loss).

3.7.2 Transmission Main

Certain information that appears here has been redacted from this version of the report.

3.7.3 Maintain System Pressure, Required Fire Flows, and Fire Flow Capacity

As exhibited within Section 2.2.8, the highest needed fire flow of 4000 GPM was identified within the Village's most recent ISO Survey for a duration of 240 minutes. Therefore, 0.96 MG of instantaneous fire protection storage should be provided throughout the Village PWS. Additionally, the Recommended Standards for Water Works (10 State Standards), 2018 identifies a minimum of 20 PSI for fire pressure, meaning that the Village must ensure these values are met within their service area. Additionally, 10 State Standards suggests working pressures within distribution system be between 60 and 80 PSI. The below summarizes the values that the Village must achieve to meet these design parameters, and the typical working pressures which water users should experience.

Table 27: Summary of Required and Suggested Distribution Flows, Pressures, and Capacity

Description	Reference Standard, Units	Reference	Type	Level of Needed Compliancy
Fire flow rate	4000 GPM	Village ISO Survey	Instantaneous minimum	Recommended
Fire capacity	0.96 MG	Village ISO Survey	Instantaneous minimum	Required
Fire pressure	20 PSI	10 State Standards	Instantaneous minimum	Required
System pressure	35 PSI	10 State Standards	Static minimum	Required
Working pressure	60 PSI	10 State Standards	Static minimum	Recommended
	80 PSI	10 State Standards	Static maximum	Recommended

<u>*Southern Water District Fire Protection Flows and Pressures*</u>
The WTP Clearwell service area, referred to herein as the Southern Water District (SWD), is the area which services customers along the path of water from the Clearwell to the Existing Water Tank along the Clearwell's two (2) 12-inch diameter watermains and its one (1) 24-inch diameter watermain. Distinctly, the SWD is not supplemented by the Existing Pump Station, Water Tank, NCWD 0.5 MG Tank, nor the Existing Pump Station. See Figure J-1 for a representation of the SWD. The approximate elevation of the highest elevation customer within the SWD is 886-feet above sea level and its lowest customer is approximately 818-feet above sea level, while the Clearwell's High Water Level (HWL) is 955-feet above sea level.

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In summary, the Clearwell is not sufficient to meet requirements set forth by the Village ISO Survey and 10 State Standards to the customers within the Southern Water District. See Section 6.3 for an evaluation of potential alternatives to ensure these requirements are met.

Northern Water District Fire Protection Flows and Pressures
The Existing Water Tank, Existing Pump Station, NCWD 0.5 MG Water Tank, and Existing Pump Station are hydraulically capable of providing flows and pressures to the remainder of the Village, defined as the existing Northern Water District (NWD) for the purpose of clarity. Notably, the Northern Water District is provided daily demands by the Existing Pump Station and Existing Water Tank, while the NCWD 0.5 MG Tank and Existing Pump Station are only capable of providing emergency fire flows. See Figure J-1 for a representation of the Northern Water District. The approximate elevation of the highest elevation customer within the Northern Water District is 855-feet above sea level and its lowest customer is approximately 640-feet above sea level. The following table presents the design parameters for the Existing Water Tank, Existing Pump Station, Existing Pump Station, and NCWD 0.5 MG Water Tank:

Table 29: NWD Infrastructure Design Parameters

Title, Water Tanks	Nominal Capacity (MG)	Low Water Level (LWL) (Feet above sea level)	High Water Level (HWL) (Feet above sea level)
Existing	1.0 MG	851.5	882.5
NCWD 0.5 MG	0.5 MG	972 (1)	996 (1)
WTP Clearwell	0.3 MG	NA (4)	NA (4)
Title, Pump Stations	**Rated Flow Rate (GPM)**	**Rated Pressure Output (TDH (2))**	**Pump Centerline (Feet above sea level)**
Existing	1650	138	852
Existing	500 (3)	165	694

(1) Estimate based upon site ground surface elevation, estimate of diameter, and nominal capacity.
(2) Total Dynamic Head (TDH).
(3) Existing Pumps are capable producing 800 GPM. However, the Village and the City of Dunkirk's emergency interconnect agreement dictates that only 500 GPM be withdrawn from the City's PWS.
(4) The WTP Clearwell has the capability to supply capacity to the Existing Water Tank, directly. However, check valves and an altitude valve prevent the Clearwell from supplying pressure to the NWD.

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Certain information that appears here has been redacted from this version of the report.

3.7.4 Wastes Generated

Wastes generated by the treatment process are discussed in Section 3.5.3.8.

3.7.5 Energy Consumption

No energy audit has been completed.

3.7.6 History of Infrastructure Damage

Based on an interview with the water operator in October 2023, there is no known history of infrastructure damage due to storm or flood impacts. This finding aligns with the low level of concern associated with FEMA flood zone is Zone C, area of minimal flooding. Figure B-8 presents a map of the system flood zones.

4.0 NEED FOR PROJECT

Given CCDOH violation notifications dating back to 2007, incompliances noted within Section 3.0, the information presented in the EPA Safe Drinking Water Information System Violation Report, a number of boil water notices, contaminant MCL violations, reporting violations, the age of the water system, and the various results of many past engineering reports, the Village of Fredonia Water system is in need of improvements.

4.1 Health, Sanitation and/or Security

Extensive water quality and quantity violations have been reported. The Village PWS has incurred Chautauqua County Department of Health (CCDOH) violations on a regular basis since 2003 for their system infrastructure, as summarized within Table 19.

Table 19 is a summary of the unofficial compliance letters cited to the Village PWS over the last 20 years. A full history of CCDOH notifications is presented within Appendix C. Several of the items listed in the table above are expected to be or have been amended since September 2023.

The PWS has incurred several boil water notices in the past several years, due to various issues within the PWS. Boil water notifications are presented within Appendix C (DOH Presentation). The table below summarizes the Village's recent history of boil water notices:

Table 31: Recent Boil Water Notices (2020 - 2023)

Date	Cause
June 2020	Water main break
September 10-30, 2020	Taste and odor issue likely due to algal bloom in reservoir, appropriate treatment complicated by filter bed replacement.
February 2023	Chlorine pump failure with lack of redundancy
June 2023	Turbidity exceedance contributed to treatment technique violation

As noted within Section 3.5.4, the Village PWS has incurred contaminant violations and the EPA Safe Drinking Water Information System Violation Report displays an additional history of these violations. These resources are presented within Appendix H.

Furthermore, operation of the WTP poses a risk to operator safety due to operational issues discussed within Section 3.5.

4.2 Aging Infrastructure

The useful life estimates based on materials, manufacturing, condition, manufacturer's estimates of length of service, usage history, maintenance history, and repair history indicate that a significant portion of the PWS is in need of repair or replacement. In certain cases, a lack of redundancy could result in standard and/or emergency maintenance preventing the PWS from maintaining adequate supply. See Section 3.0 for information regarding age of infrastructure.

4.3 Reasonable Growth

The Village does not anticipate future growth, please refer to demographic information in Section 2.2.4. Population and Growth Trends. There are currently no discussions of new significant water users entering the Village. At present, the City of Dunkirk, has not expressed need for routine water supply through the Existing Pump Station Interconnection. No additional water demand is anticipated.

4.4 Water, Energy and/or Waste Considerations

No audits have been completed to date.

4.5 Suitability for Continued Use

The Village of Fredonia Water System incorporates many components considered as critical infrastructure. Critical infrastructure is considered a necessary piece of infrastructure, which, if non-operational could cause the water system to fail in some way, cause health and safety violations for system operators, or which would not allow system operators to adequately submit monitoring and sampling results to regulatory agencies. Section 3.0 provides information regarding suitability of continued use for the PWS.

4.6 Storm and Flood Resiliency

No testimonies or records exist of past storm or flood related damages to the PWS infrastructure.

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4.8 Capacity Development

DOH is required to ensure that all systems receiving DWSRF assistance have adequate technical, managerial, and financial capabilities to provide safe drinking water. Systems that lack adequate capacity may be determined as ineligible by DOH to receive DWSRF assistance unless the project to be financed corrects the technical, managerial, and financial deficiencies. For projects funded with DWSRF assistance, complete the Capacity Development Program Evaluation Form.

