
TECHNICAL MEMORANDUM

TO: Ms. Marina Fernandes, Mr. Chase Berkeley, Mr. Greg McEntee

CC: John Himlan, P.E., Project Manager

PREPARED BY: Jenna McDonald, P.E., Project Engineer

REVIEWED BY: Zachary Aaronson, P.E., Project Engineer
Todd Prokop, P.E., Technical Manager

DATE: April 14, 2023

RE: Ten Year Capital Improvement Plan Development and Hydraulic Model Update

The Town of Milton, Massachusetts (Town) has been using their existing Ten-Year Capital Improvement Plan (CIP) to replace aging water mains throughout their water distribution system. As the Town has reached the end of their existing CIP, Woodard & Curran, Inc. (Woodard & Curran) provided engineering analysis to develop a new ten-year CIP. The approach included updates to the Town's existing hydraulic model, analysis of tank operations in relation to supplying water to the Blue Hills Ski Resort while incorporating both National Grid's planned utility maintenance and the Town's street paving plans to develop a list of recommended water mains to replace each year for the next ten years. This analysis is outlined in the following memo.

1. HYDRAULIC MODEL UPDATES

1.1 System Overview and Flow Testing

Woodard & Curran received the most current version of the Town's hydraulic model from the Massachusetts Water Resources Authority (MWRA). The model was originally developed by BETA Group in 2014 as part of the systemwide master plan development. As Milton is an MWRA community, the MWRA has been utilizing their model since it was developed. Using record drawings and the list of completed CIP projects, the water mains in the model were updated to reflect recent system improvements.

Woodard & Curran conducted three days of hydrant flow testing and C-factor testing as well as system monitoring via data loggers located across the distribution system. The data collected from the testing and the data loggers were used to update the model to match existing system conditions. After the existing conditions were modeled, pipes that are slated to be replaced in the 2023 and 2024 construction seasons were updated to better reflect the conditions in the distribution system at the start of the new ten-year CIP.

The model was also converted to Infowater Pro to stay current with the software plans of the MWRA.

1.2 Demands

Actual consumption data for Fiscal Years 2021 and 2022 were provided by the Town. This data was then geocoded to allocate demands throughout the model based on the actual location of the water usage. The

existing model had a series of demand patterns applied to the data. It was determined that the water usage in the model appeared to be much higher than actual usage, and that the demand patterns were scaling the overall water usage down by a factor of 0.4 to reduce demand to actual usage. After discussing with MWRA, who stated that they did not set up the scaling patterns, the existing demand pattern was abandoned and instead the model was set up to use actual usage, as reported by Milton, and the standard MWRA diurnal curve.

The existing controls for the MWRA interconnections were not functional. The low-pressure zone receives water from two MWRA connections and has no storage facilities, meaning that water flows through the interconnections continuously. The high-pressure zone has one interconnection and two storage tanks. The interconnection supplies water based on the level of the storage tanks. This control was not properly functioning in the model and as a result the tanks were always filled at the beginning of a simulation and the system would then continue to pull water from the interconnection instead of drawing from the stored water in the tanks, which would therefore remain full. When the controls were set up correctly, the high-pressure zone model results more accurately reflected what was observed in the field during flow testing and the tanks fill and drain as expected.

1.3 Tanks and Blue Hill Ski Resort

Tank elevations and operations were updated based on record drawings and operations summaries provided by the Town. The Town of Milton has an agreement with the Blue Hill Ski Resort that allows the resort to use potable water from the Town for their snow making activities. The Blue Hill Ski Resort is operated by the Massachusetts Department of Conservation and Recreation (DCR). The Town is paid a wheeling fee for the amount of water used, but the full fee for the water is paid by DCR directly to MWRA. The resort property is located adjacent to the Blue Hill Storage Tank. As such, the Blue Hill Ski Resort draws water directly from the transmission line to the tank for their snow making needs.

