TOWN OF FALMOUTH, MAINE

Long Term Replacement Options

SEPTEMBER 2023

Mill Creek Interceptor

WRIGHT-PIERCE
Engineering a Better Environment

Mill Creek Interceptor
Long Term Replacement Options
Town of Falmouth, Maine

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Table of Contents

List of Appendices

List of Figures

List of Tables

4

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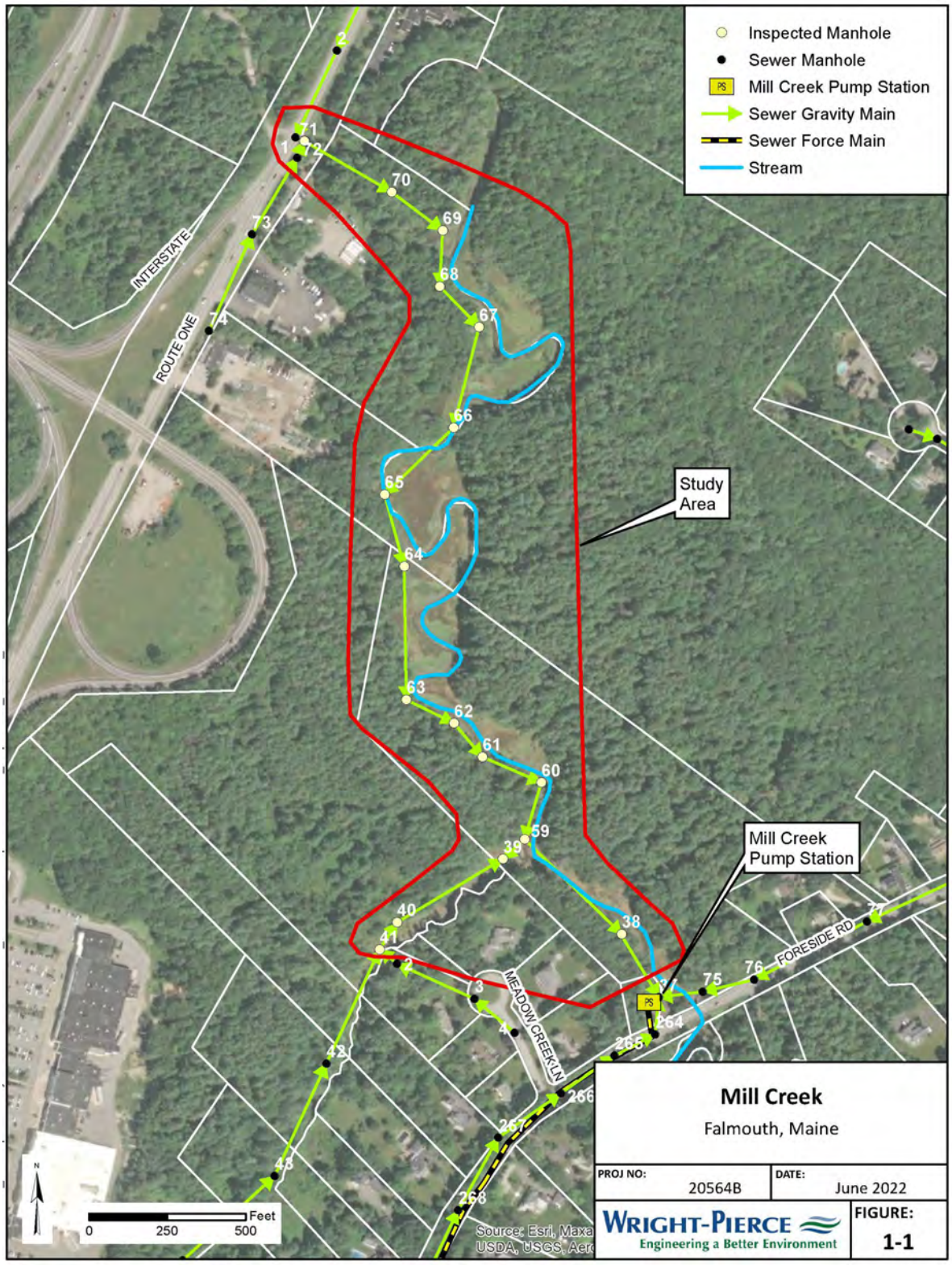
Section 1 Introduction

1.1 General

The Mill Creek Sewer Interceptor (MCI) was constructed in 1969 and runs alongside Mill Creek in eastern Falmouth from Route 1 to the Mill Creek Pump Station (MCPS). This interceptor was part of the original construction of wastewater infrastructure in eastern Falmouth, including several pump stations and the wastewater treatment facility. This interceptor serves the northern area of Route 1 from approximately Gnome Landscaping in Falmouth to Ledgeview Assisted Living in Cumberland, including flows from the Johnson Road Pump Station (JRPS) and Northbrook Drive Pump Station (NDPS). The interceptor has very limited access for maintenance and repairs and has several manholes that are located close to the edge of the eroding bank along the tidal creek. Wright-Pierce recently completed an Immediate Needs Study on this interceptor that evaluated the gravity interceptor, its manholes. and the associated risk, see Figure 1-1 below. The study also outlined actions for addressing the MCI in the short-term which include monitoring by the Town as part of its O&M program to regularly check the at-risk area manholes for additional erosion. The MCI Immediate Needs Study is included as Appendix A of this report.

In lieu of a short-term fix that would involve installing an expensive access corridor to move an at-risk manhole further away from the creek and armor the bank, the Town has elected to immediately move forward with this study that evaluates the long-term replacement options for the MCI. Following completion of the long-term options study, the Town may choose to proceed with design and construction of the recommended long-term solution to alleviate both the short-term risks associated with problem areas along the MCI as well as address the long-term needs of the Town to convey flows from the Route 1 area of Falmouth and Cumberland to the Wastewater Treatment Facility.

Figure 1-1 MCI Immediate Needs Study Area



1.2 Study Area

Wright-Pierce met with the Town to pre-screen several alternatives to address the MCI. The alternatives selected for further evaluation are listed below and are analyzed in detail in Section 2.

- Alternative 1A – Do Nothing:
  Leaving the MCI in place along Mill Creek with sewer flow continuing through the interceptor.

- Alternative 1B – Maintain Existing MCI:
  Completing the construction outlined in the Immediate Needs Study. Moving SMH 65 further away from the creek and armoring the bank around SMH 65 and SMH 66.

- Alternative 2 – Route 1 to Webes Creek:
  New pump station on Route 1 at Mill Creek that directs flow south along Route 1 to Depot Road, east on Depot Road, then north through the existing Webes Creek Interceptor to the MCPS.

- Alternative 3A – Johnson Road to Foreside Road:
  New pump station on Route 1 at Mill Creek that direct flow north up Route 1 to Johnson Road, then east along Johnson Road, then down Foreside Road to the MCPS.

- Alternative 3B – Remove Johnson Road Pump Station:
  Eliminate JRPS by installing deep gravity sewer south on Route 1 directing flows to a new UMCPS on Route 1 at Mill Creek. New pump station would direct flow along same route as alternative 3A.

- Alternative 3C – Route 1 to JRPS:
  Smaller new pump station on Route 1 at Mill Creek directing flow to a new, larger capacity JRPS. JRPS would then direct flow east on Johnson Road then south down Foreside Road to MCPS.

- Alternative 4A – Route 1 to Lunt Road Pump Station (LRPS) via Depot Road and Lunt Road:
  New pump station on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1 to Depot Road then west on Depot Road and Lunt Road to the LRPS.

- Alternative 4B – Route 1 to LRPS via Cross-Country:
  New pump station on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1, then behind the commercial shops on the west side of Route 1, then west onto Lunt Road to the LRPS.

- Alternative 4C – Route 1 to LRPS via Bucknam, Legion, Depot, and Lunt Roads:
  New pump station on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1, then west onto Bucknam Road, then south on Legion and Depot Roads, then west onto Lunt Road to the LRPS.

- Alternative 5 – Wye into Mill Creek Force Main:
  New pump station on Route 1 at Mill Creek that directs pumped flow south along Route 1, east on Depot Road, south on Hat Trick Drive to Clearwater Drive, where the new force main would wye into existing MCPS force main.

For the purpose of this report the new pump station on Route 1 will be called the 'Upper Mill Creek Pump Station' (UMCPS). Considering long-term planning in east Falmouth, this study will also include commentary and costs for upgrades to the Lunt Road Pump Station (LRPS) and Johnson Road Pump Station (JRPS). The West Falmouth Sewer Master Plan (WFSMP) recommended an upgrade to LRPS to accommodate future flows from west Falmouth. Alternatives 4A, 4B, or 4C of this study convey flow to LRPS and would therefore increase the overall design capacity of the LRPS. Therefore, the report includes cost for each alternative listed above as well as a separate planning level cost for upgrading the LRPS based on the recommended capacity from the WFSMP (in alternatives 1, 2, 3A, 3B, 3C, and 5) and for the increased capacity to include flows from a new pump station on Route 1 (in alternatives 4A/B/C). Additionally, since flow to the new UMCPS is highly dependent on sewered flows from the JRPS, this study includes a separate planning level costs for upgrading JRPS to the future build-out capacity in its sewer shed, or eliminating that pump station altogether.

2

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Section 2 Evaluation of Alternatives

The Town and Wright-Pierce completed a site walk on 11/29/2021 to evaluate the force main routes detailed in Section 1.2 above. Each alternative route was fine-tuned and the extent of force main along each route and the transition location to gravity sewer was discussed. The Town prefers to avoid cross-country lines that have limited access due to maintenance concerns and the need for access roads.

2.1 Flow Analysis

Flow through the MCI has not previously been measured. The MCPS was upgraded in 2018 and flow from Cumberland and Falmouth was analyzed during design of that upgrade. Based on the MCPS flow analysis and flow data from the JRPS and Northbrook Drive Pump Station (NDPS), flow through the MCI was estimated for this study, see the flow breakdown below and Appendix B for more information. This estimate was used as the basis for sizing the proposed UMCPS and force main, and determining the hydraulic impact on existing gravity sewers that would receive the additional flow. Future flow estimates for residential developments matched the methodology used in the 2017 West Falmouth Sewer Master Plan.

Table 2-1 Current vs Projected Future Flow Breakdown

	Current Flows		Sewered Growth		Design Peak Flow	Current Capacity
	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (MGD)	Peak Flow (MGD)	Peak Flow (MGD)	Peak Flow (MGD)
JRPS[1]	0.048	0.285	0.098	0.614	0.899	0.450
NDPS[2]	0.010	0.060	0.012	0.075	0.135	0.17 / 0.24
Gravity Flow	0.026	0.154	-	-	0.154	-
Infiltration & Inflow[3]	-	0.020	-	-	0.020	-
Mill Creek Interceptor	**-**	**0.52**	**-**	**-**	**1.21**	**1.74**
Mill Creek Pump Station[4]	-	2.63	-	1.55	4.18	4.18

Notes:

1. The future design flow projection for JRPS is 0.90 MGD (~625 GPM). Drawdown tests completed by the Town in November 2021 showed the pumps are capable of pumping 0.45 MGD (315 GPM) each.
2. Future design flow projection for Northbrook Drive Pump Station is 0.13 MGD (100 GPM). Drawdown tests completed by the Town in January 2022 showed the pumps are capable of pumping at least 0.24 MGD (170 GPM), which is more than the station was designed for at 0.17 MGD (120 GPM).
3. Estimated peak I/I in the gravity sewer area feeding the MCI is based on 4,000 gpd per inch-mile for 3,250-feet of 8-inch gravity sewer.
4. MCPS current flow based on data based on the Mill Creek Pump Station Upgrade Preliminary Design – Existing and Future Flows Memorandum dated April 15, 2015.

An upgrade to JRPS and force main would be required to meet the future design flow projection. The pump station would be upgraded to a submersible 0.90-MGD (~625 GPM) station and the 4-inch, 1,150-foot force main would be upsized to an 8-inch force main to handle future flows. However, no upgrade to the NDPS is required to meet the future design flow projection as the pump station capacity exceeds peak design flow projections.

Total peak hourly flow for the MCI is estimated at 1.21 MGD (~839 GPM), therefore the design capacity of a new UMCPS would be 1.21 MGD to handle current peak as well as projected sewered growth in the area.

It should be noted that these future build out flows used to size a new pump station are significantly higher than the expected current peak hourly flow through the MCI. The Town should closely consider whether a new pump station and force main should be sized for the full future flow projections or include a lesser allowance for future growth. Anecdotally, for stations and force mains sized for between 300 and 900 GPM, there is not a large incremental cost difference, so it is generally cost effective to size a pump station and force main for the more conservative flow estimates to avoid the need for another upgrade in a short period of time.