4.9 Financial Status

4.9.1 Rate Schedule

The Village of Fredonia charges for water use in accordance with the Village of Fredonia Code, Chapter 287, Paragraph 8 Rates for metered service within Village and Paragraph 9 Rates for metered service outside Village. The current rate schedule took effect June 1, 2023, and were increased by $0.15 within the Village and $0.1725 outside the Village. Customer water bills are rendered quarterly as stipulated in the current rate schedule and shown below.

Table 33: Current Rate Schedule

Service	Quarterly Rate Base + Fee per 1,000 gallons
Water Service In-Village Rate	$25.00 + $4.95 per 1,000 gallons
SUNY Rate (Contract)	$0 + $4.95 per 1,000 gallons
Town Rate	$0 + $5.6925 per 1,000 gallons
Bulk Sale of Water	Billed at time of purchase: $47.50 + $12.15 per 1,000 gallons

The Village charges for additional fees such as turn on/turn off, new meter for existing service, meter testing fee at customer request, fire service fee, replace meter, frost plate, curb box cover, bulk sale of water, etc. These fees are captured as Unmetered Water Sales.

Table 34: Water Budget - Income 2023/2024

Service	Budget 2023/2024
Village Metered Water Sales	$1,200,000
Village Unmetered Water Sales	$2,000
Village Interest/Penalty	$15,000
Water Rents SUNY	$110,000
Water Rents Town of Pomfret	$205,000
Unclassified – ARPA Funds for meter replacements	$30,000
TOTAL	$1,562,000

4.9.2 *User Cost of Water*

Water consumed within the Village is metered to quantify and allocate billing for water use. The current water residential billing rates include $25 per quarter plus $4.95 per 1,000 gallons. The quantity of water billed to residential customers in the Village of Fredonia was 171,493,792 gallons (Average of 2020-2023). There are 3061 Village in-district residential customers.

$$Household\ Water\ Usage = \frac{171{,}493{,}792\ Gallons\ per\ year}{3061\ customers}$$

$$Household\ Water\ Usage = 56{,}025\ Gallons\ per\ year\ per\ houshold$$

$$Annual\ Cost\ of\ Water = \$100\ per\ year + (56{,}025\ Gallons\ per\ year)(\$4.95\ per\ 1{,}000\ gallons)$$

$$Annual\ Cost\ of\ Water = \$377.33\ per\ year\ per\ EDU$$

4.9.3 *Operation and Maintenance Costs*

The June 2023 – May 2024 annual budget identifies the following allowance for Operation and Maintenance Costs. The operation and maintenance costs are paid through routine billing to residential, commercial, business, and industrial users. Vacant parcels are not charged for O&M.

Table 35: Operation and Maintenance Costs

Category	Adopted Budget
Attorney – Personal Services	$8,000
Unallocated Insurance	$103,057
Contingency	$10,000
Water Fund: Administration	$47,652
Water Fund: Purification	$669,020
Water Fund: Distribution	$343,361
Water Fund: Employee Benefits	$333,260
TOTAL	$1,514,350

4.9.4 *Existing Debt Service*

The Village Water Fund includes the following debt service. The Village refinanced through Roosevelt & Cross in 2019, the original principal was $163,874 for the six capital improvement projects listed below, the debt will retire in the year 2031. The Village also holds two EFC loans as shown below. The Water Treatment Plant had an original principal of $1,388,611 and will retire in 2051. The EFC Water Line Replacement had and original principal of $626,545 and will retire in 2050. The current total annual debt service is $197,536.60. The debt service costs are paid through routine billing to residential, commercial, and business users. The annual payment for the 2023/2024 fiscal year water fund serial bonds principal and interest was $209,477.

Loan	Remaining Principal (6/1/2023)	Remaining Years	Interest Rate
Water Line Howard Street	12,240	8	1.954915
Water Line Chautauqua	16,319	8	1.954915
Water Line Main Street	26,517	8	1.954915
Water Line Woodward	40,798	8	1.954915
Existing Water Pump	99,957	8	1.954915
Water Plant Improvement	563,052	8	1.954915
Water Treatment Plant Project EFC	1,295,000	28	2.557885
Water Line Replacement EFC	570,000	27	2.36531

4.9.5 Comparison of Income to Expenditures

As presented above, the 2023/2024 Fiscal Year anticipated a net loss as the income is less than the sum of the operation and maintenance and debt service. The Village provided water budgets for the past three years as presented in the figure below.

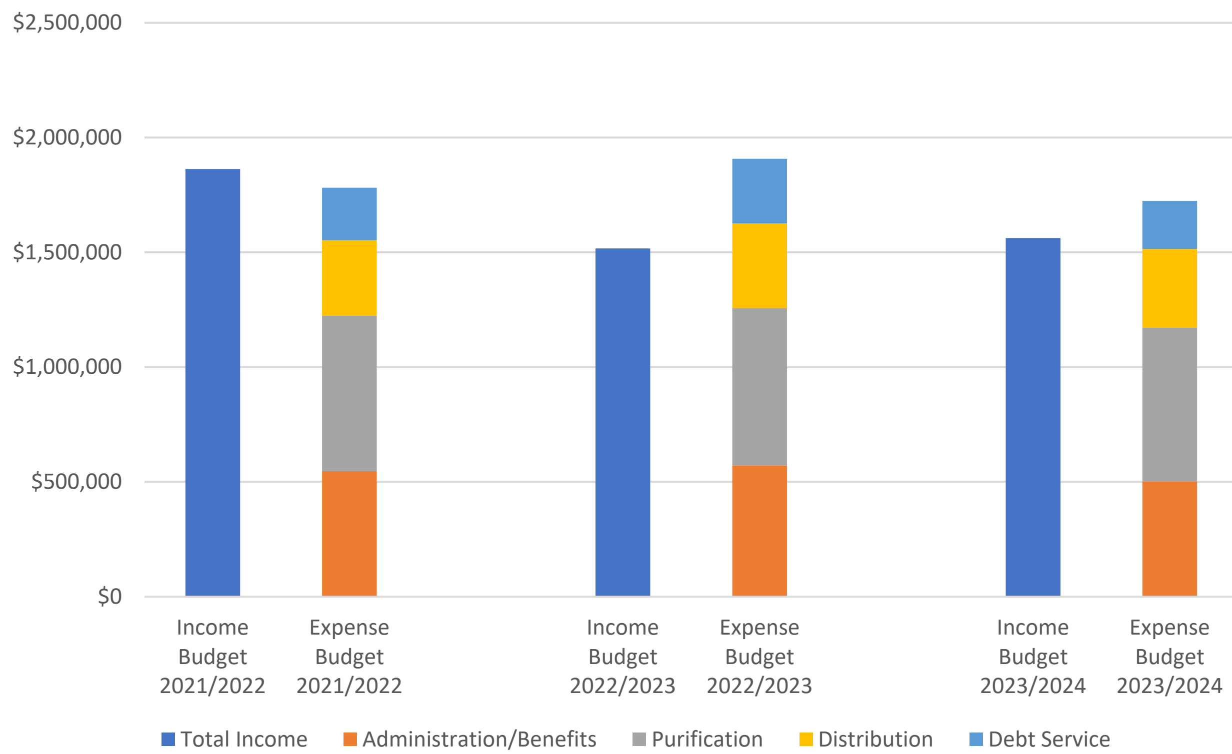

Figure 1: Village Annual Water Budget

The Village has historically had a large water fund, built over the preceding years; however, the recent trend of expenses exceeding income is causing the water fund to decrease. The water fund at the close of the 2021/22 fiscal year had a balance of $1,253,962. The water fund decreased to $976,661 at the close of the 2022/23 fiscal year. At present, the fund has approximately $500,000 based on discussion with the Village Treasurer. The Village has a policy to maintain the water fund balance between 15 and 25 percent of the annual budgeted appropriations, requiring a minimum balance of approximately $310,000.