A summary of the historic water usage by the Blue Hill Ski Resort during snow making was provided by the Town. The Blue Hill Ski Resort operators and the Water Department operators have a verbal agreement that the snow will only be made during overnight hours for only a period that keeps the water level in the adjacent tank above 10 feet. The Town reports that ski area operators are able to monitor the water level in the tank, and throttle flow as necessary to maintain the level above 10 feet. The ski area operators also provide advanced warning of planned snow making activities, which allows the Town to fill the tank prior to the start of operations. The historical usage by the Blue Hill Ski Resort was reviewed and an average usage was applied to the location of the resort's connection to the water system. A separate demand pattern was used for this demand to represent the usage during overnight hours.

2. CAPITAL IMPROVEMENT PLAN DEVELOPMENT

2.1 Ten Year Recommendation List

The 10-Year Recommendation List for the Town's new CIP was developed by looking at several factors: water main material, available fire flow, break history, pavement condition, other utility replacement needs, and proximity to other improvements. System maps that show water main material, available fire flow, and break history for the years 2021 and 2022 are included with this memo. The initial list of recommended improvements was developed looking at these three characteristics of the water mains. Recommendations were grouped by year, starting in 2025, for an approximate length of 3,000 to 4,500 linear feet of water main to replace. This length was based on water main projects listed in the Town's previous CIP.

This list was reviewed with the Town in November 2022. At this meeting it was discussed that the recommended improvements should also take into consideration streets that National Grid was targeting for utility upgrades and the condition of the existing roadway pavement. These considerations would aim to minimize the number of times a roadway was excavated and avoid areas where the roadway was recently paved. The Town also provided streets that they would like to see the water main replaced on that Woodard & Curran had previously not included based on the evaluation criteria.

The list was revised based on the Town's comments. In filling out each year's set of recommendations, Woodard & Curran also took into account the proximity of the recommendations to each other in an attempt to minimize multiple years' worth of disruption to one neighborhood. The new 10-Year CIP Recommendations List is included with this memo as both a table with estimated construction costs and a system map with the recommended improvements highlighted. Construction costs were estimated using 2022 average bid prices for recent projects in Milton and include only costs for the construction itself and a 20% contingency.

2.2 Large-scale Projects for Overall Improved Flow

The Town expressed an interest in pursuing projects that would improve the overall flow to the High-Pressure Zone both for the limited flow that is seen along Hillside Street, which is a dead end, and to the Blue Hill Ski Resort. After reviewing the hydraulic conditions and available fire flow in these areas, Woodard & Curran determined that large-scale improvements would be needed in order to significantly increase flow to these areas. These projects were included with the 10-year recommendation list as two separate items that would not be included in the annual budget for the Town's water main improvements.

Project A would increase the diameter of the water mains on Brush Hill Road and a short section of Blue Hill Avenue from the MWRA interconnection to the Blue Hill Storage Tank main. This would provide a redundant 12-inch main for the Blue Hill Ski Resort and increase the overall flow to the area while reducing the strain on the existing 12-inch Blue Hill Avenue main. This main has been prone to breaks and is under high stress from the existing demands in the area and the Blue Hill Ski Resort.

Project B would eliminate the two dead ends of the High-Pressure Zone by re-connecting the 12-inch water main on Blue Hill Avenue to the 8-inch water main on Hillside Street. This connecting loop existed previously in the system as part of an interconnection with Canton but was decommissioned when Canton separated their system from Milton's. Rebuilding this loop would provide a secondary feed to the Blue Hill Ski Resort

and eliminate the dead end on Hillside Street that sees low flows due to being at the far end of the distribution system with only one feed. This proposed project would occur largely outside of Milton, within state roadways under the jurisdiction of the Massachusetts Department of Transportation (MassDOT) and DCR.