2.2 Johnson Road Pump Station Capacity Assessment

As part of the Mill Creek Interceptor Long Term Replacement Options Study the JRPS capacity was evaluated. Past evaluation reports for the JRPS including the March 2015 report by Sevee & Maher and the July 2009 CPSA report by Wright-Pierce were reviewed and analyzed against recent pump run time data provided by the Town.

JRPS accepts gravity flow from portions of Johnson Road, several side streets off Johnson Road, and flow from Route 1 north of Johnson Road, including flow from Cumberland. It pumps to the gravity sewer in Route 1 via a 4-inch diameter, 1150-foot-long force main which eventually flows to Mill Creek Pump Station via the Mill Creek Interceptor. The sewer users in the drainage area are characterized as residential and commercial.

Existing JRPS weekly pump run times from January 2020 through November 2022 were evaluated to determine current flow conditions. The existing pumps are sized for 315 GPM and the Town completed a pump drawdown test on both pumps to verify the flow rate. The drawdown test resulted in flow rates of 313.7 GPM for both pumps. Based on the average hourly flow data provided by the Town and the pump drawdown test results the average hourly flow for the pump station is 33 GPM. A peaking factor of 6 was used to estimate the existing peak flow of 198 GPM.

Projected future flow conditions are summarized in Appendix B. Significant growth is anticipated in the area and the future design hourly flow for JRPS was determined to be 624.5 GPM. This projected future flow rate requires upgrades to the existing wetwell, pumps, and forcemain to accommodate the additional flow. The full JRPS Capacity Assessment memo is included in Appendix D.

2.3 Pump Station Location Selection

During the site walk the pump station location selection was discussed. There was consensus that tax lot U53-002 (Saint Falmouth LLC), west of Route 1 and north of Adams and Fogg, would be the ideal location for the proposed pump station. It is located at the head of Mill Creek adjacent to where the gravity sewer lines from both north and south along Route 1 converge before directing flow down the Mill Creek Interceptor. This location will require limited gravity sewer alterations. The cost of those gravity sewer alterations is covered in alternatives 2 thru 5 as part of the pump station civil costs. A property easement or land purchase would be required for this location. The cost for procurement of this property was not included in the cost estimate.

2.4 Pump Station Design Details

The pump station pumps, wet well, and force main will be sized to handle 1.21 MGD (~839 GPM). The recommended flow velocity in a sewer force main is 3 to 5 ft/s. As will be discussed later in this section, each of the force main alternatives is over 4,500-feet in length. That makes friction head a major consideration when sizing the force main and a flow rate of around 3 ft/s is preferred to reduce the overall head in the system. Therefore, the force main was sized to hit a flow velocity of around 3 ft/s at the design point of 1.21 MGD (~839 GPM). The recommended force main size for the new pump station is a 10-inch HDPE IPS SDR 17 pipe.

The pump station will be a submersible non-clog type station with two pumps in a lead-lag configuration similar to the soon to be upgraded Falmouth Road Pump Station. Pump horsepower (HP) varies for the alternatives based on their specific hydraulic conditions of each alternative. A 10-foot diameter precast concrete circular wet well and precast concrete valve pit will be installed with exterior mounted controls. The wet well will have a minimum capacity of 4,200 gallons. The station will be equipped with a backup generator and include a paved access drive from Route 1.

The various force main alternatives considered are shown on Figure 2-1 and Figure 2-2. The UMCPS location is show with the green symbol, and there are 7 different force main routes from the UMCPS as discussed below shown in solid colored lines.

Figure 2-1 Force Main Alternatives

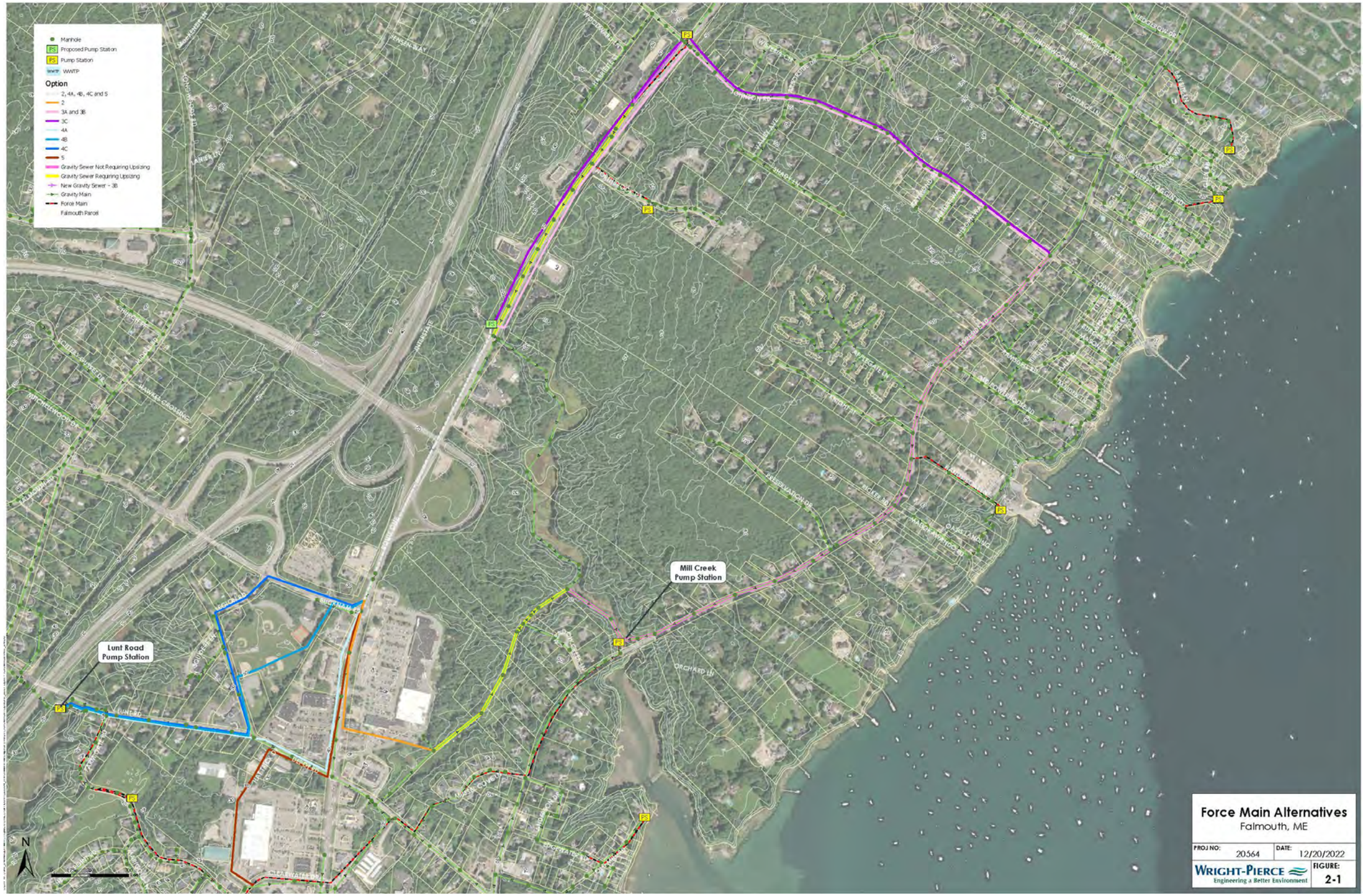


Figure 2-2 Force Main Alternatives Zoomed in View

2.5 Alternative 1A – Do Nothing

Leaving the MCI in place along Mill Creek with flow continuing through the interceptor and monitoring at-risk areas for additional erosion is not a viable long-term solution. Eventually erosion will compromise one of the at-risk manholes and result in a sanitary sewer overflow (SSO) and emergency repair. This alternative is not desired by the Town and was not considered for further evaluation.

2.6 Alternative 1B – Maintain Existing MCI

Completing the construction outlined in the Immediate Needs Study, moving SMH-65 further away from the creek and armoring the bank for both SMH-65 and SMH-66, meets the immediate needs of the interceptor but does not meet address the Town's maintenance access issues. The Town's preference is to completely replace the interceptor with a new pump station and force main in a more accessible area. This alternative was not considered for further evaluation in this study. For reference, the total project cost estimate of this alternative was $428,000 in June of 2021 (ENR 12112).

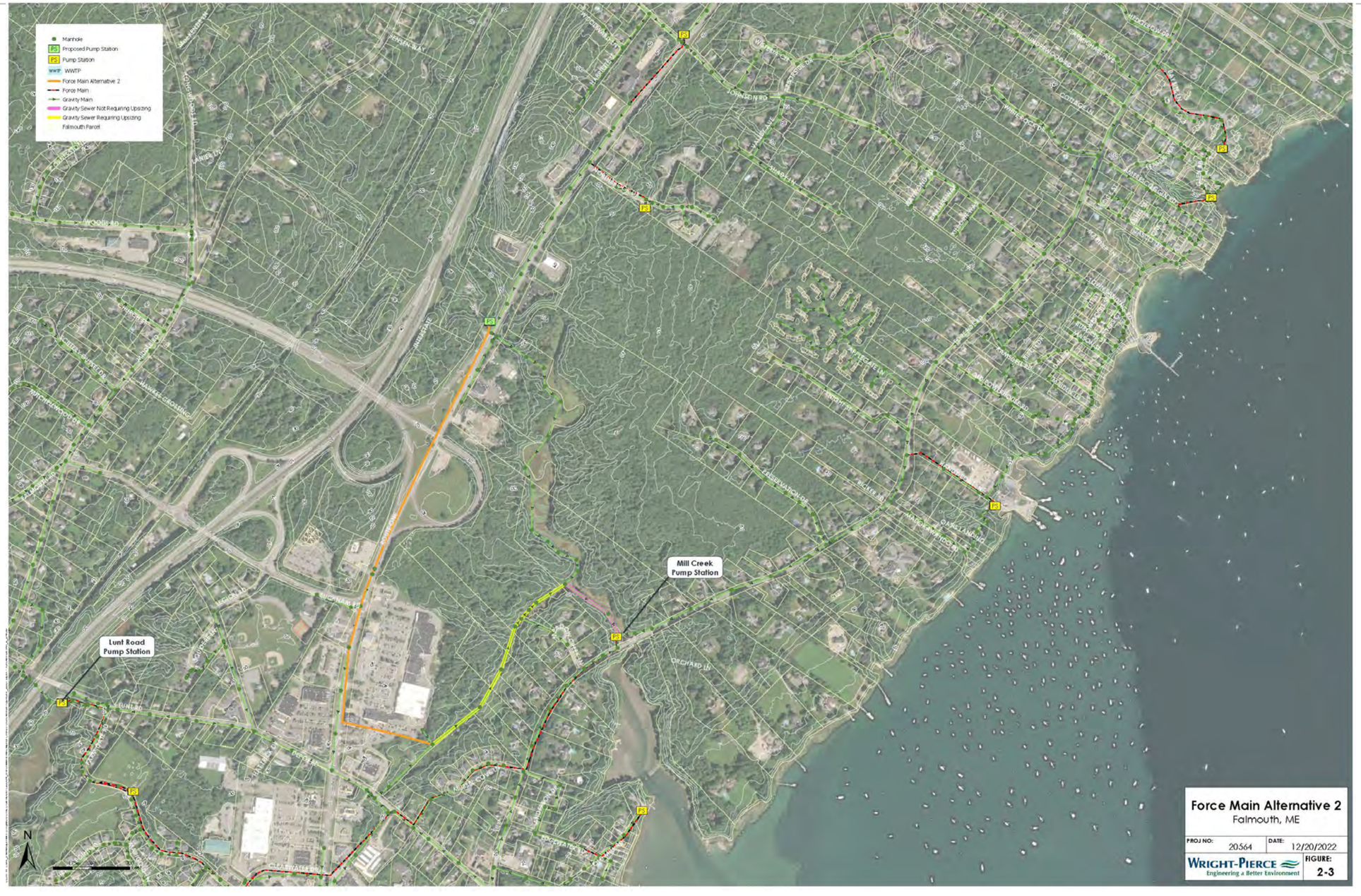
2.7 Alternative 2 – Route 1 to Webes Creek

Alternative 2 includes a new UMCPS on Route 1 at Mill Creek that directs flow south along Route 1 and cuts east between Shaw's and Walgreens and ties into Webes Creek at SMH-45, see Figure 2-3 below. The force main route is shown in solid orange line type.

The length of force main with this alternative is 4,775-feet. A private easement would be needed on Tax Lot U12-002 (Falmouth Realty Associates). A major drawback to this option is 2,200-feet of the Webes Creek interceptor would need to be upsized from SMH-45 to SMH-39 to accommodate the additional flow from the new pump station. The maximum capacity of the 14-inch Webes Creek interceptor is 540 GPM due to the 0.05% slope between SMH-43 and SMH-44 and the estimated peak hour flow for the new pump station is 1.21 MGD (~839 GPM). In order to accommodate the existing flow through the interceptor and accept the additional flow from the new pump station approximately 2,200-ft of the interceptor would have to be upsized to a 21-inch pipe.