5.0 ALTERNATIVES ANALYSIS

The following alternatives are considered in the sections below:

Table 36: Overall Alternatives Considered

Alternative	Description	Report Section
Null	No-Action	Section 5.4
No. 1	Improve Village WTP and Reservoir	Section 5.5
No. 2	Interconnect with City of Dunkirk; Decommission Village WTP & Reservoir	Section 5.6
No. 3	Interconnect with City of Dunkirk; Decommission Village WTP; Drawdown Reservoir for another use	Section 5.7

To inform consideration of these overall alternatives, consideration of the following lower-tier alternatives is presented below:

- Reservoir alternatives
- Disinfection alternatives
- Finished water storage alternatives

Note that the following improvements are recommended regardless of which overall alternative the Village selects:

- Upgrades to address the results of CCDOH's 2023 Sanitary Survey as presented in Section 3.1. For items related to implementing improvements at the WTP, it is recommended that the Village discuss with CCDOH the need to complete this work in the short-term if the Village selects an overall alternative that involves decommissioning the WTP.
- Improvements as recommended in other recent engineering reports as presented in Section 3.7.1.

5.1 Reservoir Alternatives

5.1.1 Null Alternative

Due to the current construction of the Dam and it's known shortfalls in regards to NYS Dam Safety Guidelines, no action taken would result in penalty by the NYSDEC.

5.1.2 Maintain Reservoir – Construct New Spillway

Fredonia may pursue a newly designed spillway and dam that would address the concerns with the current construction. The dam, spillway and intake systems would see large scale construction and would result in a larger, more safe dam with an intake structure that would allow Fredonia greater control over reservoir levels. This construction would maintain the reservoir as a source of drinking water, and with a return to compliance with NYS Part 673.8 would reduce the Village's liability.

5.1.3 Abandon Reservoir Usage – Decommission

The dam may be removed, along with the spillway and intake structure. In close coordination with federal and state environmental agencies, the reservoir would be redesigned as a natural stream and wetland environment. Careful engineering would be required to reduce flooding impacts without a water retention structure.

5.1.4 *Abandon Reservoir Usage – Drawdown*

Drawing the water volume down within the existing reservoir could render the dam to be found safe and in accordance with NYS Part 673.8. Many of the stability calculations that show Fredonia's dam to be outside of the guidance are dependent on water volume being held by the dam. This alternative would all the dam to remain with a construction effort to address the bypass elevations but avoiding the larger costs of removal.

5.2 Disinfection Alternatives

The following considerations apply to all alternatives considered in this section:

- Each would be designed for sufficient capacity per Ten States and the WTP rated production capacity.
- There is no anticipated change to system pressure or required operator certification grade.
- Each would be located within the WTP building, therefore there are no land requirements or environmental impacts, and large physical site considerations generally do not apply.

5.2.1 *Null Alternative*

It is acknowledged that no action is not a technically feasible alternative due to the deteriorating condition of the existing disinfection system. Refer to Section 3.5.3.5 in this report for discussion of deficiencies associated with existing conditions.

Certain information that appears here has been redacted from this version of the report.

5.2.3 *Liquid Sodium Hypochlorite*

Liquid sodium hypochlorite (delivered in bulk) was reviewed as an alternative to the existing system. Liquid sodium hypochlorite is delivered pre-mixed, which limits the operator handling required and eliminates the need to create stock solutions that introduces the possibility of mis-dosing due to improper ratio of chlorine solution or tablet to water. However, liquid sodium hypochlorite is typically delivered in a much more dilute form requiring large bulk storage tanks to be installed. Due to space constraints at the WTP, this would require an expansion of the existing chlorine room and installation of additional secondary containment measures.

5.2.4 *On-Site Generation of Sodium Hypochlorite*

Onsite liquid sodium hypochlorite generation is an alternative to traditional liquid sodium hypochlorite delivery. The system utilizes softened water mixed with salt to form a brine. This brine is then sent through an electrochemical generating unit that produces liquid sodium hypochlorite at concentrations similar to delivered liquid sodium hypochlorite. With the ability to generate on demand, the only storage needed is for the bulk salt which does not need to be stored in the same area. Additionally, the bulk storage tank size can be limited as the brine can be added to the unit when levels get low.

5.2.5 Change to Other Disinfectants

Replacement of the existing chlorination system with the following commonly-used disinfectants is considered infeasible and thus not viable for the present evaluation:

- Chlorine dioxide: Chlorine dioxide disinfection is not considered a viable replacement as it would maintain in place significant health and safety hazards.
- UV and ozone: UV and ozone disinfection produce either no (UV) or quickly dissipating (ozone) disinfectant residuals and thus cannot be used for secondary disinfection. Accordingly, it is not considered viable to replace the existing chlorination system with UV or ozone disinfection.
- Chloramine: Per Ten States' Interim Standard on the Use of Chloramine Disinfectant for Public Water Supplies, chloramine is inadequate to provide primary disinfection of surface waters.

5.3 Finished Water Storage Alternatives

Note that this alternative aims to address the following citations by the CCDOH, from Table 19:

- "Return existing tank to service and increase total system finished water storage capacity."

Furthermore, this alternative aims to address the following deficiencies, which are required and which the full list is presented within Table 32:

- Insufficient fire protection pressures and capacities are provided for the Village.
- Adequate fire protection flows and pressures are not provided for many water users within the South side of the distribution system.

Additionally, the alternative aims to fulfill and add to recommendations identified within past engineering reports which have not been resolved, from Table 26 as follows:

- Construct a second tank (0.25 MG to 0.50 MG) at existing site to reduce reliability on the Dunkirk interconnection, O'Brien & Gere 2017.

Note that prior to installing and bringing online a proposed water storage tank, additional infrastructure must be installed to ensure fire and system pressures are adequately met in the system. These additional items would, at minimum, require the installation of several Pressure Reducing Valves (PRVs) within the water distribution system. Furthermore, the removal of the underground check valves would take place after-PRV installation. These improvements noted above would create two separate pressure zones within the PWS, to provide adequate fire and system pressures and ensure that working pressures are reasonable and safe. The following describes the two proposed pressure zones within the PWS and Figure J-1 demonstrates the two, similarly:

- *Northern Pressure Zone (NPZ)*
  The NPZ water user elevations above sea level would range from 640-feet above sea level to 772-feet above sea level and all users within would be supplied water by the Existing Water Tank, no longer supplemented by the Existing Pump Station. It is expected that users within the NPZ would experience pressures between 105 PSI and 80 PSI.
- *Southern Pressure Zone (SPZ)*
  The SPZ water user elevations above sea level would range from 772-feet above sea level to 886-feet above sea level and all users within would be supplied water by the proposed uphill water tank (see Alternatives Analysis for a discussion of available sites). It is expected that users within the NPZ would experience pressures between 100 PSI and 80 PSI.

The division of the distribution system into these zones is wholly necessary if an additional water storage tank is to be installed as the new water storage must provide fire pressures for high elevation water users. Thereby causing abnormally high pressures for water users in low elevations.

5.3.1 *Null Alternative*

As presented in Table 19, CCDOH has given the Village a violation for lack of finished water storage capacity. Therefore, the Null Alternative of No Action is infeasible.

5.3.2 *If Maintaining WTP*

This alternative explores implications of finished water storage installation if the Village selects Overall Alternative 1 (see Section 5.5). In this case, the Village will still be required to provide adequate finished water storage for its residents. As part of this alternative, the Village would choose to continue to operate and maintain its existing 1.0 MG Water Storage Tank and its 300,000-gallon clearwell located on the WTP site. Therefore, in accordance with findings presented in Section 3.5.3.7, it is recommended that the Village install an additional 1.35 MG water storage tank to ensure adequate fire demand and system pressures. See calculations provided within Section 3.5.3.7 for a determination of total water storage required.

The following options are presented below for implementation of additional storage:

BOCES Water Storage Tank
Installation of a 1.35 MG composite elevated water storage tank within the un-utilized, private land, along an existing Village access easement originally established prior to 1980.

Spoden Road Water Storage Tank
Installation of a 1.35 MG ground water storage tank within the Village-owned land.