Attachments: Ten Year CIP Recommendations Table

Milton System Map of Water Main Materials
Milton System Map of Available Fire Flow
Milton System Map of Break History
Ten Year CIP Recommendations Map
Large Scale Recommendations Map

TABLE

Town of Milton, MA
10-Year Capital Improvement Plan

Year	Street Name	Limits		Pipe Diameter (in.)	Material	Installation Year	Length (ft)	New Pipe Diameter (in.)	Project Costs	Notes
		From	To							
2025	Pagoda St/Cir	Route 138	Hudson St	41.02 6-inch	Cast Iron	1912,1915, 1942	800 8-inch	\$ 360,000.00	Replaces cast iron main in an area with low AFF	
	Essex Road	Blue Hill Terrace	Crown St	73.31 6-inch	Cast Iron	1912, 1925	400 8-inch	\$ 180,000.00	Replaces old cast iron main; Coordinate with Blue Hill Terrace 2035	
	Crown St	Essex Road	Blue Hill Terrace	60.24 6-inch	Cast Iron	1925	500 8-inch	\$ 225,000.00	Replaces old cast iron main; Coordinate with Blue Hill Terrace 2035	
	Pagoda St	Ferncroft Rd	End	54.05 6-inch	CICL	1929	450 8-inch	\$ 203,000.00	Replaces old, small diameter main in an area with low AFF	
	Ferncroft Road	Truro Lane	Blue Hill Terrace	44.4 6-inch	Cast Iron	1912, 1929	1300 8-inch	\$ 585,000.00	Replaces cast iron main in an area with low AFF; Coordinate with Blue Hill Terrace 2035	
	Aberdeen Road	Brush Hill Road	Blue Hill Road	72.65 6-inch	Cast Iron	1917	950 8-inch	\$ 428,000.00	Replaces cast iron main; National Grid performing work 2023	
				55.30			4400	\$ 1,981,000.00		
2026	Parkway Cres	Blue Hills Pkwy	Parkway Cres	53.93 6-inch, 8-inch	CICL	1925	400 8-inch	\$ 180,000.00	Replaces old, small diameter main in an area with low AFF	
	NE Parkway Cres	Parkway Crews	river	53.93 6-inch	CICL	1925	250 8-inch	\$ 113,000.00	Replaces old, small diameter main in an area with low AFF	
	Meagher Ave	Audubon Road	river	60.73 6-inch	Cast Iron	1924	600 8-inch	\$ 270,000.00	Replaces cast iron main, in an area with low AFF	
	Weston St	Meagher Ave	End	65.71 6-inch	Cast Iron	1924	200 8-inch	\$ 90,000.00	Replaces cast iron main, in an area with low AFF	
	Waldo Road	Eliot St	End	52.56 6-inch	CICL	1931	400 8-inch	\$ 180,000.00	Replaces cast iron main	
	Cantwell Road	Eliot St	End	36.56 6-inch	Cast Iron	1915	500 8-inch	\$ 225,000.00	Replaces cast iron main	
	Pond Street	Pierce St	End	6-inch	CICL	850 8-inch	\$ 383,000.00	Added by Water Department as priority replacement		
				48.03			4250	\$ 1,913,000.00		