It should be noted, that upsizing the Webes Creek interceptor would require significant environmental permitting because the interceptor is in a wetland and adjacent to Webes Creek (similar to the Mill Creek Interceptor). This makes this alternative less desirable, especially considering that one of the main drivers of this study is to eliminate the need for a cross-country sewer with limited access along Mill Creek.

Figure 2-3 Alternative 2



2.7.1 Summary of Alternative 2 Scope of Work

The scope of alternative 2 is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM). Submersible, duplex pump station with two 12 HP Flygt N-series pumps or equal.
- Length of new force main: 4,775-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: Approximately 2,200-ft of 14-inch gravity sewer upsized to 21-inch. 10' wide gravel access road along upsized Webes Creek interceptor included.
- Easements required: Yes, parking lot and driveway between Walgreens and Shaw's, Tax Lot U12-002 (Falmouth Realty Associates).
- One air release manhole (high point along Route 1) and zero drain manholes.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Future upgrade of the LRPS per WFSMP to a 2.13 MGD (~1,480 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating would be confirmed during final design.

2.7.2 Estimated Construction Cost of Alternative 2

A detailed project cost estimate for alternative 2 is included in Appendix C. The estimated project cost estimate for this alternative is $8.25M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.8 Alternative 3A – Johnson Road to Foreside Road

Alternative 3A includes a new pump station on Route 1 at Mill Creek that directs flow north up Route 1 to Johnson Road, then east along Johnson Road, then down Foreside Road to the MCPS, see Figure 2-4 below. The force main route is shown in solid light pink line type.

The length of force main with this alternative is 7,015-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way for the entire route. The receiving sewer along Foreside Road is a 16-inch interceptor that transitions to 18-inch approximately 2,060 feet south of the intersection of Johnson Road and Foreside Road before discharging to the MCPS. The maximum capacity of the interceptor along Foreside Road is 3.0 MGD (~2,100 GPM) due to the 0.2% slope of the 18-inch pipe between SMH-389 to SMH-390. The slope of the 16-inch segments is significantly more than the 18-inch segments, so the hydraulic capacity is limited by the 18-inch segment mentioned above. Estimated peak hour flow for the new pump station is 1.21 MGD (~839 GPM) and existing peak hour flow through the interceptor is estimated to be 1.75 MGD (~1220 GPM). Therefore, no upsizing of the gravity interceptor along Foreside Road is required to accommodate the additional flow from the new pump station. Note that the gravity sewer along Johnson Road is only 8-inch diameter so it does not have the capacity to accept the additional flow from the pump station without being upsized. If this option is selected, the Town may want to consider a shorter force main to the high point on Johnson Road along with upsizing the 8" gravity sewer to accommodate flows from the UMCPS. A thorough hydraulic analysis of the Foreside Road sewer is recommended to verify the capacity before adding the additional UMCPS flow and flow metering is recommended to verify existing flow conditions.

Figure 2-4 Alternative 3A

2.8.1 Summary of Alternative 3A Scope of Work

The scope of alternative 3A is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 50 HP Flygt N-series pumps or equal.
- Length of new force main: 7,015-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: No, all work within public road right-of-way.
- Two air release manholes (one on Route 1 and one on Johnson Road) and one drain manhole.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Future upgrade of LRPS per WFSMP to a 2.13 MGD (~1,480 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.8.2 Estimated Construction Cost of Alternative 3A

A detailed project cost estimate for alternative 3A is included in Appendix C. The estimated project cost estimate for this alternative is $7.28M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.9 Alternative 3B – Remove Johnson Road Pump Station

Alternative 3B includes a new pump station on Route 1 at Mill Creek that directs flow north up Route 1 to Johnson Road, then east along Johnson Road, then down Foreside Road to the MCPS, see Figure 2-5 below. The force main route is shown in solid pink line type.

The length of force main with this alternative is 7,015-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way for the entire route. The receiving sewer along Foreside Road is a 16-inch interceptor that transitions to 18-inch approximately 2,060 feet south of the intersection of Johnson Road and Foreside Road before discharging to the MCPS. Similar to alternative 3A, no upsizing of the gravity interceptor along Foreside Road is required to accommodate the additional flow from the new pump station.

This alternative includes eliminating JRPS by installing deep gravity sewer south on Route 1 directing flows to the new UMCPS on Route 1 at Mill Creek. The new 15-inch gravity sewer would be sized to handle 0.90 MGD (~625 GPM), which is the future design flow for JRPS. This size pipe would flow approximately 25% full during current peak events; and 55% at estimate future peak flow. A 12-inch pipe could also handle the peak future flow requirements but would require a greater minimum pitch, that would results in deeper installation trench and higher construction cost. The depth of the proposed 15-inch interceptor ranges from 5.0-feet to 16.4-feet in depth. A conservative cost per unit foot length of gravity sewer was assumed based on the depth of the gravity sewer in the cost estimate ($800/LF for 6' to 8' deep, $1000/LF for 8' to 12' deep, and $1200/LF for 12' to 17' deep). The cost assumed is highly subjective and could drop significantly if the sewer can be located on the shoulder of the road, out of traffic and other buried utilities. In addition to the high cost per linear foot of pipe, the cost estimate also assumes a higher overall quantity of ledge excavation required per linear foot of pipe installed compared with

the other alternatives (due to the deeper gravity sewer). Ultimately, this alternative is feasible but the final cost are highly dependent on the final gravity sewer route selection and ledge depth encountered to install the pipe.

Figure 2-5 Alternative 3B

2.9.1 Summary of Alternative 3B Scope of Work

The scope of alternative 3B is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 50 HP Flygt N-series pumps or equal.
- Length of new force main: 7,015-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer: 3,300-feet of 14-inch gravity sewer along Route 1
- Easements required: No, all work within public road right-of-way.
- Two air release manholes (one on Route 1 and one on Johnson Road) and one drain manhole.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- JRPS removed as part of this alternative.
- Future upgrade of LRPS per WFSMP to a 2.13 MGD (~1,480 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.9.2 Estimated Construction Cost of Alternative 3B

A detailed project cost estimate for alternative 3B is included in Appendix C. The estimated project cost estimate for this alternative is $11.98M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.10 Alternative 3C – Route 1 to JRPS

Alternative 3C includes a new pump station on Route 1 at Mill Creek that is considerably smaller than the UMCPS in alternatives 3A and 3B, that directs flow north up Route 1 to a new, larger capacity JRPS. JRPS would then direct flow east on Johnson Road to the gravity sewer on Foreside Road. The gravity sewer on Foreside Road would direct the flow to MCPS, see Figure 2-6 below. The force main route is shown in solid purple line type.

UMCPS would be sized to handle 0.31 MGD (~215 GPM). The length of UMCPS force main with this alternative is 3,320-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way for the entire route. The new JRPS would be sized for 839 GPM capacity and would require 3,950 LF of a new 10" force main to Foreside Road. The receiving sewer along Foreside Road is a 16-inch interceptor that transitions to 18-inch approximately 2,060 feet south of the intersection of Johnson Road and Foreside Road before discharging to the MCPS. Similar to alternative 3A, no upsizing of the gravity interceptor along Foreside Road is required to accommodate the additional flow from the new pump station. This alternative would require both the UMCPS and the JRPS to be upgraded simultaneously.

Figure 2-6 Alternative 3C

2.10.1 Summary of Alternative 3C Scope of Work

The scope of alternative 3C is summarized below:

- Reroute existing gravity sewer to new 0.31 MGD (~215 GPM) submersible, duplex pump station with two 11 HP Flygt N-series pumps or equal.
- Length of new force main: 3,320-ft.
- Details of new force main: 6" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: No, all work within public road right-of-way.
- Two air release manholes (one on Route 1 and one on Johnson Road) and one drain manhole.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Simultaneous upgrade of JRPS to a 1.21-MGD (~839 GPM) submersible pump station and install new 10" HPE IPS SDR 17 force main 3,950 to Foreside Road gravity sewer.
- Future upgrade of LRPS per WFSMP to a 2.13 MGD (~1,480 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.10.2 Estimated Construction Cost of Alternative 3C

A detailed project cost estimate for alternative 3C is included in Appendix C. The estimated project cost estimate for this alternative is $4.92M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.11 Alternative 4A – Route 1 to LRPS via Depot Road and Lunt Road

Alternative 4A includes a new UMCPS on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1 to Depot Road then west on Depot Road and Lunt Road to the LRPS, see Figure 2-7 below. The force main route is shown in solid light blue line type on the figures.

The length of force main with this alternative is 6,965-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way.

Lunt Road was paved in 2020 so there is a paving moratorium along Lunt Road until July 1, 2025. The moratorium requires a variance from the Town Manager with approval from the Department of Public Works for work in the road. The variance would require full road width (curb to curb) repaving where the new pipe is being installed along the road or 50-feet of paving on either side of the pipe trench if the new pipe is being installed straight across the road.

The option to pipe burst the old LRPS force main and replace it with the new pump station force main was examined to potentially avoid the paving variance. The old force main is a 6-inch diameter pipe that runs near the existing gravity sewer in Lunt Road. Based on a discussion with Vortex Companies (formerly Ted Berry) the option to pipe burst the old force main is not feasible due to the proximity of the existing gravity pipe. Minimum separation distance for pipe bursting is 5-feet. The two pipes are only a few feet from each other and were likely installed in the same trench during construction.

The LRPS pump nameplate capacity is 0.86 MGD (600 GPM) at 100-ft total dynamic head (TDH) and force main is an 8-inch HDPE DR 11 DIPS. Wright-Pierce previously completed an evaluation of the LRPS capacity in 2019 that considered low-cost options to increase capacity of the LRPS in the short-term. Additionally, as part of the West Falmouth Sewer Master Plan, Wright-Pierce identified the projected future design flow to the LRPS to address future growth in West Falmouth, and included a recommendation to upgrade the LRPS to 2.13 MGD in the future. For alternative 4A/B/C to be feasible, the LRPS would need to be upgraded to an larger capacity concurrent with construction of the UMCPS and force main as the flows that would be directed to LRPS exceed its current capacity.

Estimated peak hour flow for the new UMCPS is 1.21 MGD (~839 GPM). Therefore, the estimated peak hourly flow of the LRPS with the additional flow from the new pump station is 3.34 MGD (~2,319 GPM) for alternatives 4A, 4B, and 4C.

Figure 2-7 Alternative 4A

2.11.1 Summary of Alternative 4A Scope of Work

The scope of alternative 4A is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 15 HP Flygt N-series pumps or equal.
- Length of new force main: 6,965-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: No, all work within public road right-of-way. Note paving easement along Lunt Road.
- Two air release manholes (one on Route 1 and one on Lunt Road) and one drain manhole.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Concurrent upgrade of LRPS to a 3.34 MGD (~2,319 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.11.2 Estimated Construction Cost of Alternative 4A

A detailed project cost estimate for alternative 4A is included in Appendix C. The estimated project cost estimate for this alternative is $7.41M. Note that this alternative would also require concurrent upgrade of the LRPS estimated at $7.54M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.12 Alternative 4B – Route 1 to LRPS via Cross-Country Route

Alternative 4B includes a new pump station on Route 1 at Mill Creek that directs flow south down Route 1, southwest through the Town ball fields to Depot Road, east on Depot Road, then west onto Lunt Road to the LRPS, see Figure 2-8 below. The force main route is shown in solid blue line type in the figures.

The length of force main with this alternative is 6,491-feet. This route would require an easement through Town property (Tax Lot U58-004). As previously mentioned, a paving moratorium along Lunt Road would be required. Reference Section 2.11 for a discussion of the LRPS peak flow estimate with the additional new pump station flow (~2,300 GPM) which would also apply to this alternative.

Figure 2-8 Alternative 4B

2.12.1 Summary of Alternative 4B Scope of Work

The scope of alternative 4B is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 15 HP Flygt N-series pumps or equal.
- Length of new force main: 6,491-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: Yes, Town owned ball fields (Tax Lot U58-004).
- Two air release manholes (one on Route 1 and one on Lunt Road) and two drain manholes.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Concurrent upgrade of LRPS to a 3.34 MGD (~2,319 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.12.2 Estimated Construction Cost of Alternative 4B

A detailed project cost estimate for alternative 4B is included in Appendix C. The estimated project cost estimate for this alternative is $6.45M. Note that this alternative would also require concurrent upgrade of the LRPS estimated at $7.54M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.13 Alternative 4C – Route 1 to LRPS via Bucknam, Legion, Depot, and Lunt Roads

Alternative 4C includes a new UMCPS on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1, then west onto Bucknam Road, then south on Legion and Depot Roads, then west onto Lunt Road to the LRPS, see Figure 2-9 below. The force main route is shown in solid dark blue line type on the figures.