Appendix J presents a life-cycle cost analysis of the two alternatives which shows a significant difference in anticipated life-cycle cost between the alternatives, primarily due to:

- The significant cost surrounding construction of an elevated water storage tank compared to the cost of a ground water storage tank.
- The ability for the Spoden Road tank to be constructed on Village-owned land.

Certain information that appears here has been redacted from this version of the report.

Due to the significant cost difference, discussion of overall alternative 1 in Section 5.5 assumes the selection of the Spoden Road alternative. Per discussions with water system personnel, the Spoden Road site would require electrical upgrades to support the proposed infrastructure, which introduces uncertainty and the potential for additional cost. Nonetheless, the Spoden Road alternative is assessed at having a significantly lower life-cycle cost.

5.3.3 *If Interconnecting with City of Dunkirk*

This alternative explores implications of finished water storage installation if the Village selects Overall Alternative 2 (see Section 5.6) or Overall Alternative 3 (see Section 5.7). As part of these overall alternatives, the Village would choose to continue to operate and maintain its existing 1.0 MG Water Storage Tank but to decommission its 300,000-gallon clearwell located on the WTP site. Therefore, in accordance with findings presented in Section 3.5.3.7, it is recommended that the Village install an additional 1.65 MG of water storage to ensure adequate fire capacity and system pressures.

In the options discussed below, service area topography and the presence of the Chautauqua County/Dunkirk Airport significantly limited the feasible sites upon which to construct a finished water storage tank near the center of the Village. Conceptually, if constructing a tank near the center of the Village, it is advantageous for its overflow elevation to match that of the existing storage tank; however, elevations in much of the Village are such that the resulting tank would be an elevated tank exceeding 100 feet in height and, in some cases, approaching 200 feet in height. Tanks of this height introduce the possibility to obstruct flight path approaches for the aforementioned airport, as shown in Figure J-2. After consulting the Federal Aviation Administration (FAA) online Notice Criteria Tool, the Billy Blvd. site described below was determined as the optimal combination for a finished water storage tank location given site ground elevation and the desire to minimize or eliminate impact to air travel. Were a tank to be constructed at this site, further coordination with FAA would be required to ensure full compliance.

The following options are presented below for implementation of additional storage:

Option 1 - Additional Two (2) Water Storage Tanks, Billy Blvd. and WTP Site
The following option investigates the feasibility of installing a 0.7 MG water storage tank near Billy Blvd, to receive City of Dunkirk finished water and distribute by gravity to the remainder of the Village of Fredonia PWS. Additionally, this option explores the feasibility of installing a second, 0.96 MG water storage tank on the existing WTP site. The following summarizes the path of water originally purchased from the City of Dunkirk and transferred from the City's Water Storage Tank:

1. Water is transferred from the City of Dunkirk Water Storage Tank.
2. A proposed Village of Fredonia Pump Station boosts water flowrate and pressures and allows for re-chlorination, polyorthophosphate addition, and provides means for pH adjustment, if necessary.
3. Water is pumped through a 12-inch diameter transmission main from the proposed Pump Station, approximately 3.2-miles to the site of the proposed Billy Blvd Elevated Water Tank, located on parcel 113.12-2-49 on private land. The proposed Billy Blvd. water storage tank would distribute water by gravity throughout the New Northern Pressure Zone as defined within Section 5.3 and fill the Existing Water Tank by gravity. Note that conceptually the Billy Blvd. tank overflow elevation would be established at the same elevation as the existing tank overflow elevation.
4. The Existing Pump Station would be rehabilitated and refurbished in order to retrofit the station with new booster pumps utilized to pump from the Existing Water Tank, through the existing 12-inch diameter watermain previously terminating at the WTP Clearwell.
5. This 12-inch main would be disconnected from the decommissioned clearwell and re-piped to provide influent flow to the new 0.96 MG WTP Ground Water Tank.
6. The new WTP Water Tank's effluent piping would tie into the existing 24-inch diameter watermain, currently providing effluent from the clearwell. The 24-inch diameter main would be separated and sealed from the clearwell and re-utilized to service the new Southern Pressure Zone.

Option 2 - Additional Two (2) Water Storage Tanks, Billy Blvd and BOCES Site
The following option investigates the feasibility of installing a 0.7 MG water storage tank near Billy Blvd in the same manner described in Option 1. Additionally, this option explores the feasibility of installing a second, 0.96 MG water storage tank on the existing BOCES site, which is defined within Section 5.3.2. The following summarizes the path of water originally purchased from the City of Dunkirk and transferred from the City's Water Storage Tank:

1. (Items 1 through 4 duplicate items 1 through 4 of Option 1).
2. This 12-inch main would be disconnected from the decommissioned clearwell and re-piped to provide influent flow to the new 0.96 MG BOCES Elevated Water Tank.
3. The new BOCES Water Tank's effluent piping would tie into the existing 24-inch diameter watermain, currently providing effluent from the clearwell. The 24-inch diameter main would be

separated and sealed from the clearwell and re-utilized to service the new Southern Pressure Zone.

Option 3 - Additional Water Storage Tank at WTP Site
The final option is the possibility of utilizing the previously described proposed Pump Station to pump through a new 12-inch transmission main directly into the 24-inch watermain located on the intersection of W Main and Water Street. This scenario would need to ensure that the pump would not be capable of causing surges within the distribution system, likely by providing flow from the station 24/7 by utilization of Variable Speed Drives (VFDs). This option includes a 1.65 MG water storage tank at the WTP, but avoids the need to construct a finished water storage tank in the Village.

Appendix J presents a life-cycle cost analysis of the two alternatives which shows a significant difference in anticipated life-cycle cost between the alternatives. Due to the significant cost difference, discussion of Overall Alternative 2 (see Section 5.6) or Overall Alternative 3 (see Section 5.7) in Section 5.5 assumes the selection of the Option 3 – Additional water storage tank at WTP Site.

5.4 Overall Null Alternative: No-Action

This alternative provides a baseline comparison for all other alternatives and consists of the "do nothing" alternative. This alternative provides the lowest initial cost; however, taking no action in proactively maintaining the Village's existing infrastructure would result in continued degradation of the existing Village's facilities and will degrade the quality of service provided to the ratepayers. Taking no action will not correct non-compliance or failing infrastructure, result in unmeasurable reactionary spending as processes and equipment failures occur, be unsustainable, and is anticipated to result in future CCDOH violations. Cost of deferred replacement typically requires replacement on an emergency basis and requires greater financing. Additional deferred costs could include cost of damages, social cost, costs associated with loss of water, costs of lost water revenue. It is determined that this Null Alternative of No Action is infeasible to address the deficiencies described in Sections 3.1 and 4.7.

5.5 Overall Alternative 1 – Improve Village WTP and Reservoir

5.5.1 Description

This alternative involves upgrading the existing dam, reservoir, WTP, and other water system components to address existing deficiencies and maintain reliable, high-quality drinking water to the service area.

Dam and Reservoir Infrastructure
The reservoir must come into NYSDEC Compliancy through spillway capacity, drawdown capability improvements and completion of a hydrology report. Appendix E presents the full findings of the dam investigation, while Section 3.2 presents a summary of the findings.

The existing dam and spillway would need to be isolated by the construction of a temporary cofferdam and water flow managed through a siphon system and the treatment plant bypass to protect the work site. The existing spillway and core wall would be removed to expose sound rock for anchoring new construction. With the rock exposed and prepared, a new spillway would be formed and placed. New dam construction would incorporate a new Low-Level Outlet (LLO) Gate to meet impoundment drawdown requirements. With the dam construction complete, the cofferdam would be removed and site restored for operation. The Village would retain the ability to use the reservoir as a potable water source.

Reservoir intake structure and piping
The CCDOH requires that the reservoir intake structure is secured and to ensure that all lines exiting the tunnel are buried. It is recommended that the valves adjacent to the day light of the tunnel are replaced and buried alongside its connected piping within valve boxes. Additionally, the CCDOH requires investigation of streambank stabilization at the WTP site and an estimate of repair cost for stabilization is given within this alternative.