2027	Morton Terrace	Morton Road	End	34.58 6-inch	CICL	1939	450 8-inch	\$ 203,000.00	Replaces old, small diameter main in an area with low AFF	
	Morton Road	Eliot St	Canton Ave	38.74 6-inch	Cast Iron	1912	1350 8-inch	\$ 608,000.00	Replaces cast iron main	
	Brook Hill Road	Eliot St	Canton Ave	35.05 6-inch	Cast Iron	1912	1450 8-inch	\$ 653,000.00	Replaces cast iron main	
	West Side Road	Brook Hill Road	Cross country main	43.45 6-inch	Cast Iron	1912	700 8-inch	\$ 315,000.00	Replaces cast iron main	
	Brookside Park	Brook Hill Road	End	25.56 6-inch	CICL	1924	250 8-inch	\$ 113,000.00	Replaces old, small diameter main in an area with low AFF	
				37.02			4200 8-inch	\$ 1,892,000.00		
2028	Ridge Road	Brook Road	Hinckley Road	43.67 8-inch	Cast Iron	1924	950 8-inch	\$ 428,000.00	Replaces cast iron main	
	Brandon Road	Brook Road	Hinckley Road	50.56 6-inch	Cast Iron	1924	800 8-inch	\$ 360,000.00	Replaces cast iron main	
	Fairfax Road	Brook Road	Hinckley Road	49.36 6-inch	Cast Iron	1924	750 8-inch	\$ 338,000.00	Replaces cast iron main	
	West St	Blue Hills Pkwy	Laurel Rd	47.58 6-inch	Cast Iron	1916	550 8-inch	\$ 248,000.00	Replaces cast iron main, in an area with low AFF	
				47.58			3050	\$ 1,374,000.00		
2029	Windsor Road	Brook Road	Hinckley Road	63.56 8-inch	Cast Iron	1926	950 8-inch	\$ 428,000.00	Replaces cast iron main	
	Standish Road	Brook Road	Central Ave	67.71 6-inch	Cast Iron	1912	1900 8-inch	\$ 855,000.00	Replaces cast iron main	
	Greenleaf Road	Windsor Road	Standish Road	28.56 6-inch	Cast Iron	1926	350 8-inch	\$ 158,000.00	Replaces cast iron main	
	Allerton Road	Hinkley Road	Central Ave	53.27 6-inch	Cast Iron	1912	1150 8-inch	\$ 518,000.00	Replaces cast iron main	
				59.84			4350	\$ 1,959,000.00		
2030	Park St	Canton Ave	End	37.87 6-inch	Cast Iron	1912	900 8-inch	\$ 405,000.00	Replaces cast iron main in area with known breaks and low AFF	
	Frothingham St	Brook Road	Canton Ave	56.56 6-inch	Cast Iron	1912	1000 8-inch	\$ 450,000.00	Replaces cast iron main in an area with low AFF	
	Thompson/Lantern Lane	Canton Ave	Brook Road	6-inch	CICL	1931&1935	1700 8-inch	\$ 765,000.00	Added by Water Department as priority replacement	
	Woodland Road	Stone Bridge Lane	End	68.09 6-inch	Cast Iron	1965	1500 8-inch	\$ 675,000.00	Replaces cast iron main in an area with low AFF	
				56.70			5100	\$ 2,295,000.00		
2031	Cliff Road	Eliot St	End	42.2 6-inch	Cast Iron & CICL	1924	1900 8-inch	\$ 855,000.00	Replaces cast iron main	