The length of force main with this alternative is 7,127-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way for the entire route. As previously mentioned, a paving moratorium along Lunt Road would be required. Reference Section 2.11 for a discussion of the LRPS peak flow estimate with the additional new pump station flow (~2,300 GPM) which would be required for this alternative.

Figure 2-9 Alternative 4C

2.13.1 Summary of Alternative 4C Scope of Work

The scope of alternative 4C is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 15 HP Flygt N-series pumps or equal.
- Length of new force main: 7,127-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: No, all work within public road right-of-way.
- Two air release manholes (one on Route 1 and one on Lunt Road) and two drain manholes.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Concurrent upgrade of LRPS to a 3.34 MGD (~2,319 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.13.2 Estimated Construction Cost of Alternative 4C

A detailed project cost estimate for alternative 4C is included in Appendix C. The estimated project cost estimate for this alternative is $6.89M. Note that this alternative would also require concurrent upgrade of the LRPS estimated at $7.54M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.14 Alternative 5 – Wye Into Mill Creek Force Main

Alternative 5 includes a new UMCPS on Route 1 at Mill Creek that directs flow south down Route 1. Routing the flow down Route 1, then east on Depot Road south on Hat Trick Drive to Clearwater Drive, where the new force main would wye into the existing MCPS force main, see Figure 2-10 below. The force main route is shown in solid red line type on the figures.

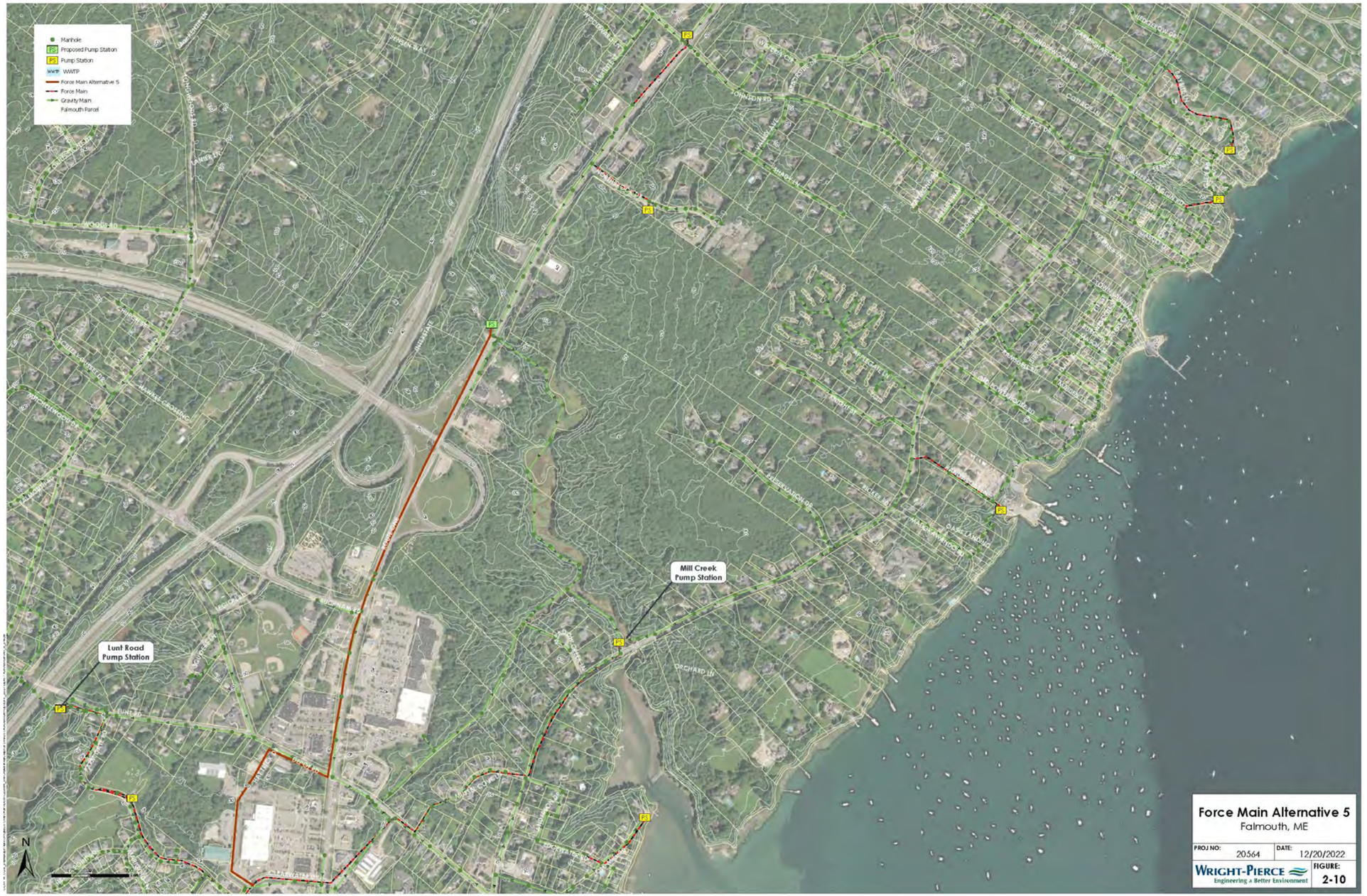
The length of force main with this alternative is 6,210-feet. No private easements would be required with this route as the force main would be located within the public road right-of-way for the entire route. Hat Trick Lane does not take a direct path from Depot Road to Clearwater Drive, but the proposed force main route attempts to reduce the overall length of the force main while staying within the public right-of-way.

Tying into the MCPS force main will impact the MCPS pumps. That impact was analyzed for this evaluation to confirm the existing MCPS pumps would still pump as intended with a simultaneous separate pumped input to the existing force main. The original design duty points for the MCPS jockey pumps are 1,050 GPM at 57-ft TDH and 1,800 GPM at 82-ft TDH for the wet weather pumps. During wet weather, both wet weather pumps may be called to run at 2,900 GPM at 97-ft TDH combined. The new UMCPS would wye into the 16-in DR 18 PVC MCPS force main along Clearwater Drive, approximately 1,800-ft from the WWTF. Based on preliminary hydraulic calculations, the additional 839 GPM from the UMCPS in this 1,800-ft section of existing MCPS force main would have a minimal impact on the existing MCPS pumps. The additional flow would add approximately 7-feet of head to the system when both wet weather pumps and one UMCPS pump are in operation at the same time. This would slightly reduce the capacity of the MCPS wet weather pumps. Based on MCPS run time data (2020-2021), those wet weather pumps only run periodically (about one hour per month). This alternative would reduce overall flow to the MCPS, which would further reduce the need for the wet weather pumps to run. An automatic run cycle program is

recommended to be added to the MCPS wet weather pumps if this alternative is selected to ensure the wet weather pumps periodically run even if there are no wet weather events.

If this alternative is selected, a full hydraulic analysis is recommended for the WWTF to determine the impact of pumping an additional 839 GPM directly to the WWTF via the MCPS force main and the UMCPS. No additional flow is being added to the WWTF, but it will be transferred to the WWTF faster than the current gravity flow through the Mill Creek interceptor. In addition, to the full hydraulic model of the WWTF, the full Mill Creek force main system with multiple pump station inputs (both the new UMCPS and existing MCPS) should be modeled using analytic modeling software to confirm the preliminary analysis calculations and UMCPS pump sizing.

Figure 2-10 Alternative 5



2.14.1 Summary of Alternative 5 Scope of Work

The scope of alternative 5 is summarized below:

- Reroute existing gravity sewer to new 1.21 MGD (~839 GPM) submersible, duplex pump station with two 30 HP Flygt N-series pumps or equal.
- Length of new force main: 6,210-ft.
- Details of new force main: 10" HDPE IPS SDR 17.
- Length of gravity sewer requiring upsizing: No upsizing needed.
- Easements required: No, all work within public road right-of-way.
- Two air release manholes (one on Route 1 and one on Hat Trick Drive) and one drain manhole.
- Potential for ledge will be determined with probes and borings if this is the selected alternative.
- Future upgrade of JRPS to a 0.90-MGD (~625 GPM) submersible pump station and upsize 1,150-foot force main to 8-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.
- Future upgrade of LRPS per WFSMP to a 2.13 MGD (~1,480 GPM) submersible pump station and upsize 4,600-foot force main to 16-inch. Force main size, pipe material, and pressure rating will be confirmed during final design.

2.14.2 Estimated Construction Cost of Alternative 5

A detailed project cost estimate for alternative 5 is included in Appendix C. The estimated project cost estimate for this alternative is $7.30M. Table 2-2 at the end of Section 2 summarizes the various alternative project cost estimates.

2.15 Alternative Cost Comparison

Table 2-2 below contains the estimated project cost for each of the alternatives evaluated in Section 2. Costs outlined in this memorandum have an ENR Index of 12791, dated March 2022, and should be increased for inflation based upon projected date of construction. The current ENR Index is 13473, dated August 2023, which is a 5.3% increase from March 2022. Construction prices are currently very volatile and inflation factors should be considered carefully for any project projected to take place in the next several years. A detailed project cost estimate for each alternative is included in Appendix C.

Table 2-2 includes five separate cost columns identified left to right as: total project cost for the Upper Mill Creek Pump Station and force main; total project cost for the Lunt Road Pump Station and force main; total project cost for the Johnson Road Pump Station and force main; total project cost for the next concurrent upgrade that may include upgrading one or two of the three pump stations in this evaluation; and total long-term project costs that includes upgrading all three pump stations included in this evaluation. When reviewing this cost table, it is important to review the overall cost of each individual pump station (first three cost columns from the left), the overall cost of the next proposed upgrade (fourth cost column from the left) and the overall cost of all three pump stations (right-most cost column).

Table 2-3 highlights the specifics of each alternative. As noted previously, the LRPS was identified in the WFSMP to be upgraded to handle future flows from west Falmouth. Therefore, as part of this study, WP considered both the expected cost for the LRPS upgrade based on the capacity identified in the WFSMP, as well as a higher capacity to accommodate addition flows from the Mill Creek Interceptor sewer shed. Likewise, the JRPS costs were also included in this evaluation as its flow directly affects the Mill Creek Interceptor and resulting size of the new UMCPS.

Table 2-2 Alternative Cost Comparison

Engineer's Estimate of Total Project(s) Costs					
Alternative	UMCPS, FM & Sewer	LRPS & FM Upgrade	JRPS & FM Upgrade	Concurrent Project Cost for next Upgrade	Overall Long-term Projects Costs for UMCPS, LRPS & JRPS
2 - Rt 1 to Webes Creek	$8,250,000	$6,190,000	$3,130,000	$8,250,000	$17,570,000
3A - Johnson Rd to Foreside Rd	$7,280,000	$6,190,000	$3,130,000	$7,280,000	$16,600,000
3B - Remove JRPS / Deep Rt 1 sewer	$11,980,000	$6,190,000	$0	$11,980,000	$18,170,000
3C - Rt 1 to JRPS / sm UMCPS, lg. JRPS	$4,920,000	$6,190,000	$5,040,000	$9,960,000	$16,150,000
4A - Rt 1 to LRPS via Depot Rd and Lunt Rd	$7,410,000	$7,540,000	$3,130,000	$14,950,000	$18,080,000
4B – Rt 1 to LRPS via Cross-Country	$6,450,000	$7,540,000	$3,130,000	$13,990,000	$17,120,000
4C - Rt 1 to LRPS via Bucknam, Legion, Depot, and Lunt Rd	$6,890,000	$7,540,000	$3,130,000	$14,430,000	$17,560,000
5 - Wye into Mill Creek Force Main	$7,300,000	$6,190,000	$3,130,000	$7,300,000	$16,620,000

Table 2-3 Alternative Comparison Summary

Alternative	UMCPS Flow Basis (MGD)	UMCPS Proposed Pump	Length of New Force Main Required (ft)	Details of New Force Main	Length of new or upsized Gravity Sewer (ft)	Easements Required	Air Release / Drain Manholes Required	Total Project Cost for UMCPS & Force Main only	Concurrent Total Project Cost for Next Upgrade	JRPS Upgrade	LRPS Upgrade
2 - Rt 1 to Webes Creek	1.21	(2) 12 HP Flygt N-Series or equal	4,775	10" HDPE IPS DR 17	2,200	1 (Tax Lot U12-002)	1 / 0	$8.25M	$8.25M	Upgrade to 0.90 MGD station and upsize 1,150-ft FM to 8"	Upgrade to 2.13 MGD station and upsize 4,600-ft FM to 16"
3A - Johnson Rd to Foreside Rd		(2) 50 HP Flygt N-Series or equal	7,015		0	N/A	2 / 1	$7.28M	$7.28M		
3B - Remove JRPS / Deep Rt 1 sewer					3,300			$11.98M	$11.98M	N/A	
3C - Rt 1 to JRPS / sm. UMCPS; lg. JRPS	0.31	(2) 11 HP Flygt N-Series or equal	3,320	6" HDPE IPS DR 17				$4.92M	$9.96M	Upgrade to 1.21 MGD station and install 3,950-ft of new 10" FM	
4A - Rt 1 to LRPS via Depot Rd and Lunt Rd	1.21	(2) 15 HP Flygt N-Series or equal	6,965	10" HDPE IPS DR 17	0			$7.41M	$14.95M	Upgrade to 0.90 MGD station and upsize 1,150-ft FM to 8"	Upgrade to 3.34 MGD station and upsize 4,600-ft FM to 16"
4B - Rt 1 to LRPS via Cross-Country			6,491			1 (Tax Lot U58-004)	2 / 2	$6.45M	$13.99M		
4C - Rt 1 to LRPS via Bucknam, Legion, Depot, and Lunt Rd			7,127			N/A		$6.89M	$14.43M		
5 - Wye into Mill Creek Force Main		(2) 30 HP Flygt N-Series or equal	6,210				2 / 1	$7.30M	$7.30M		Upgrade to 2.13 MGD station and upsize 4,600-ft FM to 16"

The lowest cost alternative when considering the individual upgrades for the UMPS, force main and sewer alone is alternative 3C at $4.92M. This alternative also has the lowest overall cumulative project cost at $16.15M. However, since this alternative also requires immediate and concurrent upgrade of the JRPS, it is not the least expensive immediate upgrade at $9.96M.