WTP process components
In accordance with compliance issues cited in Table 19 and Table 32, the following improvements are recommended:

- Install a sludge flow meter on the effluent of the sludge holding basin to accurately measure flow from the sludge holding basin to the stream. The nominal size of the flow meter will need to be investigated before designed, as the existing piping is not readily accessible nor are record drawings suspected to be reliable. The meter's range of flow should be larger than the total of water expected to be lost through the plant on a given day, maximum.
- Rehabilitate or replace clarifier sludge draw down valving at the WTP. These components have been impossible to access for rehabilitation or replacement for much of this year, as both clarifiers must remain in operation to provide the WTP the capacity to meet service area demand and the valving cannot be accessed while the given clarifier remains in operation. Per WTP operators in September 2023, one clarifier would not be capable of producing adequate water quality if attempting to meet regularly experienced demands.

Certain information that appears here has been redacted from this version of the report.

- Construct a backwash storage tank to ensure cross-connection protection is achieved.
- Replace existing backwash pumps with smaller pumps to pump through new piping to the backwash storage tank. Configure the backwash tank to offer cross connection control by ensuring that its influent piping invert elevation is above its overflow elevation. An additional benefit of using this backwash tank is that it is sufficient in providing fire capacity and pressure to the WTP.

- Construct an additional clarifier equivalent in size to each of the existing clarifiers to meet Ten States capacity requirements and provide redundancy. Expand WTP building to enclose the proposed clarifier.

WTP site components
New York State Building Code requires structures such as the WTP to be protected with adequate fire flowrates, volumes, and pressures. The backwash water tank described above will be capable of providing 500 GPM for a duration of 60 minutes. Furthermore, 10 State standards requires that adequate security is provided at the WTP. Due to this requirement and operator interest, fencing, a lockable gate, and cameras will be provided at the WTP.

To stabilize the slope adjacent to the WTP Building and thus prevent building damage and ensure operator safety, the following measures are recommended. Refer Figure J-3 for a figure identifying the area within which components would be constructed.

- During detailed design of any WTP improvements project, conduct further site investigations to confirm conceptual recommendations presented herein.
- Construct soldier pile and concrete lagging wall with tiebacks, tiebacks running beneath the WTP Building, soldier piles drilled into rock and lagging panels keyed into the underlying rock (height is to be determined depending on how items may be sloped).
- Construct a big-block concrete wall keyed into or doweled into underlying rock with geotextile on back face of wall to prevent migration of fines into tributary.
- Construct a gabion wall doweled into underlying rock with geotextile on back face of wall to prevent migration of fines into tributary.

WTP structural, mechanical, plumbing, electrical, and control components
Recommended structural, mechanical, plumbing, electrical and control improvements are presented in Appendix H.

Water Distribution System
A 1.35 MG water tank on Spoden Road, as shown in Figure J-4 will be installed to satisfy fire flow needs. Water will gravity flow from the clearwell to a new wet well on the Spoden Road site. Consequently, a small pumphouse or enclosure will provide the pressures necessary to elevate the water from the wet well to as high as the overflow of the water storage tank. From the water tank, water will gravity flow throughout the SPZ as defined within Section 5.3.

With the PWS split into two pressure zones, the SPZ supplied by the Spoden Road Water Tank and the NPZ supplied by the Existing Water Tank and with gravity flow from the clearwell to both tank sites, there is no inherent requirement to continue utilizing either the Existing Pump Station nor Existing Pump Station. It is recommended that the Existing Pump Station continue to be exercised to ensure continued service as an emergency interconnection and water source from the City. At the Existing Pump Station, given its condition and its need for improvement, it is recommended to decommission it if this alternative is selected.

5.5.2 Impact on existing facility

Dam, Reservoir and WTP Infrastructure
As a direct result of the implementation of recommendations surrounding Alternative 1 and the Village dam and reservoir, the Village's dam and reservoir infrastructure and WTP would be brought to compliance. There would be little to no change to existing design flows, nor personnel changes, nor changes to water distribution pressures.

Water Distribution System Infrastructure

The proposed alternative would alter the structure of the PWS by addition of a water storage tank, decommissioning of the existing Pump Station, and implementation of a Northern and Southern Pressure Zone. These changes would likely result in a net increase in infrastructure throughout the distribution system. Service area pressure would change (within acceptable ranges), PRVs would need to be calibrated at regular intervals, and the addition of a new water tank on Spoden Road would require regular visits as well as some operation and maintenance at the site.

5.5.3 Location map and/or schematic

Certain information that appears here has been redacted from this version of the report.

5.5.4 Land requirements

This alternative does not require the Village to acquire land.

5.5.5 Environmental impacts and mitigation measures

The foremost environmental impacts associated with this alternative are anticipated to relate to the following portions of the work:

- The dam construction would require a detailed review by regulatory agencies and area stakeholders including residents, NYSDEC, USFWS, US Army Corps of Engineers, and others. These agencies would review and comment on the plan. This coordination may also lead to construction limitations and requirements.
- Slope stabilization adjacent to the WTP would be extremely likely to require permitting through regulatory parties in order to construct and alter an existing stream embankment.
- Protection of the existing exposed transmission main in the streambank will require access, impose disturbance on the local environment, and likely require work in the waterway. Refer to Section 3.7.2.

For all portions of the proposed work, it is recommended to proceed in a manner that includes all involved stakeholders, thoroughly considers environmental impacts, and seeks to minimize environmental impacts through best available mitigation practices. Section 2.0 discusses existing environmental conditions associated with sites for proposed work.

5.5.6 Construction and site considerations

As evidenced within record drawings showing subsurface profiles of some of the Village's infrastructure sites, it should be noted that the WTP site has historically been noted to have a high bedrock table. Construction concerns exist with the feasibility of altering infrastructure within the stream embankment adjacent to the WTP (including slope stabilization measures and efforts to protect existing transmission main piping), due to the need to:

A. Utilize an extremely heavy crane to deposit large construction equipment, such as excavators, forklifts, and other critical equipment within the 80-foot-deep stream embankment, or,

B. Organize extensive permitting and likely sizable permitting fees for the creation of an access road from the area of the stream closest to the Spoden Road and County Route 60 intersection to the WTP embankment, approximately 1600-feet along its path. Additionally, negotiations with property owners would have to take place in order to secure a potential access easement to transfer equipment from Spoden Road to the stream.

5.5.7 Permit requirements

Dam and Reservoir Infrastructure Improvements
Because the dam and reservoir are man-made, it is anticipated that United States Army Corps of Engineers and NYS Department of Environmental Conservation (NYSDEC) permits would be required for proposed improvements.

Reservoir intake structure and piping Improvements
Intake pipe and structure improvements are anticipated to require United States Army Corps of Engineers and NYS Department of Environmental Conservation (NYSDEC) permitting. CCDOH regulatory approval would be required for improvements to the reservoir intake structure and piping. Construction plans would be transferred to the NYSDEC and subsequent parties if any construction were to be proposed within the existing stream embankment limits.

WTP Improvements
CCDOH regulatory approval would be required for improvements to the WTP. Village, Town, County or State Code Enforcement approval would be required to ensure compliance with local building code.

Water Distribution System
CCDOH regulatory approval would be required for improvements to the water distribution system. Village, Town, County or State Code Enforcement approval would be required to ensure compliance with local building code.

5.5.8 Storm and flood resiliency

As available documentation establishes none of the sites identified within the proposed alternative encompass portions of a 100-year flood zone, it is unlikely that significant flooding concerns would be prevalent. However, all construction would be protected by adequate stormwater protection and erosion control measures.

Furthermore, no proposed construction would be impacted by rising sea levels or major surface water body level changes, due to the project's lack of proximity to these bodies.

The reconstructed dam would improve Fredonia's flood resistance and regain good standing with New York State as a sound dam.

5.5.9 Constructability and schedule

Construction of a majority of the improvements allocated within the proposed alternative can be completed at any season within the calendar year without significant implications, with the exception of concrete work which is significantly more expensive in cold weather. Some utility trenching, dam reconstruction, and the proposed streambank stabilization will be required within the project scope.

However, this trenching would not be necessary to complete during periods of seasonal soil freezing. Therefore, there is no concern related to seasonal variation in weather conditions.