	Sheldon St	State St	End	23.71 6-inch	Cast Iron	1912, 1930	850 8-inch	\$ 383,000.00	Replaces cast iron main in an area with low AFF	
	Plymouth Ave	State St	End	75.15 6-inch	Cast Iron	1915	1000 8-inch	\$ 450,000.00	Replaces cast iron main in an area with low AFF	
	Alden Rd	Plymouth Ave	Grafton Ave	6-inch	Cast Iron	1916	300 8-inch	\$ 135,000.00	Replaces cast iron main in an area with low AFF	
	Mathaurs St	Pleasant St	Clay St	58.66 6-inch	Cast Iron	1913, 1935	900 8-inch	\$ 405,000.00	Replaces cast iron main in an area with low AFF	
				49.09			5850	\$ 2,228,000.00		
2032	Meredith Circle	Route 28	Route 28	57.59 6-inch	Cast Iron	1923	1400 8-inch	\$ 630,000.00	Replaces cast iron main in an area with low AFF	
	Buckingham Road	Reesdale Rd	Highland St	55.59 6-inch	Cast Iron	1912, 1936	1200 8-inch	\$ 540,000.00	Replaces old, small diameter main in an area with low AFF	
	Orchard Road	Pleasant St	End	55.55 6-inch	Cast Iron	1929, 1942, 1948	650 8-inch	\$ 293,000.00	Replaces cast iron main in an area with low AFF	
	Cross country behind Vinewood	Murray Ave	End	6-inch	Cast Iron	1912	1100 8-inch	\$ 495,000.00	Replaces cast iron main in an area with low AFF	
				56.44			4350	\$ 1,958,000.00		
2033	Wendell Park	Canton Ave	Manning Ln	61.5 6-inch	CICL	1927	2000 8-inch	\$ 900,000.00	Replaces old, small diameter main in an area with low AFF	
	Holmes Lane	Canton Ave	End	6-inch	CICL	1930	350 8-inch	\$ 158,000.00	Replaces old, small diameter main in an area with low AFF	
	Dudley Ln	Brook Road	Adam St	8-inch	Cast Iron	1917, 1923	1000 8-inch	\$ 450,000.00	Replaces cast iron main	
	Lincoln St	Thacher St	Brook Road	59.56 6-inch	Cast Iron	1912	800 8-inch	\$ 360,000.00	Replaces cast iron main	
				60.95			4150	\$ 1,868,000.00		
2034	School St	Canton Ave	Randolph Ave	92.56 6-inch	Cast Iron	1912	1200 8-inch	\$ 540,000.00	Replaces cast iron main in an area with known breaks	
	Blue Hill Terrace	Route 138	Blue Hills Parkway	93.34 6-inch	Cast Iron	1912	1300 8-inch	\$ 585,000.00	Replaces cast iron main in an area with low AFF	
	Dana Ave	Brush Hill Road	Town Line	93.34 6-inch	Cast Iron	1912	550 8-inch	\$ 248,000.00	Replaces cast iron main in an area with low AFF	
	Fairmount Ave	Brush Hill Road	Town Line	93.34 6-inch	Cast Iron	1914	550 8-inch	\$ 248,000.00	Replaces cast iron main in an area with low AFF	
	Tucker St	Brush Hill Road	Blue Hill Road	89.65 6-inch	Cast Iron	1914	750 8-inch	\$ 338,000.00	Replaces cast iron main	
				92.49			4350	\$ 1,959,000.00		