Alternative 3A and 5 have the lowest short-term immediate project costs at $7.28M and $7.30M respectively, as the UMCPS is the only upgrade required in the short term and the JRPS and LRPS upgrades can be completed at a later date when future flows increase.

Alternative 3B, is more costly than alternatives 2, 3A, 3C, and 5 at $11.98M for an immediate upgrade and has the highest total cumulative project costs of $18.17M but eliminates the Johnson Road PS from the Town's collection system which has other benefits as explained in Section 2.16 below.

Overall, the cost spread between the highest overall cost alternative 3B and the lowest alternative 3C is $2.02M representing a 11% difference. Differences between the three lowest cost alternatives 3A, 3C and 5 (based on lowest long-term overall cost) is only $450,000, or less than 3% difference.

2.16 Other Considerations

In addition to the overall estimated costs, there are other factors that should be considered by the Town.

2.16.1 Operations and Maintenance

Operations and maintenance costs are not included in this evaluation but should be factored into the Town's decision.

Alternative 3B to remove the JRPS eliminates the operation and maintenance cost of an entire pump station in Town. Transporting flow via a gravity sewer in lieu of pumping will result in energy savings over time. In addition, there is considerable man-power hour savings in the operation and maintenance that could be eliminated freeing up staff to do other critical work. There would be additional deep gravity sewer and manholes to maintain in the collection system, but overall there would still be a net benefit in manpower hours and maintenance cost to the Town by eliminating the JRPS. In addition to the O&M savings of reducing the number of pump stations in the system, the Town should also consider the long-term cost savings associated with eliminating the need to upgrade the JRPS as the useful life of its equipment and infrastructure ends over time.

Alternative 3B and 5 are the only alternatives that do not increase the number of times the wastewater from the Mill Interceptor needs to be pumped before it reaches the WWTF. This results in a lower relative operations (electricity) cost for these alternatives versus the other alternatives evaluated.

2.16.2 Inter-municipal Agreements

The MCPS was upgraded in 2017, with a significant portion of its capacity attributed to sewer flows from the Town of Cumberland. Directing sewer flow that is currently transported via the Mill Creek interceptor to MCPS to an upgraded LRPS (as described in alternatives 4A, 4B and 4C) would significantly change the percentages of Falmouth versus Cumberland flow into both the MCPS and the LRPS.

The MCPS was upgraded to include future peak flows from both Falmouth and Cumberland. Should the MCI be eliminated and sewered flow from that area be pumped directly to LRPS (alternatives 4A/B/C), or wye'd into the MCPS force main on Clearwater Drive (alternative 5), future peak flow projections to the MCPS would be decreased.

2.16.3 Other Planned Work in Town

There may be opportunity to construct some or all of the horizontal portions (force main and/or gravity sewer) work along with other planned work in town. Combining pipe installation with other construction work in Route 1, Johnson Road, or other roads could lower the overall costs to the Town by reducing and/or offsetting some mobilization, pavement, and inspection costs.

2.17 Funding Opportunities

This evaluation includes an analysis of potential upcoming funding and grant opportunities for this project.

2.17.1 Hazard Mitigation Grant Program (HMGP)

The Maine Emergency Management Agency (MEMA) administers the federal Hazard Mitigation Grant Program (HMGP). Funds may be available statewide following a Presidential Major Disaster Declaration as requested by the Governor, with priority given to projects in the area of the state affected by the disaster. These funds assist communities to enact mitigation measures that reduce the risk of loss of life and property from future disasters. Eligible applicants include local governments who are part of a Federal Emergency Management Agency (FEMA) approved multi-jurisdictional county hazard mitigation plan (or plan that is in the process of being updated), Native American tribes, and private non-profit organizations (sponsored by local government).

The Cumberland County Hazard Mitigation Plan (HMP) 2022 identifies "Reduc(ing) damage, injury and loss of life resulting from flooding" as a goal of the County HMP.

The Maine Emergency Management Agency must submit sub-applications to FEMA within 12 months of the Presidential Major Disaster Declaration; therefore, application deadlines vary. A minimum 25% local match is required.

2.17.2 Building Resilient Infrastructure and Communities (BRIC)

FEMA administers the Building Resilient Infrastructure and Communities (BRIC) program to support states, local communities, tribes, and territories with pre-disaster mitigation activities. Approximately $1 billion was available for FY 2021 of which $56 million was allocated to States/Territories, $25 million was allocated to Tribes, and $919 million was available for national competition. Local governments, including cities, townships, counties, special district governments, and Native American tribal organizations are considered Sub-applicants and must submit subapplications for mitigation planning and projects to their State/Territory applicant agency. Eligible projects include:

- Mitigation Projects: cost-effective projects designed to increase resilience and public safety; reduce injuries and loss of life; and reduce damage and destruction to property, critical services, facilities, and infrastructure.

The maximum grant award for nationally competitive Sub-applications was $50 million. The maximum award to States/Territories and Tribes was $1 million per applicant for all Sub-applications. Funding is available for up to 75% of the eligible activity costs, with a 25% non-federal match required. FEMA may contribute up to 90% of the eligible

activity costs with a 10% match for small and impoverished communities of less than 3,000 in population with residents having an average per capita annual income not exceeding 80% of the national per capita income. Applications were accepted in the fall, this last application period was between September 30, 2022, and January 27, 2023.

2.17.3 Clean Water State Revolving Fund Loan (CWSRF)

The CWSRF program provides low-interest rate financing to municipalities to construct water quality protection projects such as sewers and wastewater treatment facilities. A variety of publicly owned water quality improvement projects are eligible for financing. As part of the Bipartisan Infrastructure Law (BIL), Maine expects to receive $13.78 million for the CWSRF Supplemental Grant. The Supplemental CWSRF Grant requires that Maine provide at least $6.75 million, 49% of its total grant amount, as loan forgiveness to eligible projects based on the affordability tier system.

2.17.4 Maine Infrastructure Adaptation Fund (MIAF) Grant

The MIAF grant program is administered through the Maine Department of Transportation (DOT) and provides grants to municipalities to improve stormwater, drinking water, and wastewater infrastructure from extreme weather, flooding, sea-level rise, and other climate change events. The grants help protect public infrastructure most at risk from impacts of climate change and benefit public safety. The most recent round of Requests for Applications (RFA) closed on May 31, 2022 with $20M in allocations.

2.17.5 Congressional Earmarks

The 117th Congress wrote a new set of rules that allowed them to revive Congressionally directed spending on projects — known as "earmarks." Earmarks can support a wide range of local priority projects ranging from transportation investments, water, wastewater, stormwater infrastructure, and water quality protection projects; and economic development initiatives that improve distressed and blighted areas and encourage community revitalization. To take advantage of earmarks, a locality must submit a request to at least one Member of Congress who will determine which projects to support. Member-selected projects are submitted for grant funding to 10 designated Appropriations Subcommittees, each of which reviews the submissions to consider its placement in legislation.

The US House of Representatives issues requests for Community Project Funding and the US Senate issues Congressionally Directed Spending Requests. These two programs allow communities to work directly with Congress to bring awareness to important local projects that are deserving of federal partnership and have full community support.

The Town of Falmouth submitted a CDS funding application in 2023 for the proposed project and were initially short-listed for funding. However, the final funding lists included in the federal appropriations bill did not include the proposed project. The Town may want to consider re-applying next year.

2.17.5.1 US House of Representatives — Community Project Funding Requests

In 2021, the US House of Representatives reinstated the use of earmarks (member-directed spending requests) and it is expected that these "Community Project Funding Requests" will be accepted again next year. Within the US House Committee on Appropriations, there are subcommittees for different agencies and accounts, If Falmouth is interested in applying for water or wastewater-related assistance, Infrastructure Investment and Jobs Program (IIJP) listing is required far earmark projects under the Interior Subcommittee USEPA STAG program as well as a

20% local match. If Falmouth is interested in applying under the Homeland Security Subcommittee Pre-Disaster Mitigation (PDM) program, a letter of support from Heather Dumais, State Hazard Mitigation Officer, affirming the project is eligible must accompany the earmark request.

The application would be made through Representative Chellie Pingree's office typically in late winter or early spring each year. Fiscal Year 2022 | U.S. Representative Chellie Pingree (house.gov)

2.17.5.2 US Senate — Congressionally Directed Spending Requests

The US Senate also reinstated the earmark process and is expected to do so again next year. The same requirements as for water and wastewater infrastructure Community Project Funding Requests would apply. Within the US Senate Committee on Appropriations, there are subcommittees for different agencies and accounts.

Applications would be made through both Senator Angus King's office Congressionally Directed Spending Requests - FY2023 (senate.gov) and Senator Susan Collin's office Appropriations Request | U.S. Senator Susan Collins (senate.gov) in late winter or early spring each year.

3

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Engineering a Better Environment

Section 3 Recommended Plan

3.1 Recommended Alternative

Based on past discussions, alternative 2 should be ruled out from further analysis based on the upgrade needs and continued reliance on the Webes Creek interceptor, an aged, cross-country interceptor in an environmentally sensitive area. Additionally, based on this analysis, the costs associated with alternatives 4A, 4B and 4C, are considerably higher than routing the Mill Creek Interceptor flow to the MCPS or its force main. Therefore, the Town may want to eliminate those alternatives from further consideration as well.

As noted previously, there is little cost difference between alternatives 3A, 3C, 5; and, soil borings/probes in the area have helped reduce the amount of uncertainty in the soil conditions at the proposed pump station site and along the proposed force main and/or gravity sewer routes. The presence of ledge and the associated cost to remove was updated from the original estimate and is more representative of in-situ conditions. Final alternative selection should be completed by the Town based on their long-term goals and preferences.

3.2 Next Steps

Following the supplemental soil investigations, Wright-Pierce has updated the estimated alternative costs accordingly and is ready to provide the Town any additional information necessary to select a preferred alternative. Once an alternative is selected, preliminary investigations such as survey of the selected route, additional ledge borings, and environmental/wetland delineation can be completed and an amendment for preliminary and final design can be developed.

Concurrent with the survey and preliminary design, the Town may also want to consider starting the process for development and submission of funding applications for this project. Wright-Pierce Strategic Funding Manager held a meet the Town of Falmouth on February 2, 2023, to discuss funding opportunities for this project, and a summary of the various funding opportunities that could be a good fit for this project are included in Section 2.17. The level of effort for developing funding applications varies, please let us know if the Town requests assistance.