The dam removal and reconstruction would initiate with a detailed engineering and permitting effort spanning a year. Once the engineering was completed and all stakeholders consulted, the bid and construction effort can be expected to cover 2 years culminating in commissioning the newly constructed dam. This would be a significant construction effort including excavation and large-scale concrete placements.

5.5.10 Cost Estimate

A life-cycle cost estimate is presented within Appendix J. The notable factor for this alternative is the service area would continue to receive water produced by the Village of Fredonia, therefore there would be no costs associated with purchasing water from another entity (as there is for Alternatives 2 and 3).

5.5.11 Non-Monetary Factors

The major non-monetary consideration of Alternative 1 is that the Village would be capable of relying on its own infrastructure, rather than that of a separate municipality. The Village should consider other factors such as water quality, personnel impacts, history of compliance issues, the need for significant action in the short-term and sustained commitment in the long-term, and community objections when considering this alternative.

This alternative allows Fredonia to retain their independent water source and continue to control the supply and treatment of the Village's potable water via the reservoir. Routine maintenance and inspection will continue to be required. The dam will retain its Class C High Hazard status within the State of New York.

5.6 Overall Alternative 2 – Interconnect with City of Dunkirk; Decommission Village WTP & Reservoir

5.6.1 Description

The second alternative analyzed investigates the monetary and non-monetary implications of a potential permanent interconnection with the City of Dunkirk PWS with the intention that the City provide adequate flow and pressure to satisfy all Village demands. The alternative involves installation of infrastructure on both Village of Fredonia and City of Dunkirk owned land, and would not involve acquisition of private land, ensuring that the project could move forward quickly, assuming that municipal parties, regulatory agencies, and other stakeholders agree regarding the suitability and constructability of the proposed project.

This proposed alternative would entail decommissioning of the Village WTP in its entirety, installation of a 1.65 MG water storage tank on the former WTP site, restructuring and rehabilitation of the existing Pump Station and new construction of a suitable pump station, ideally located on the site of the City of Dunkirk's existing Water Tank as well as a 12-inch transmission watermain from this proposed pump station to the downtown area of the Village where a 24-inch watermain is present and can be connected to.

In essence, the second proposed alternative analyzed would consist of four major project areas. The major project areas are explored below, and additional minor construction sites are included:

Village Reservoir and Dam Site
A significant cost and construction project as part of the second alternative would be the full decommissioning of the Village Reservoir and Dam. This construction would entail significant restructuring and demolition of the structures associated with the dam reservoir and would result in a full restoration of the original stream, last seen before the early 1900s. This portion of the project's construction cost is significant, due to the high level of restoration efforts required to restore the area previously submerged by the reservoir to its original condition.

In summary, the project would most notably entail significant earth and concrete removal and disposal, along with significant restoration efforts projected for the remainder of the 30-year planning period following reservoir decommissioning.

WTP Site
The second major construction site involved within the second alternative presented would be located on the site of the existing WTP. Cost of decommissioning the existing plant would consist of demolition of above ground structures and their removal as well as use of flowable fill to ensure that underground structures to be abandoned-in-place are not liable to create significant ground surface movements.

Furthermore, the WTP would entail the construction of a new, 1.65 MG Water Storage tank, referred to as the WTP Water Tank. Both the decommissioning efforts and new ground storage water tank are demonstrated in Figure J-7. A significantly sized foundation would be required in order to recess the water tank within the existing bank of soil near the edge of the WTP's existing parking lot.

Additionally, level sensing should be considered to ensure automatic actuation of water tank fill pumps located on the Existing Site, based upon water level within the tank. The proposed water storage tank would incorporate separate influent and effluent piping. Influent piping to the water tank would tie into the existing 12-inch watermain that currently assists in filling the Existing Water Tank from the clearwell. This piping would be disconnected from the clearwell and connected to additional 12-inch influent piping to the proposed water tank influent. The water tank's effluent piping would similarly tie into the existing 24" watermain, currently serving as distribution from the clearwell to residents and the Existing Water Tank. Optimal configuration of piping connections to the distribution system and isolation and pressure reducing valves, and operational controls to prevent the development of problematic high water age conditions in either tank will be critical to maintain high water quality.

Phasing implications of this alternative would consider that all new infrastructure at the WTP and other construction sites would need to be constructed prior to all decommissioning and rehabilitation/ repurposing efforts explored.

Existing Pump Station Site
The Existing Pump Station will be used to convey water from the Existing Water Tank to the proposed WTP Water Tank. The Existing Pump Station is in some need of repair. Additionally, the Existing Pump Station houses a host of piping, equipment and appurtenances, much of which are acceptable to remain. However, piping within the below-grade section of the Existing Pump Station may be reconfigured to allow for pumped flow from the Existing Water Tank to the proposed WTP Water Tank. The existing pumps within the station are not suitable for adapted use for pumped flow into the WTP Water Tank and will require replacement. These pumps will be considerably down-sized from the pumps which currently exist within the space and are anticipated to consist of two (2) end-suction, 50 horsepower pumps.

Pump Station Site

It is proposed to install a new pump station, referred to as the Pump Station in order to convey water from the City of Dunkirk PWS into the center of the Village of Fredonia distribution system, near the intersection of W Main St. and Water St. This pump station will provide adequate space to allow for re-chlorination, pH adjustment, and polyorthophosphate addition. Pumps within the space are estimated to consist of three (3) end-suction, 100 horsepower pumps.

Miscellaneous Minor Construction Zones
In order to convey flow from the Pump Station Site to the center of the Village, approximately 12,000 LF of 12-inch transmission main would be installed as shown in Figure J-10. Additionally, PRVs would be installed in order to separate the PWS into multiple pressure zones, as shown in Figure J-1.

5.6.1.1 Impact on existing facility

The existing dam and spillway would be partially or wholly removed and replaced with an intentionally designed and constructed habitat. The existing reservoir would be reduced to the natural streambeds and resulting environments. The Village would no longer have access to the reservoir as a potable water source.

Dam and Reservoir Infrastructure
As a direct result of the implementation of recommendations surrounding Alternative 2, the Village's dam and reservoir infrastructure would be decommissioned in its entirety.

WTP Infrastructure
As a direct result of the implementation of recommendations surrounding Alternative 2, the Village's WTP infrastructure would be decommissioned in its entirety.

Water Distribution System Infrastructure
The proposed alternative would certainly alter the structure of the PWS by addition of an additional water storage tank, rehabilitation and repurposing of Existing Pump Station, and implementation of a Northern and Southern Pressure Zone. These changes would likely result in a net decrease in infrastructure throughout the distribution system. PRVs would need to calibrated at regular intervals, and the addition of a new water tank on the WTP site would require regular visits as well as some operation and maintenance at the site. All changes would be designed such that distribution system pressure throughout the service area is maintained within acceptable ranges.

5.6.1.2 Physical Impact

The existing reservoir would be restored with the intent of recreate the original state of that area prior to the creation of a reservoir.

The existing WTP would be decommissioned and demolished, as described in Section 5.6.1.

5.6.1.3 Compatibility of Finished Water with Village Distribution System

The Village of Fredonia currently utilizes corrosion control chemical injection to establish and maintain a protective lining on the interior of pipes within its distribution system. This is particularly important as record documentation (2017 Water Quality Evaluation by O'Brien & Gere) indicates over 50% of water main in the distribution system was installed prior to 1970 when it became common practice to protect pipe interiors with cement lining. As such, the interior of these pipes is more susceptible to corrosion than cement-lined pipes and maintaining corrosion control practices is critical.

The City of Dunkirk presently does not inject chemicals or have another specific method by which they establish and maintain protective lining on the interior of pipes within its distribution system. At present, City of Dunkirk finished water quality data documenting observed values for common parameters including but not limited to pH, temperature, alkalinity, hardness, and other parameters relevant to corrosion control are unavailable and their detailed consideration is outside the scope of the present evaluation. Therefore, conservatively, the present evaluation assumes the Village will have to inject chemicals to adjust pH and maintain existing pipe lining (i.e. an orthophosphate) at the interconnection to maintain its current corrosion control system. The present evaluation also anticipates the Village will have to add chlorine (liquid sodium hypochlorite) at the interconnection to ensure suitable residual throughout its distribution system.