Total miles replaced: 13.3

Town of Milton, MA
10-Year Capital Improvement Plan

Year	Street Name	From	To	Pipe Diameter		Material	Installation Year	Length (ft)	New Pipe Diameter (in.)	Project Costs	Notes
				RSR	(in.)						
Project A	Brush Hill	Meter	Bradlee Road	53.62	10-inch	CLCI	1934	2850	12-inch		
	Brush Hill	Bradlee Road	Blue Hill Ave	52.26	8-inch	CLCI	1932	9150	12-inch		
	Blue Hill Ave	Brush Hill	Tank		6-inch	Cast Iron	1912	1650	16-inch		
				Total				13650		\$ 9,566,000.00	
Project B	Route 138	Town Line	Blue Hill River Rd		12-inch (abando DI		1995	3000	12-inch		
	Blue Hill River Road	Route 138	Hillside St at Town Line	54.64	12-inch (abando DI		1995	4000	12-inch		
					Total			7000		\$ 5,250,000.00	

Total miles replaced: 3.9

MAPS

Existing Cast Iron Pipes
Milton, MA
Capital Improvement Plan



Legend

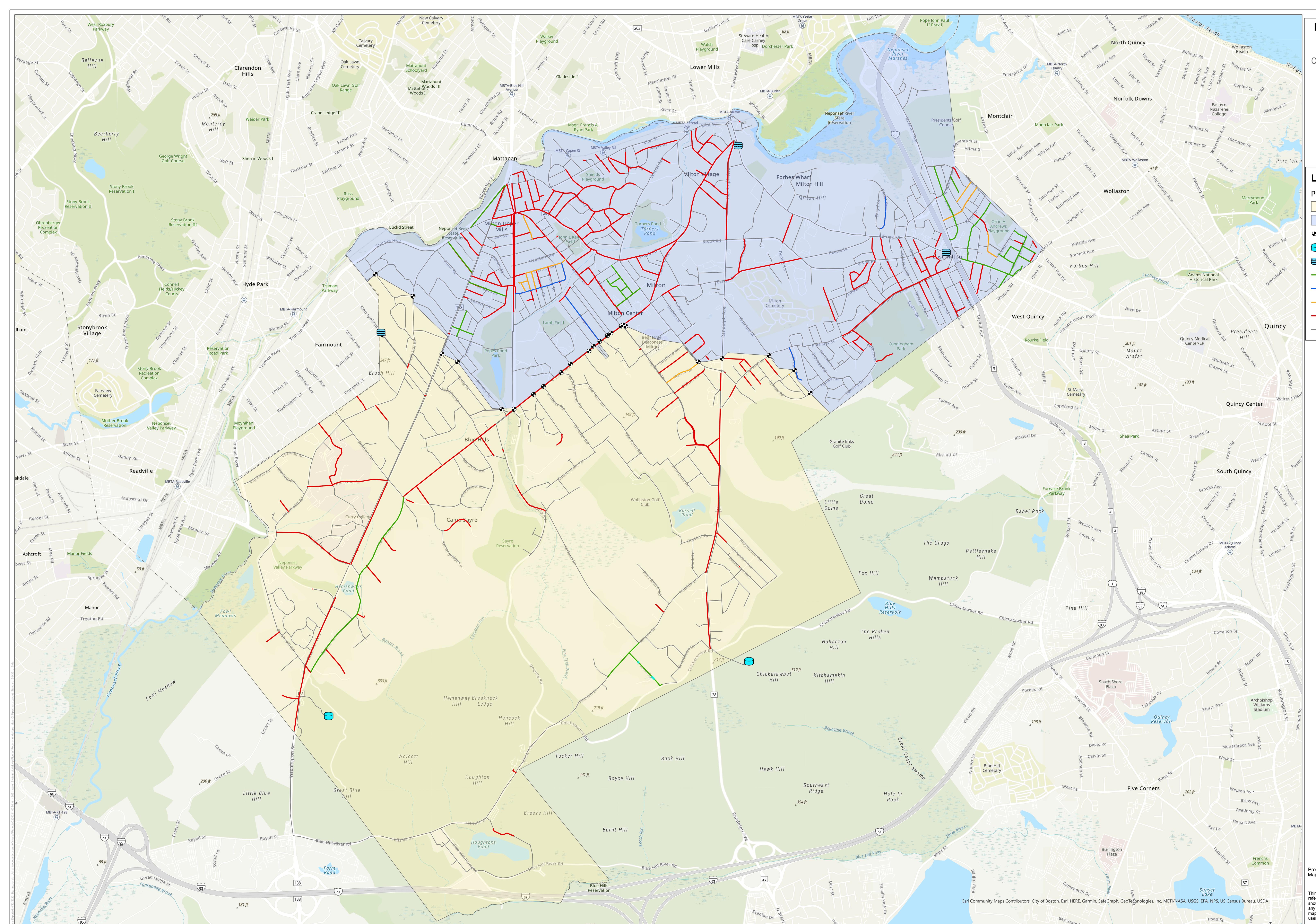
Pressure Zone
HIGH
LOW
● Boundary Valve
■ Tank
■ Interconnection
— Replaced Between 2015 - 2022
— Planned for Replacement in 2023
— Planned for Replacement in 2024
— Cast Iron
— Water Main

0 312.5 625
1.250
Feet
1 inch equals 1,250 ft



Project #: 0234291.00
Map Created: April 2023

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Available Fire Flow

Milton, MA
Capital Improvement Plan



Legend

Pressure Zone

HIGH
LOW

Water Main Diameter

- 4-inch and smaller
- 6
- 8
- 10
- 12
- 16
- 20
- Boundary Valve
- Tank
- Interconnection