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APPENDIX

A

WRIGHT-PIERCE
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Appendix A
MCI Immediate Needs Study

TOWN OF FALMOUTH, MAINE

Immediate Needs Study

APRIL 2022

Mill Creek Interceptor

WRIGHT-PIERCE
Engineering a Better Environment

Mill Creek Interceptor

Town of Falmouth, Maine

April 2022

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Table of Contents

List of Appendices

List of Figures

List of Tables

Section 1 Introduction

1.1 General

The Mill Creek Sewer Interceptor was constructed in 1969 and runs alongside Mill Creek in eastern Falmouth. This interceptor was part of the original construction of wastewater infrastructure in eastern Falmouth, including several pump stations and the wastewater treatment facility. This gravity interceptor conveys flow from the Town of Cumberland and portions of eastern Falmouth cross country from Route 1 to the Mill Creek Pump Station on Foreside Road (Route 88). The Town has concerns about the long-term viability of this interceptor given erosion and the meanderings of Mill Creek, which have exposed some portions of the interceptor as well as previously buried manholes. The purpose of this study is to evaluate the condition of the interceptor, identify immediate needs and provide the Town with repair/rehabilitation alternatives that include probable construction costs.

1.2 Study Area

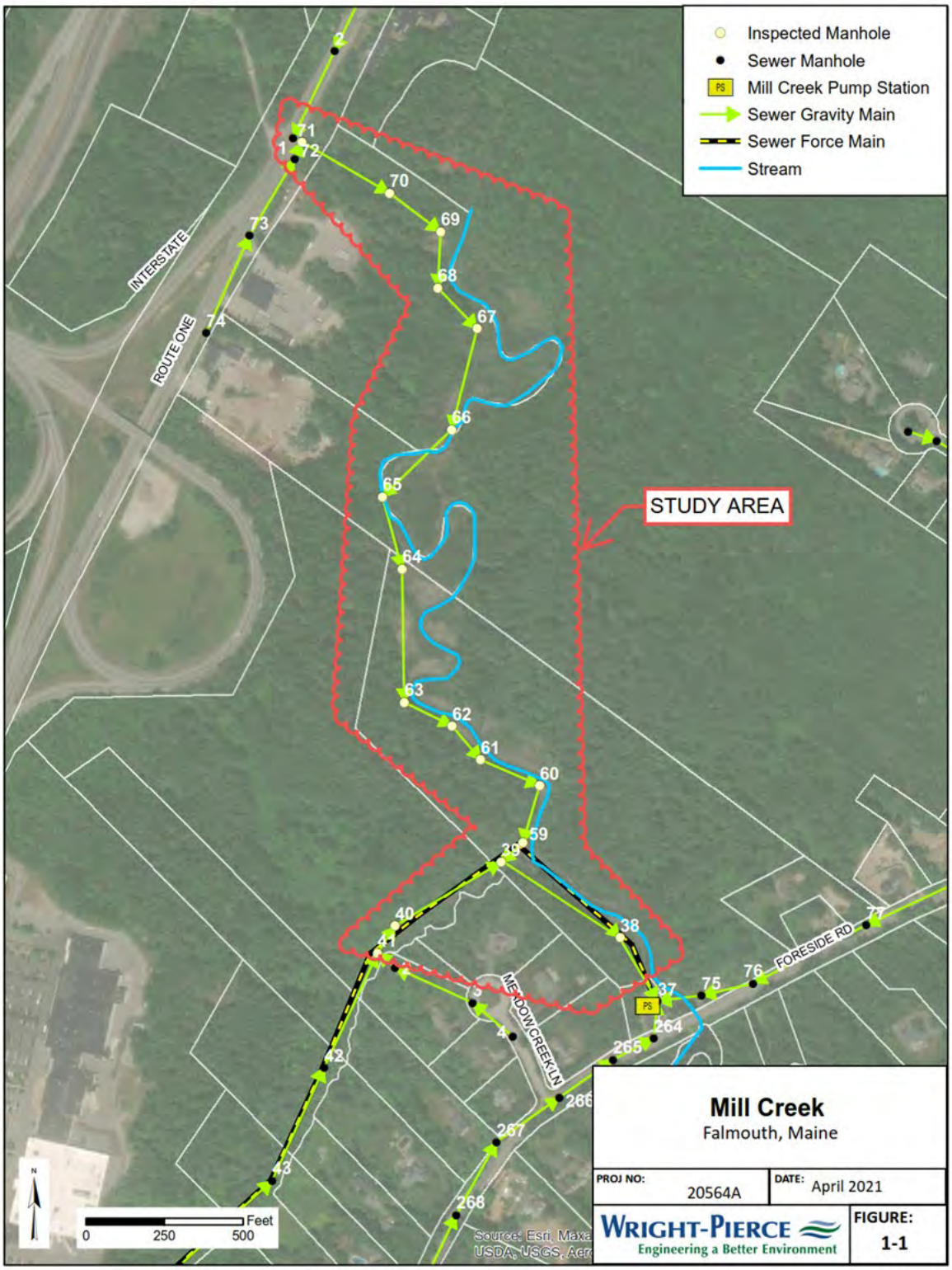
The study area includes the following manhole and pipe segments as shown on Figure 1-1:

- 15 manholes along the Mill Creek interceptor: SMH 38, 39, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, and 71.
- 2 manholes along the Webes Creek interceptor: SMH 40 and 41.

Initial discussions with the Town indicated concern only with the Mill Creek interceptor. However, the two manholes along Webes Creek just upstream of the confluence with Mill Creek were in similar condition and have a similar risk of failure as the manholes along Mill Creek and were therefore included in the scope.

The Vortex Companies (formerly Ted Berry Company) completed the closed-circuit television (CCTV) inspections of the interceptors. Their surveys also included additional pipe segments along Webes Creek between the following manholes: SMH 42, 43, 44, and 45 . Manholes 44 and 45 are not shown on Figure 1-1 for clarity.

Figure 1-1 Study Area Map



1.3 Project Background And Understanding

In January 2021, the Town of Falmouth alerted Wright-Pierce about concerns regarding some exposed manholes along the Mill Creek interceptor. The concerns are compounded by the wooded and cross-country location of this interceptor which limits access to most of the manholes. Several manholes along the interceptor are located only a few feet from the edge of an eroding bank along the tidal creek. One manhole of critical concern (Manhole 65) is approximately 50-75% within the creek on the edge of a steep and eroding bank, and the gravity sewer pipe from that manhole is visible below the water surface at low tide.

1.4 Project Goals

The Town has asked Wright-Pierce to evaluate the existing interceptor and to make recommendations for both short-term/immediate repair/rehabilitation options as well as long-term recommendations for the interceptor. The focus of this evaluation and scope of work will be assessing the existing condition of the interceptor and manholes and developing recommendations for immediate/short-term repairs, planning level costs, and permitting implications. Data gathered during this assessment will be used to develop the framework for a separate study focused on long-term recommendations associated with the interceptor, which may include abandoning the interceptor and re-routing sewer flows through a different part of Town.

Section 2 Field Investigations

2.1 Previous Field Investigation Efforts

The Town completes routine maintenance of the interceptors and first identified the erosion concerns along the creek. No other known investigations of this interceptor have happened over the past 51 years.

2.2 Methodology

Wright-Pierce completed a preliminary site walk with Town personnel on January 19th, 2021 to discuss the project and potential repair/rehabilitation alternatives. Separate site visits were conducted for the manhole inspections by Wright-Pierce personnel, and sewer line CCTV by Vortex Companies as discussed below.

2.2.1 Manhole Inspections

Manhole inspections were conducted on the manhole interiors and visible portions of the exterior of the manholes in accordance with National Association of Sewer Service Companies (NASSCO) standards. NASSCO Level 2 Manhole Assessment Certification Program (MACP) inspections were completed on the 17 manholes identified in Section 1.2 on March 18th, 2021 by a NASSCO certified Wright-Pierce engineer. The inspections included visual observation from the surface and the use of a pole camera to document interior conditions and observations.

Level 2 MACP inspections are intended to gather detailed information to fully document all existing defects, determine the condition of a manhole, and provide specific information to recommend or specify corrective actions. The inspections include documenting the visible interior and exterior condition of each component of the manhole including the: cover, frame, chimney, cone, wall, bench, channel, and pipe connections. Findings of the inspections are presented in Section 2.3.1.

2.2.2 Sewer Line CCTV

CCTV inspections of the gravity interceptors along Mill Creek and Webes Creek were completed by Vortex Companies on March 8th – 10th, 2021. The CCTV inspections followed NASSCO Pipeline Assessment Certification Program (PACP) guidelines including documenting the four standard families of codes (Structural, Operations and Maintenance, Construction Features, and Miscellaneous Features). Structural defects and Operations and Maintenance defects are the most common and relevant to this type of inspection. The Structural defects describe various defects where the pipe is damaged or otherwise defective (e.g. cracks, fractures, holes, etc.). The Operation and Maintenance defects describe various types of foreign objects that are found in pipes and may interfere with the operation of the conveyance system (e.g. deposits, roots, infiltration, obstructions, vermin, etc.).

Vortex pre-cleaned the interceptor before the CCTV inspections in locations where they could access the manhole(s). Since this cross-country line has limited access points, several pipe sections were not pre-cleaned before the inspections. The inspections were completed with a sewer inspection crawler that was equipped with a camera to document and record the findings.

Defects were coded by Vortex in accordance with NASSCO PACP guidelines. A NASSCO certified Wright-Pierce engineer reviewed the CCTV footage. Findings of the inspections are presented in Section 2.3.2.

2.2.3 Other Observations

Level 2 MACP inspections only consider the condition of the manhole itself. It does not attempt to rationalize the location of the manholes in regard to risk. Specifically, for this situation, the inspections do not consider the

location of the manholes in relation to the creek bank, erosion along the creek, the rim elevation of the manholes versus the 100-year FEMA base flood elevation (BFE), and projected sea-level rise scenarios. These items were evaluated separately and their impact on the proposed repair/rehabilitation alternatives are discussed in Section 2.3.3.

2.3 Findings

2.3.1 Manhole Inspections

Table 2-1 summarizes the manhole defects observed during the inspections.

Table 2-1 Observed Manhole Defect

Manhole Number	Depth[1] (feet)	Component	Code	Grade[2]	Location 1[3]	Location 2[3]
38	10	Bench	Deposits Attached Rags	1	12	12
39	12	Channel	Deposits Attached Grease	1	6	9
40	1	Chimney Exterior	Broken	4	12	12
41	4	Wall Interior	Deposits Attached Rags	1	2	4
41	1	Chimney Exterior	Crack Multiple	3	12	3
59	5	Chimney Interior	Deposits Attached Rags	1	12	12
60	5	Wall Interior	Deposits Attached Rags	1	2	4
61	1	Chimney Exterior	Crack Multiple	3	12	12
63	5	Chimney Interior	Infiltration Dripper	3	12	12
64	9	Wall Interior	Infiltration Dripper Barrel	3	12	12
64	1	Chimney Exterior	Crack Longitudinal	2	12	12
67	0	Frame	Fracture Longitudinal	3	4	4
68	9	Wall Interior	Infiltration Dripper	3	1	3
69	2	Chimney Interior	Infiltration Dripper	3	12	12
69	9	Stub Connection	Infiltration Dripper	3	3	3

1. Observation depths are measured from the rim of the manhole down to the defect.

2. Grades are given on a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.

3. MACP inspections use clock positions to locate observations. The outlet pipe of a manhole is always at the 6 o'clock position. For example, a defect from 12 to 3 would be equivalent to 25% of the manhole circumference.

No grade 5 defects were observed. Overall, the worst structural manhole defects were cracking or broken concrete on the exposed chimney sections. This is likely due to weather and natural wear on the structures. There were several locations where infiltration was noted, which indicates some groundwater and rainwater are getting into the sanitary sewer system. There were also several locations where deposits were noted which indicates a history of sewer line backups into the manholes. Pictures of the identified defects are cataloged in Appendix A.

2.3.2 Sewer Line CCTV

Table 2-2 summarizes the pipe defects observed during the CCTV inspections.