Certain information that appears here has been redacted from this version of the report.

5.6.3 Land requirements

This alternative does not anticipate the need for land acquisition; however, it also assumes the City of Dunkirk will be amenable to construction of the interconnection pump station on a City-owned parcel adjacent to the existing Water Tank.

5.6.4 Environmental impacts and mitigation measures

For all portions of the proposed work, it is recommended to proceed in a manner that includes all involved stakeholders, thoroughly considers environmental impacts, and seeks to minimize environmental impacts through best available mitigation practices. Section 2.0 discusses existing environmental conditions associated with sites for proposed work.

The dam decommissioning effort would be conducted through a close partnership with environmental stakeholders such as NYSDEC, USFWS, and US Army Corp of Engineers. These partners would assist in and direct the design of the habitats to replace the existing reservoir. These environmental agencies would offer requirements and expectations for all habitat related materials and placement while overseeing the construction and disposal of debris.

5.6.5 Construction and site considerations

Limited construction and site considerations exist as the proposed improvements involve construction on relatively flat, un-used land on parcels owned by the Village or City.

The dam removal and decommissioning effort would focus on earth-work and soil removal. The concrete structures that make up the dam and spillway would be removed, partially or wholly and the site would be restored to a natural habitat. Large quantities of soil may need to be removed from the site pending quality testing. The habitat restoration effort would include engineered routing of the stream bed, plunge pools, vegetation, and rocky structures. These features would be designed and placed during the construction effort.

5.6.6 Permit requirements

Dam and Reservoir Infrastructure decommissioning
Because the dam and reservoir are man-made, it is anticipated that United States Army Corps of Engineers and NYS Department of Environmental Conservation (NYSDEC) permits would be required for decommissioning.

Reservoir intake structure and piping decommissioning
Intake pipe and structure removal is anticipated to require United States Army Corps of Engineers and NYS Department of Environmental Conservation (NYSDEC) permitting.

CCDOH regulatory approval would be required for removal and/or decommissioning of piping between the reservoir intake and WTP.

WTP decommissioning
CCDOH regulatory approval would be required for decommissioning of the WTP.

Water Distribution System
CCDOH regulatory approval would be required for any improvements allocated within the distribution system.

Village, Town, County or State Code Enforcement offices would be involved in any component of the final project to ensure compliance with local building code.

NYSDEC and subsequent parties would be consulted if any construction were to be proposed within the existing stream embankment limits within the water distribution system.

5.6.7 Storm and flood resiliency

As available documentation establishes none of the sites identified within the proposed alternative encompass portions of a 100-year flood zone, it is unlikely that significant flooding concerns would be prevalent. However, all construction would be protected by adequate stormwater protection and erosion control measures.

Furthermore, no proposed construction would be impacted by rising sea levels or major surface water body level changes, due to the project's lack of proximity to these bodies.

Post dam removal, the natural stream flows would be restored. Careful hydraulic analysis of the watershed would be conducted prior to removal and the stream characteristics designed to prevent flooding during expected rainfall events.

5.6.8 Constructability and schedule

Construction of a majority of the improvements in the proposed alternative can be completed at any season within the calendar year without significant implications, with the exception of concrete work which is significantly more expensive in cold weather. Some utility trenching and dam deconstruction will be required within the project scope. However, this trenching would not be necessary to complete during periods of seasonal soil freezing. Therefore, there is no concern related to seasonal variation in weather conditions.

5.6.9 Cost Estimate

A life-cycle cost estimate is presented within Appendix J. Significantly, this alternative has a high initial cost due to the cost of dam and reservoir decommissioning and a significant consumption cost due to having to purchase water from Dunkirk.

5.6.10 Non-Monetary Factors

The major non-monetary consideration of this alternative is that the Village would lose its ability to independently control its PWS, as it would be reliant on Dunkirk for potable water. Accordingly, it would have minimal control over water rates. This alternative would simplify the Village water system and thus minimize operations, maintenance, administrative, and regulatory burdens.
Removal of the dam and reservoir would require Fredonia to relinquish their independent water source. The restoration of habitat could benefit the residents through recreational use. The removal of the dam would eliminate the Village owned liability of a Class C High Hazard dam.

5.7 Overall Alternative 3 – Interconnect with City of Dunkirk; Decommission Village WTP; Drawdown Reservoir

5.7.1 Description

Proposed alternative 3 would be in all ways equal to that of alternative 2. However, rather than decommissioning of the Village reservoir and dam, the dam would be reused for alternative usages.

Please see Section 5.6.1 for the remainder of the alternative 3 description, as they are equivalent.

5.7.2 Impact on existing facility

Dam and Reservoir Infrastructure
See Section 5.1 for a detailed description of this alternative's impact to the Village reservoir and dam.

Please see Section 5.6.1.1 for the remainder of the alternative 3 *impact on existing facility*, as they are equivalent.

5.7.2.1 Physical Impact

Dam and Reservoir Infrastructure
See Section 5.1 for a detailed description of this alternative's physical impact to the Village reservoir and dam.

Please see Section 5.6.1.2 for the remainder of the Alternative 3 *physical impact*, as they are equivalent.

5.7.2.2 Compatibility of Finished Water with Village Distribution System

Please see Section 5.6.1.3 for Alternative 3 *compatibility of finished water with Village distribution system*, as they are equivalent.

5.7.3 Location map and/or schematic

Please see Section 5.6.2 for Alternative 3 *location map and/or schematic*, as they are equivalent.

5.7.4 *Land requirements*

Please see Section 5.6.3 for Alternative 3 *land requirements*, as they are equivalent.

5.7.5 *Environmental impacts and mitigation measures*

Please see Section 5.6.4 for Alternative 3 *environmental impacts and mitigation measures*, as they are equivalent.

5.7.6 *Construction and site considerations*

Please see Section 5.6.5 for Alternative 3 *construction and site considerations*, as they are equivalent.

5.7.7 *Permit requirements*

Please see Section 5.6.6 for Alternative 3 *permit requirements*, as they are equivalent.

5.7.8 *Storm and flood resiliency*

Please see Section 5.6.7 for Alternative 3 *storm and flood resiliency*, as they are equivalent.

5.7.9 *Constructability and schedule*

Please see Section 5.6.8 for Alternative 3 *constructability and schedule*, as they are equivalent.

5.7.10 *Cost Estimate*

A detailed cost estimate is presented within Appendix J. Alternative 3 involves the lowest capital cost. This alternative would involve a relatively low O&M cost, and cost of short-lived assets. However, the major disadvantage of purchasing water from the City by the Village of Fredonia is that consumption costs would be high.

5.7.11 *Non-Monetary Factors*

The major non-monetary consideration of Alternative 1 is that the Village would simplify its water system such to the extent that future capital and short-lived asset costs decrease in their likelihood to occur. Additionally, the Village would incur extremely lightened risk of future compliance issues with the simplification of their water system.

The Village should consider other factors such as water quality, personnel impacts, history of compliance issues, and community objections when considering this alternative.

6.0 SUMMARY AND COMPARISON OF ALTERNATIVES

If field investigations and further design work during detailed design reveal that significant modifications are necessary, this analysis and the recommendation of an alternative will have to be re-evaluated. At the present level of investigation, the summary and comparison follow. A summary table of technically feasible alternatives identifying major differences, pros and cons, non-monetary factors, and costs is provided in below.

6.1 Reservoir Alternatives

Table 37 presents a summary table of the feasible reservoir alternatives considered including major differences, pros and cons, non-monetary factors, and a summary of life-cycle costs. The full life-cycle cost analysis is presented in Appendix J.