Available Fire Flow

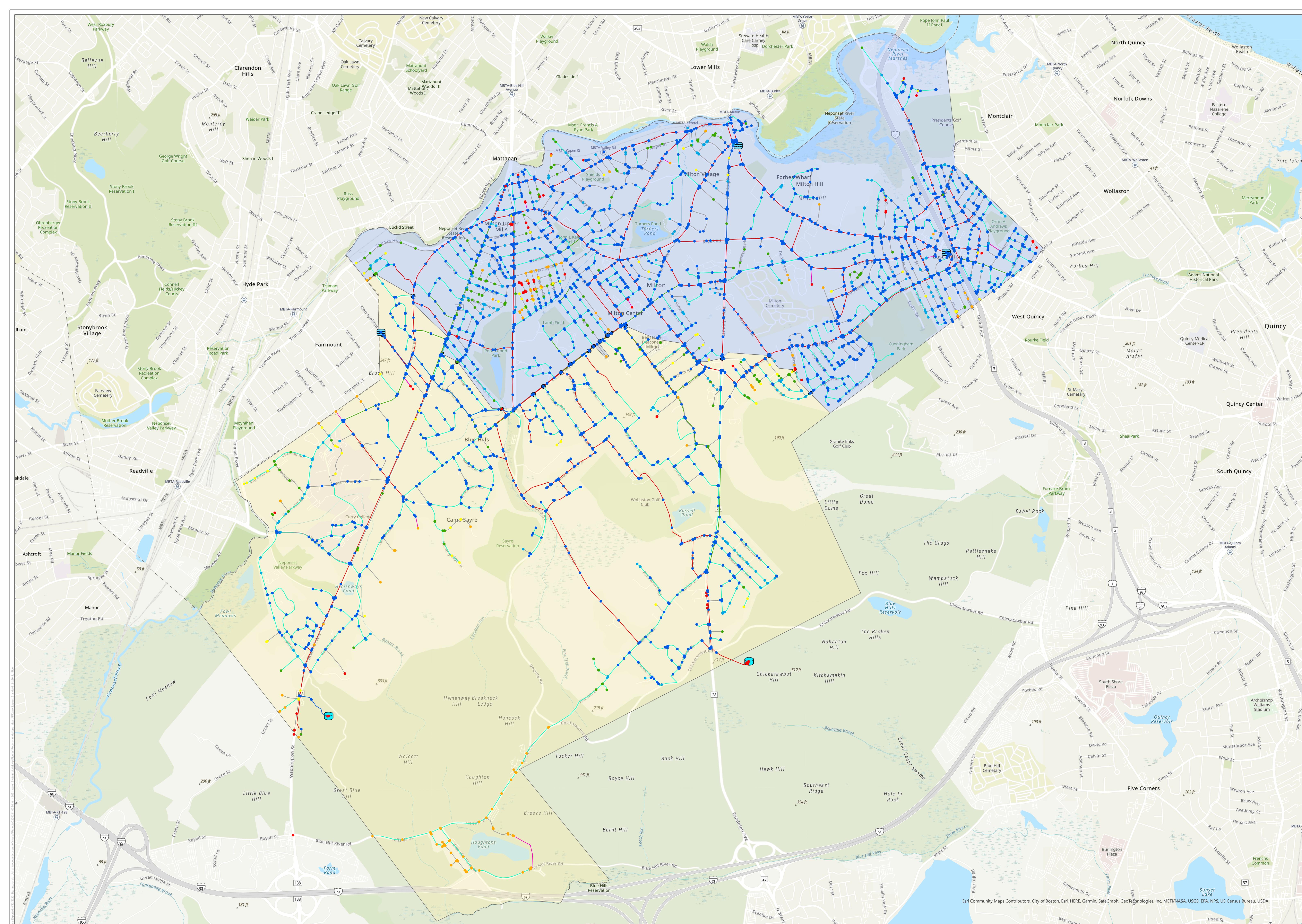
- Less than 500 GPM
- 500 - 999 GPM
- 1000 - 1499 GPM
- 1500 - 1999 GPM
- 2000 - 2499 GPM
- Greater than 2500 GPM