Table 2-2 Observed Pipe Segment Defects

Pipe Segment	Description	Grade[1]	Direction[2]	Distance[3] (feet)	Clock 1[4]	Clock 2[4]
38 - 37	Deposits Settled Fine	3	Downstream	7	6	
38 - 37	Deposits Settled Gravel	2	Upstream	102.0-209.8	6	
38 - 37	Deposits Attached Grease	2	Upstream	0-50.3	4 & 8	
39 - 38	Deposits Settled Fine	4	Downstream	157.3	8	12
39 - 38	Deposits Settled Fine	3	Upstream	2.8	6	
39 - 38	Deposits Settled Fine	2	Downstream	80.1-156.8	6	
40 - 39	Infiltration Runner Joint	4	Downstream	63.3	7	11
40 - 39	Deposits Attached Encrustation	2	Downstream	63.3	7	5
40 - 39	Deposits Attached Other	2	Downstream	359	8	
40 - 39	Deposits Attached Grease	2	Downstream	0-400.2	4 & 8	
43 - 42	Infiltration Dripper Joint	3	Downstream	147.4	11	
43 - 42	Deposits Settled Fine	3	Downstream	78.1-222.3	6	
43 - 42	Deposits Settled Fine	3	Downstream	222.3-265.2	6	
43 - 42	Deposits Attached Encrustation	2	Downstream	147.4	7	11
43 - 42	Deposits Attached Grease	2	Downstream	195.3-222.3	8	
44 - 43	Deposits Attached Grease	2	Downstream	100.4-176.8	5 & 7	
45 - 44	Deposits Settled Fine	2	Downstream	368.8-400.7	6	

Pipe Segment	Description	Grade[1]	Direction[2]	Distance[3] (feet)	Clock 1[4]	Clock 2[4]
46 - 45	Infiltration Runner Joint	4	Upstream	306.9	4	
46 - 45	Infiltration Dripper Joint	3	Upstream	306.9	2	
46 - 45	Obstruction Rocks	3	Upstream	392.7	6	
46 - 45	Deposits Settled Fine	2	Upstream	5.4-321.8	6	
46 - 45	Deposits Attached Encrustation	2	Upstream	20.1	9	
46 - 45	Deposits Attached Encrustation	2	Upstream	306.9	2	
46 - 45	Infiltration Stain Joint	1	Upstream	20.1	9	
46 - 45	Infiltration Stain Joint	1	Upstream	176.1	9	
60 - 59	Deposits Settled Fine	5	Downstream	0	8	12
60 - 59	Joint Separated Medium	3	Upstream	71.1	6	
61 - 60	Deposits Settled Fine	3	Downstream	109	6	
61 - 60	Deposits Settled Fine	3	Upstream	0	6	
65 - 64	Crack Longitudinal	2	Downstream	3.7	4	
65 - 64	Deposits Attached Grease	2	Downstream	154.1-174.7	6	
66 - 65	Deposits Settled Fine	2	Downstream	21.8-39.3	6	
66 - 65	Deposits Settled Fine	2	Downstream	47.3	6	
66 - 65	Deposits Settled Fine	2	Downstream	334.1	6	
67 - 66	Deposits Attached Other	2	Downstream	15.1-57.8	11	1
67 - 66	Deposits Attached Grease	2	Downstream	287.4-332.4	5 & 7	
68 - 67	Deposits Settled Fine	3	Downstream	32.1-87.3	6	
68 - 67	Deposits Settled Fine	2	Downstream	11.0-32.1	6	
68 - 67	Deposits Settled Fine	2	Downstream	117.1-200.0	6	
69 - 68	Deposits Settled Fine	2	Downstream	54.3-159.8	6	

Pipe Segment	Description	Grade[1]	Direction[2]	Distance[3] (feet)	Clock 1[4]	Clock 2[4]
71 - 70	Deposits Settled Fine	3	Downstream	210.6	6	
71 - 70	Deposits Attached Encrustation	2	Downstream	114.5	2	
71 - 70	Deposits Settled Fine	2	Downstream	1.0-54.3	6	
71 - 70	Deposits Attached Grease	2	Downstream	30.9-54.3	5	7
71 - 70	Deposits Settled Fine	2	Downstream	73.5-210.6	6	
71 - 70	Deposits Settled Fine	2	Upstream	52.9-85.5	6	
71 - 70	Infiltration Stain Joint	1	Downstream	114.5	1	

1. Grades are given on a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.

2. The direction of the survey is noted as either upstream or downstream. In this situation, the downstream manhole is always the lowered number manhole (e.g. A survey in pipe segment 38-37 going downstream would start from manhole 38).

3. Distance is the measured length from the manhole where the survey began. Distance 0 is at the starting manhole wall. Distances given in ranges are continuous defects over that range.

4. MACP inspections use clock positions to locate observations. 6 o'clock is at the bottom invert of the pipe. A defect with two clock positions spans that section of pipe.

Overall, no major structural pipe defects were noted. One grade 5 level operation and maintenance defect was noted in pipe segment 60-59, a large deposit of solids was noted at the discharge pipe of manhole 60. There were several locations where infiltration was noted which indicates some groundwater and/or creek water is getting into the sanitary sewer system. There were also several locations where deposits were noted which indicate that low flow periods allow sediment to build up in the pipes. Pictures of the identified defects are cataloged in Appendix B.

2.3.3 Other Observations

Two major items were considered when evaluating the manhole:

1. Distance between manholes and the creek and expected erosion over time.
2. Manhole Rim elevations versus the 100-year BFE and projected sea-level rise scenarios.

2.3.3.1 Distances Between Manholes and Creek

Each manhole was measured from the closest point of the structure to the creek bank. This distance was noted and categorized into one of five category grades based on potential risk, see Table 2-3. Grades are given on a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.

- Grade 5: 1' or less from manhole to creek
- Grade 4: 1' – 3' from manhole to creek
- Grade 3: 3' – 5' from manhole to creek

- Grade 2: 5'-10' from manhole to creek
- Grade 1: >10' from manhole to creek

Table 2-3 Manhole to Creek Distances

Manhole Number	Distance from Manhole to Creek (feet)	Grade
38	35	1
39	23	1
40	50	1
41	7	2
59	6	2
60	10	2
61	14	1
62	25	1
63	10	2
64	50	1
65	0	5
66	3	4
67	14	1
68	11	1
69	75	1
70	>100	1
71	>100	1

The route of the creek can be seen in Figure 1-1 for reference.

Manhole 65 is partially in the creek and there has been significant erosion observed around the structure, as can be seen in Figure 2-1. The erosion around this manhole indicates risk as follows:

- Risk of additional erosion undermining the structure and/or pipe and causing failure,
- Risk of external force damaging the pipe (for example, a boulder or tree transported by floodwaters down the creek).

Manhole 65's defect and proximity to the creek is considered the most risk observed in the project area. If no repair/rehabilitation measures are taken in the short term a serious failure could occur resulting in a sanitary sewer overflow (SSO).

Manhole 66 is also showing signs of erosion and is only a few feet from the edge of the creek bed, as shown in Figure 2-2. Armoring the area around the manhole and the creek bed adjacent to the structure is recommended to prevent further erosion of the creek bank.

There are several other manholes with a grade of 2, which indicates a relatively close proximity to the creek (5-10 feet). These manholes should be monitored but are not considered critical risk at this time.

Figure 2-1 Manhole 65 Erosion

Figure 2-2 Manhole 66 Erosion

2.3.3.2 Manhole Rim Elevations and the 100-year Flood Elevation

Manhole rim elevations were determined based on record drawings of the interceptor. The 100-year BFE is 9-feet (based on NAVD 88 datum) as shown in Figure 2-3. Most manholes along this interceptor are located within the 100-year floodplain. Manhole rim elevations compared with the 100-year BFE were calculated and are presented in Table 2-4. To quantify the possibility of the manholes being inundated during a flooding event, each manhole was given a grade based on the relationship between the rim elevation and the 100-year BFE. Grades are given on a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.

- Grade 5: 0' or less (Rim Elevation minus FEMA Flood Elevation)
- Grade 4: 0.1' – 1' (Rim Elevation minus FEMA Flood Elevation)
- Grade 3: 1.1' – 3' (Rim Elevation minus FEMA Flood Elevation)
- Grade 2: 3.1'-5' (Rim Elevation minus FEMA Flood Elevation)
- Grade 1: >5' (Rim Elevation minus FEMA Flood Elevation)

Table 2-4 Manhole Rim Elevations Versus 100 Year Flood Elevation

Manhole Number	Rim Elevation (feet)	100-Year FEMA Flood Elevation (feet)	Rim Elevation minus FEMA Flood Elevation (feet)	Grade
38	8.6	9	-0.4	5
39	8.4	9	-0.6	5
40	11.6	9	2.6	3
41	11.7	9	2.7	3
59	9.6	9	0.6	4
60	8.7	9	-0.3	5
61	9	9	0	5
62	9.4	9	0.4	4
63	9	9	0	5
64	9.5	9	0.5	4
65	9.5	9	0.5	4
66	10	9	1	4
67	9.3	9	0.3	4
68	9.7	9	0.7	4
69	10.7	9	1.7	3
70	14.2	9	5.2	1

Manhole Number	Rim Elevation (feet)	100-Year FEMA Flood Elevation (feet)	Rim Elevation minus FEMA Flood Elevation (feet)	Grade
71	26.2	9	17.2	1

As shown in Table 2-4, 5 manholes are grade 5 with rim elevations at or slightly below the BFE. Another 6 manholes are grade 4, with rim elevations within 1 foot of the BFE. This indicates a high chance of I/I entering the collection system during a severe flooding event.

Figure 2-3 FEMA 100-Year Flood Elevation Map

When analyzing the 100-year BFE it is also important to consider sea-level rise and how that may impact the 100-year BFE over the long-term planning period. The National Oceanic and Atmospheric Administration (NOAA) was the main source of sea-level rise projections reviewed for the purposes of this study. Projections for the Portland, Maine area are presented in Table 2-5 below.

Table 2-5 Sea Level Rise Projections

Year	Intermediate (feet)	High (feet)	Extreme (feet)
2030	0.79	1.38	1.51
2040	1.12	2.13	2.36
2050	1.48	2.95	3.38
2060	1.90	3.90	4.59
2070	2.33	4.92	5.91
2080	2.82	5.97	7.32
2090	3.35	7.28	9.02
2100	3.84	8.73	10.79

Looking at specifically the projections for the year 2040, a sea-level rise of 1.12 to 2.36-feet is anticipated, and assuming the 100-year BFE increases at the same magnitude, 8 additional manholes would be categorized as a level 5 under extreme predictions, and 7 additional manholes would be categorized as a level 5 for the intermediate predictions. This joins the other 5 manholes already classified as grade 5 in Table 2-4. Sea level rise projections should be analyzed in more detail in a long-term study and be considered when determining the long-term feasibility of maintaining the Mill Creek and Webes Creek Interceptors. Note that storm surge is not anticipated in this location and was therefore not included in the sea level rise projections.

2.3.4 Summary

Based on the findings of the manhole inspections, sewer line CCTV, and analysis of the manhole locations, potential repair/rehabilitation options were determined. As previously mentioned, The erosion around manholes 65 and 66 is considered the most serious defects observed in the project area. If no repair/rehabilitation are taken in the short term a serious failure could occur resulting in a SSO.

Other observations reveal a number of other repair/rehabilitation needs including potentially raising the rims of the manholes above the 100-year BFE, concrete repairs on the exterior of the manholes, cleaning the debris from the sewer pipes, and lining the sewer pipes and manholes to reduce inflow and infiltration (I/I) into the system. Repair options are explored in more detail in Section 3 and the recommended project is summarized in Section 4.

Section 3 Evaluation Of Options

Various manhole and sewer line repair/rehabilitation alternatives and construction mobilization considerations are discussed in this section. The recommended repair/rehabilitation projects and permit considerations are summarized in Section 4.

3.1 Manholes

3.1.1 Manhole 65 Proximity to Creek

The creek bank erosion around manhole 65 is severe and requires stabilization to prevent further erosion. A severe storm or flooding event could undermine the manhole and result in the influent or effluent pipes to the manhole being dislodged or the entire manhole falling into the creek causing an SSO. The only thing holding the structure in place now is gravity and the weight of the concrete barrel and base sections. Options to address concerns that were considered include:

- Do-nothing (remains as is).
- Reconstructing the bank and stabilizing at manhole 65, this could also involve re-routing the creek and/or using sheeting to protect the manhole and prevent further erosion of the bank.
- Moving manhole 65 further away from the creek bank and extending/rerouting the sewer.
- Monitor creek bank and manholes as part of Town's O&M program.

The do-nothing option could have serious environmental and public health implications should further erosion or a storm event cause a failure and or SSO at manhole 65. Therefore, this option has not been considered further.

The existing soils, topography, and hydrology of Mill Creek have resulted in a meandering creek with sharp bends and serious erosion especially along the outside of creek bends. Under normal and low flow conditions, reconstructing and stabilizing the bank would most likely be sufficient to prevent further erosion and the resulting failure of the manhole or its inlet and outlet pipes.