Table 37: Reservoir Alternatives

Alternative	Maintain Reservoir – Construct New Spillway	Abandon Reservoir Usage – Decommission	Abandon Reservoir Usage - Drawdown
Major Difference(s)	• Reservoir and dam will continue to exist in improved form.	• Reservoir and dam to be decommissioned and area to be returned to its natural state.	• Reservoir and dam to continue to exist, but be modified such that they cannot serve as public water supply, but can be re-purposed.
Pros	• Continued use of existing system and assets, including water supply.	• Minimizes O&M, admin., and regulatory burden • Eliminates uncertainty related to reservoir & dam future viability	• Reduced cost relative to alternatives • Can beneficially repurpose reservoir
Cons	• High O&M, admin., and regulatory burden • High cost (short & long-term)	• Reduced PWS control • High cost (short & long-term)	• Reduced PWS control
Summary of life-cycle cost analysis	• Estimated 30-year life-cycle cost (2023 present value): $14,503,000	• Estimated 30-year life-cycle cost (2023 present value): $13,500,000	• Estimated 30-year life-cycle cost (2023 present value): $6,699,000

Note: Pros and cons rows include non-monetary factors.

6.2 Disinfection Alternatives

Table 38 presents a summary table of the feasible disinfection alternatives including major differences, pros and cons, non-monetary factors, and a summary of life-cycle costs. The full life-cycle cost analysis is presented in Appendix J.

Table 38: Disinfection Alternatives

Alternative	Null Alternative (Continue Using Trichlor tablets)	Liquid Sodium Hypochlorite	On-Site Chlorine Generation
Major Difference(s)	• Solid tablets and manual dilution by operators.	• Product arrives on-site ready for use in liquid form.	• On-site generation from salt instead of recurring delivery.
Pros	• Operators are experienced with O&M of system.	• Simple chemical feed system. • Smaller footprint. • Product does not require any preparation or modification prior to use. • Available in totes of various sizes; provides flexibility to	• Lowest life-cycle cost. • Lengthy periods between needed deliveries. • Decreased health and safety hazards and security risk.

		system design and operation. • Decreased health and safety hazards and security risk.	
Cons	• Significant health and safety hazards that complicate WTP O&M and introduce security risks. Owner considers these hazards unacceptable. • Challenging to maintain consistent stock solution strength given the requirement to prepare on-site.	• Higher life-cycle cost and cost of deliveries. • Susceptible to interruptions in delivery schedule. • Requires building expansion.	• Higher complexity. • Highest capital cost.
Summary of life-cycle cost analysis	• Estimated 30-year life-cycle cost (2023 present value): $1,235,000	• Estimated 30-year life-cycle cost (2023 present value): $1,172,000	• Estimated 30-year life-cycle cost (2023 present value): $1,032,000

Note: Pros and cons rows include non-monetary factors.

6.3 Finished Water Storage Alternatives

If Maintaining WTP

Table 39 presents a summary table of the feasible disinfection alternatives including major differences, pros and cons, non-monetary factors, and a summary of life-cycle costs. The full life-cycle cost analysis is presented in Appendix J.

Table 39: If Maintaining WTP: Finished Water Storage Alternatives

Alternative	1.35 MG Spoden Road Water Tank	1.35 MG BOCES Water Tank
Major Difference(s)	• Tank at Spoden Rd. site which receives flow from clearwell using oldest existing 12-inch watermain from clearwell.	• Tank at BOCES site which could receive flow from clearwell using existing 12-inch and 24-inch mains from clearwell. oldest existing 12-inch watermain from clearwell.
Pros	• Ground storage tank, which maintains low cost. • Lower life cycle cost. • Parcel is already under Village ownership. • Access road already present; easier to access.	• Direct accessibility/tie in point(s) to existing 12-inch and 24-inch watermains from clearwell.
Cons	• Would require power upgrade to the site. • Use of oldest 12-inch watermain from clearwell.	• Elevated tank required, which increases cost. • Higher life-cycle cost. • Several miles of access road required to be installed; more challenging to access. • Village does not own land; easement or land acquisition would be required.
Summary of life-cycle cost analysis	• Estimated 30-year life-cycle cost (2023 present value): $5,993,000	• Estimated 30-year life-cycle cost (2023 present value): $17,260,000

Note: Pros and cons rows include non-monetary factors.

If Interconnecting with City of Dunkirk

Table 40 presents a summary table of the feasible disinfection alternatives including major differences, pros and cons, non-monetary factors, and a summary of life-cycle costs. The full life-cycle cost analysis is presented in Appendix J.

Table 40: If Interconnecting with City of Dunkirk: Finished Water Storage Alternatives

Alternative	Construct Small Tank at WTP, Rehab Existing PS, Construct Interconnection PS, Construct Tank in Village at Billy Blvd.	Construct Tank at BOCES, Rehab Existing. PS, Construct Interconnection PS, Construct Tank in Village at Billy Blvd.	Construct Large Tank at WTP, Rehab Existing PS, Construct Interconnection PS
Major Difference(s)	• Three total system tanks. • Water from Dunkirk is first pumped to storage tank after which is enters dist. syst. by gravity.	• Three total system tanks. • Water from Dunkirk is first pumped to storage tank after which is enters dist. syst. by gravity.	• Two total system tanks. • Water from Dunkirk is pumped directly into distribution system.
Pros	• Gravity flow throughout distribution system. • Can optimize pump operation with goal simply to maintain tank level within acceptable range.	• Gravity flow throughout distribution system. • Can optimize pump operation with goal simply to maintain tank level within acceptable range.	• Shorter length of transmission main required from Dunkirk. • One fewer tank relative to other alternatives, thus decreased maintenance. • Lowest life-cycle cost.
Cons	• Higher life-cycle cost. • Three total system tanks. • Possibility for further cost increases to comply with FAA regulations. • Land acquisition required.	• Higher life-cycle cost. • Three total system tanks. • Possibility for further cost increases to comply with FAA regulations. • Land acquisition required.	• Requires pump station to operate continuously.
Summary of life-cycle cost analysis	• Estimated 30-year life-cycle cost (2023 present value): $31,483,000	• Estimated 30-year life-cycle cost (2023 present value): $40,924,000	• Estimated 30-year life-cycle cost (2023 present value): $18,738,000

Note: Pros and cons rows include non-monetary factors.

6.4 Overall Alternatives

Table 41 presents a summary table of the feasible PWS improvement alternatives considered including major differences, pros and cons, non-monetary factors, and a summary of life-cycle costs. The full life-cycle cost analysis is presented in Appendix J.

Table 41: Overall Alternatives

Alternative	Improve Village WTP & Reservoir	Interconnect with City of Dunkirk; Decommission Village WTP & Reservoir	Interconnect with City of Dunkirk; Decommission Village WTP; Drawdown Reservoir for another use
Major Difference(s)	• WTP: Upgrade • Reservoir: Upgrade • Interconnection: None	• WTP: Decommission • Reservoir: Decommission • Interconnection: Construct	• WTP: Decommission • Reservoir: Drawdown • Interconnection: Construct

Pros	• Continued use of existing system and assets, including water supply. • Independent control of PWS including rates • With improvements, may be able to expand service area in future	• Minimizes O&M, admin., and regulatory burden • Eliminates uncertainty related to reservoir & WTP future viability	• Minimizes O&M, admin., and regulatory burden • Eliminates uncertainty related to reservoir & WTP future viability • Reduced cost relative to Alt. 2 • Can beneficially repurpose reservoir
Cons	• Continued reliance on WTP site with challenging constraints • High O&M, admin., and regulatory burden • High cost (short & long-term)	• Complete reliance on Dunkirk for water. • Reduced PWS control • Minimal control over water rates • High cost (short & long-term)	• Complete reliance on Dunkirk Water. • Reduced PWS control • Minimal control over water rates
Summary of life-cycle cost analysis	• Simple annual average total cost over 30-year life-cycle (2023 present value): ○ Total: $5,582,000 ○ Total per EDU: $1,245	• Simple annual average total cost over 30-year life-cycle (2023 present value): ○ Total: $6,882,000 ○ Total per EDU: $1,535	• Simple annual average total cost over 30-year life-cycle (2023 present value): ○ Total: $6,425,000 ○ Total per EDU: $1,433

Note: Pros and cons rows include non-monetary factors.

7.0 RECOMMENDED ALTERNATIVE

Village input is necessary to complete Section 7.0. LaBella will complete it incorporating Village input after Village officials have had the opportunity to review this report.