0 312.5 625
1.250
1 inch equals 1,250 ft



Project #: 0234291.00
Map Created: April 2023

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System Recommendations

Milton, MA
Capital Improvement Plan



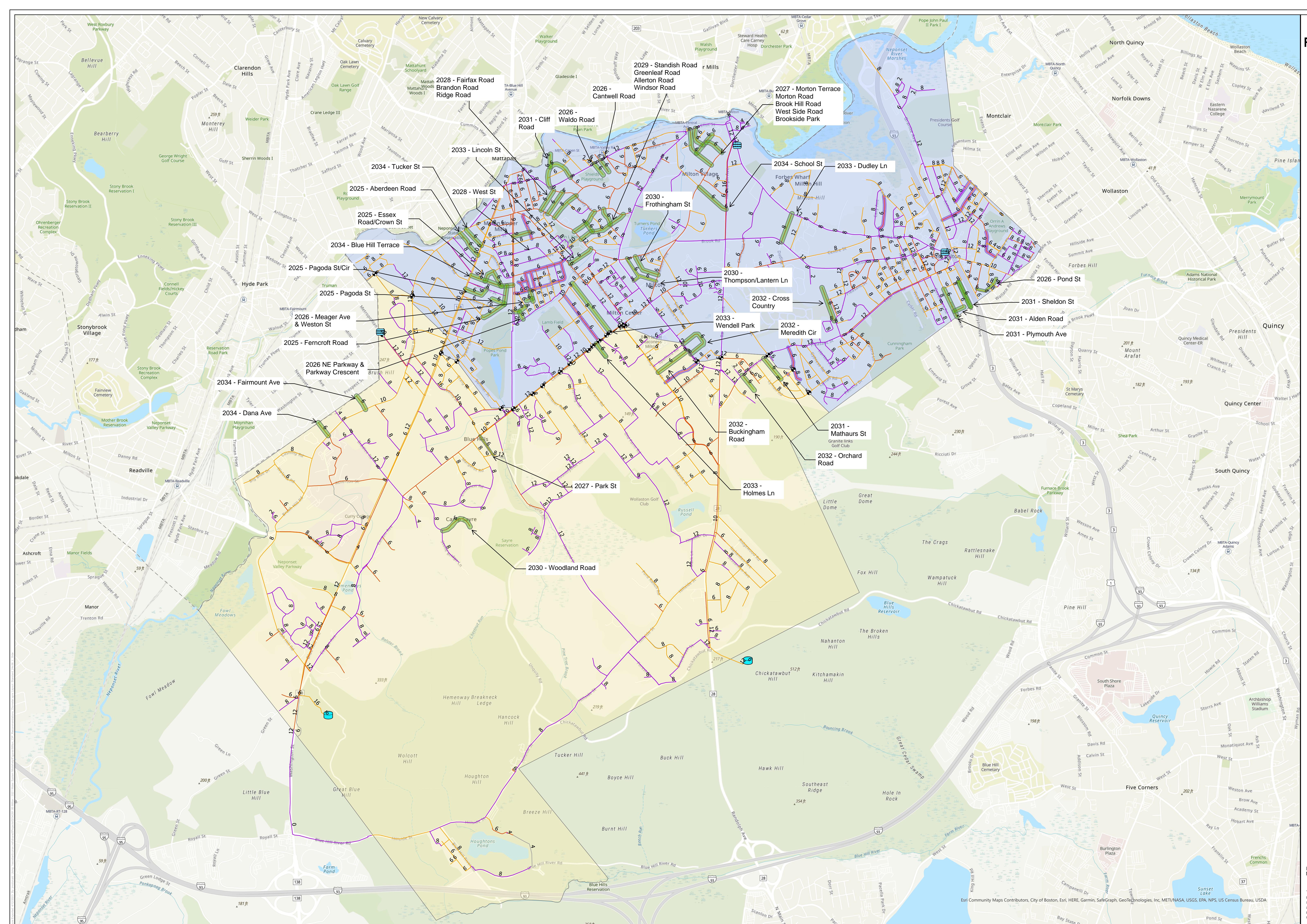
Legend

- Boundary Valve
- Tank
- Interconnection
- Water Main Material
 - Cast Iron
 - CICL
 - Ductile Iron
 - 2023 - 2024 Replacements
- CIP Recommendations
- Pressure Zone
 - HIGH
 - LOW

0 312.5 625
1.250
1 inch equals 1,250 ft


Project #: 0234291.00
Map Created: April 2023

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System Recommendations
Milton, MA
Capital Improvement Plan

Legend

- Boundary Valve
- Tank
- Interconnection
- Water Main Material
 - Cast Iron
 - CICL
 - Ductile Iron
- Large Scale Projects
- Pressure Zone
 - HIGH
 - LOW

Woodard & Curran

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