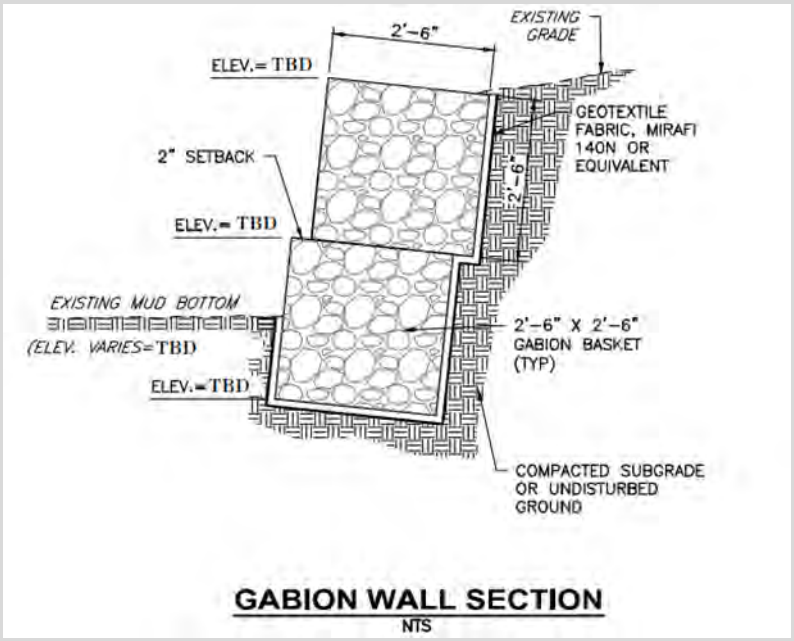
StreamStats was used to conduct a preliminary analysis of the creek flow and to determine anticipated flow during different storm recurrence intervals. This analysis concluded that there is a high volume of flow experienced within the creek bed during storm events. Velocities were estimated to be between 1 ft/sec and 5 ft/sec.

It would be difficult to reconstruct the creek bank in this area without significantly re-routing the creek to offset the cross-sectional area lost adding fill and stabilizing the bank. During high flow/high-velocity events (as modeled with StreamStats), changing the flow path along this creek may have other consequences that result in detrimental changes upstream such as flooding or exacerbated erosion. Based on this uncertainty, reconstructing and stabilizing the bank alone as a way to protect manhole 65 was ruled out.

The third option at manhole 65 would be to move the sewer further away from the creek in this area. To accomplish this, the manhole would be removed, the incoming sewer line to manhole 65 would be extended further into the bank and a new manhole 65 would be installed further away from the creek. Then, to re-connect the new downstream pipe to the existing downstream pipe, an additional manhole 65A would be installed to transition and change direction between the new outlet pipe to the existing. Bypass pumping around this section of interceptor would be required to accomplish this work. With the new manholes and pipe in place, the existing creek bank could be stabilized with gabion baskets in its current configuration. Figure 3-1 is an example detail for

the gabion baskets bank stabilization. The gabion basket layout would be finalized during design and would attempt to match the existing creek bank route to minimize disturbance to creek flow. This option is described further in Section 4 and depicted in Figure 4-1.

Figure 3-1 Gabion Basket Detail



The fourth option is for the Town to monitor the creek bank and manhole 65 for any signs of additional erosion as part of the Town's O&M program. This is the lowest cost option and is discussed in more detail in Section 4.

3.1.2 Manhole 66 Proximity to Creek

The area around manhole 66 is also showing signs of erosion, but it is not as severe as manhole 65. The erosion at manhole 66 could be caused by surface runoff or erosion during high creek levels. Options to address concerns that were considered include:

- Do-nothing (remains as is).
- Reconstructing the bank and stabilizing at manhole 66, this could also involve re-routing the creek and/or using sheeting to protect the manhole and prevent further erosion of the bank.
- Moving manhole 66 further away from the creek bank and extending/rerouting the sewer.
- Monitor creek bank and manholes as part of Town's O&M program.

Although, less of an immediate risk than at manhole 65, the do-nothing option could also have serious environmental and public health implications similar to manhole 65. Bank erosion has been witnessed over time by sewer department staff, and based on this, the remaining bank at manhole 66 could be eroded in a short period of time. Therefore, the do-nothing option was not considered further.

Considering there is still some embankment soil left at manhole 66, this location may be a better candidate for bank stabilization than manhole 65. This would involve reinforcement with gabion baskets and matting to prevent further erosion. The layout of the gabion baskets would be finalized during final design and would attempt to match the existing creek bank route to minimize disturbance to creek flow. This option is described further in Section 4.

At manhole 65, moving the manhole and rerouting the piping was feasible due to the sharp (almost 90-degree) bend in the interceptor at that manhole. The bend at manhole 66 is less sharp and would therefore require significantly more pipe replacement to route the interceptor further away from the creek. That additional length of pipe makes this option significantly more expensive than stabilizing the bank alone, therefore, this option seems less feasible than bank stabilization.

The fourth option is for the Town to monitor the creek bank and manhole 65 for any signs of additional erosion as part of the Town's O&M program. This is the lowest cost option and is discussed in more detail in Section 4.

3.1.3 Other Manholes and Proximity to Creek

Considering the difficult access to this site, this study prioritizes only immediate needs based on manholes close to the creek bank rated grade 4 and 5 as defined in Table 2-3. Other manholes along the interceptor are not at critical risk of failure. However, due to the constant erosion along the creek, all other manholes should be monitored by the Town over time as part of their O&M program to document further erosion and any increase in risk of failure. No repair options at these manholes were considered except as noted below.

3.1.4 Flood Elevation

Risk of the manholes being inundated is significant based on the rim elevations of the structures and the location of the interceptor next to a tidal creek. The 100-year BFE is 9-feet (based on NAVD 88 datum) and many manholes in the study have little to no buffer above the 100-year BFE. Raising the manhole rims to at least 2-feet above the 100-year BFE reduces the risk of flooding and meets NEIWPCC's TR-16 guidance on flood protection. The following options have been considered:

- Do-nothing
- Raise the rims by either adding riser rings, barrel sections or extending the chimney of the structures to the desired elevation.
- Providing watertight covers.

Occasional inflow and infiltration into the sewer system are a concern, however, it is not considered an immediate concern. Over time, as base flood elevations rise, the increase in inflow and infiltration may become more of a concern. Therefore, the do-nothing option in regard to rim elevation for many manholes may be desirable to the Town in the short-term along this interceptor.

Raising the rim elevation to above the flood and/or sea-level rise levels is another option for the Town to consider. However due to the difficult access to the site, and to limit costs, the Town may choose to only raise manhole rim elevation at select manholes, or perhaps only at manholes receiving other repairs/upgrades.

The Town does not want to consider water-tight bolt-on covers, as this would make access for future maintenance very difficult. Therefore, this option will not be considered further.

Any work to raise the rims of the manhole should also consider the projected sea-level rise scenarios presented in Table 2-5, and at a minimum meet NEIWPCC TR-16 guidance of BFE +2-feet.

3.1.5 Exterior and Interior Manhole Condition Assessment

Several manholes are showing signs of wear on the exposed exterior sections of the structures in the form of cracks and surface spalling. This wear does not pose an immediate threat to the structural integrity of the manholes. However, continued wear could increase rainwater inflow into the structures and eventually result in structural failure of the manhole(s) in the long term. It is recommended repairs are made to the exterior of the manholes when/if the rims of the structures are raised.

Signs of infiltration were noted in several manholes. Exterior coating or wrapping of any new manholes could minimize water intrusion or epoxy coating the interior of the existing structures could also reduce I/I. The Town may want to consider this option in the future more if I/I reduction becomes a priority at the Mill Creek Pump Station or the Wastewater Treatment Facility.

3.2 Sewer Interceptor Pipe

3.2.1 Pipe Defects

There were no serious structural defects noted in the pipe along the interceptor. The only pipe that is considered at risk of failure is the pipe at manhole 65 which could dislodge or break if that manhole were to become undermined or fail. The pipe is also exposed and considered vulnerable to damage by objects in the flow path. Options for repair of that area are described in Section 3.1.1. Repair options for the non-critical defects noted below are described below for information only. It is suggested that the Town consider long-term planning and a future study to address the long-term needs of the Mill Creek Interceptor before addressing non-critical defects.

Non-critical defects such as infiltration stains, drippers, and gushers were noted in the CCTV inspections. Options evaluated for the interceptor pipe include:

- Do-nothing
- Relining the pipe
- Point repairs
- Routine maintenance/jetting

As noted previously, these defects are not considered critical, and therefore, the do-nothing approach may be the best option in the short term.

The Town could also consider relining individual pipe segments or the entire interceptor(s) to reduce extraneous groundwater and rainwater from getting into the collection system. Relining would extend the life of the pipe and also minimize the impact of the cracks and joint separations that were noted in the inspections.

Individual point repairs or the replacement of individual pipe segments would address these defects and extend the life of the interceptor while reducing infiltration and inflow. However, this work would require excavation in a difficult to access area with environmental impacts and relining may be more feasible and have less environmental impact.

The Town has a 40-foot maintenance easement for the Mill Creek Interceptor, 20-feet on either side of the sewer main. There are limited options to access the interceptor and its manholes. However, where access is available, the Town may want to consider a routine maintenance and jetting schedule in this area. A jetting plan should be developed to clean the Mill Creek and Webes Creek interceptors on a regular basis (at least once every 3-5 years). The CCTV inspections noted a few dozen locations of deposits in the form of gravel, fines, grease, and encrustations. These deposits likely occur during low flow events when suspended material falls out of suspension. Regular jetting would reduce these deposits and improve flow through the interceptors.

3.3 Construction Mobilization Considerations

A local contractor was consulted to determine the feasibility of mobilizing equipment to the site to complete the various repair/rehabilitation alternatives focusing on the immediate needs. A site visit with Crooker Construction, Wright-Pierce, and Town staff was completed on April 26th, 2021 to discuss site access and potential repair/rehabilitation options.

The major items the Crooker Construction representative mentioned that would impact the constructability of any repair/rehabilitation projects are summarized below:

- Permitting
  - It should be researched and determined what Maine DEP will allow for site alteration and remediations methods. If this is considered a maintenance item on existing infrastructure the permitting requirements may be less stringent and less costly. Note that our initial conversations with DEP indicated that work to address manhole 65 would most likely not be considered a maintenance item for permitting purposes.

- Access to structures
  - A minimum 20-foot wide access easement with a temporary (or permanent) gravel access road would be needed to access any of the manholes with large equipment that would be necessary for the work at manhole 65 and 66. For manhole 65 an access road could be cut from Gnome Landscaping or the 295-spur. For manhole 66 the walking path behind Gnome Landscaping could be widened to allow equipment access or the use of crane matting could be used across the creek bed to access manhole 66 from the manhole 65 access road.
  - Winter construction would be preferable to minimize site disturbance and environmental impact in and around the creek.

- Easements
  - Temporary or permanent access easements would be required from property owners to allow for access to the manholes.
  - The existing boundaries of the Mill Creek Interceptor easement should be confirmed to determine if additional easements are needed to reroute the sewer line.

Section 4 Recommendations

4.1 General

The proposed project below considers the information gathered during the sewer line CCTV and manhole inspections, manhole and creek locations, permit requirements, construction feasibility, and the cost of repairs/rehabilitation.

4.2 Permit Requirements

The permit requirements for any repair/rehabilitation project(s) along the interceptors were researched to determine the impact on project scope. Three main permitting requirements were identified:

- Town of Falmouth - Shoreland Zoning Permit
  - This permit would apply to work within 100-feet horizontal distance of the normal high-water line of any designated stream or brook. Manholes 38-69 would fall within this distinction and require a permit and Planning Board approval. The permit can be obtained on the Town of Falmouth's website and requires a description of the project and the Code Enforcement Officer's approval.

- Maine DEP Natural Resources Protection Act (NRPA) - Individual Permit
  - Based on correspondence with a DEP representative, the Town has a right to maintain the structures and sewer line that are there. Any work on the existing infrastructure would qualify for an exemption to an Individual Permit under 480-Q. However, the exemption states that no additional encroachment into the protected natural resource is allowed without a permit. This would include any tree clearing, road building, installation of gabion baskets, or moving structures. Ultimately, the proposed alterations would require an individual permit and a 120-day review period from DEP.

- Army Corps of Engineers – Maine General Permit Category 1 (Self Verification Notification)
  - Mill Creek and Webes Creek are impacted by the ebb and flow of the tide and therefore are classified as navigable waters. The scope for this work appears to fall under General Permit # 7 – Bank and Shoreline Stabilization Including Living Shorelines. Work under this section is governed by General Condition 28. Since the proposed work will impact less than 500 linear feet of shoreline below the high tide line (HTL) and less than 200 linear feet below the mean high-water mark (MHWM), work will fall under a Category 1 permit application. The permit application is limited to a 1-page Self-Verification Notification Form. Category 1 permits are also subject to review from the Maine Historic Preservation Commission (MHPC) and the Tribal Historic Preservation Officers (THPO).

4.3 Alternative Analysis and Estimated Construction Cost

As noted in Section 3, two Options for both Manhole 65 and Manhole 66 were selected for further evaluation:

- Short-term repair: moving manhole 65 further away from the creek bank and extending/rerouting the sewer. Reconstructing the bank and stabilizing at manhole 66, this could also involve re-routing the creek and/or using sheeting to protect the manhole and prevent further erosion of the bank.
- Monitor creek bank and manholes as part of Town's O&M program.

The scope of the short-term repair project for manhole 65 includes the following:

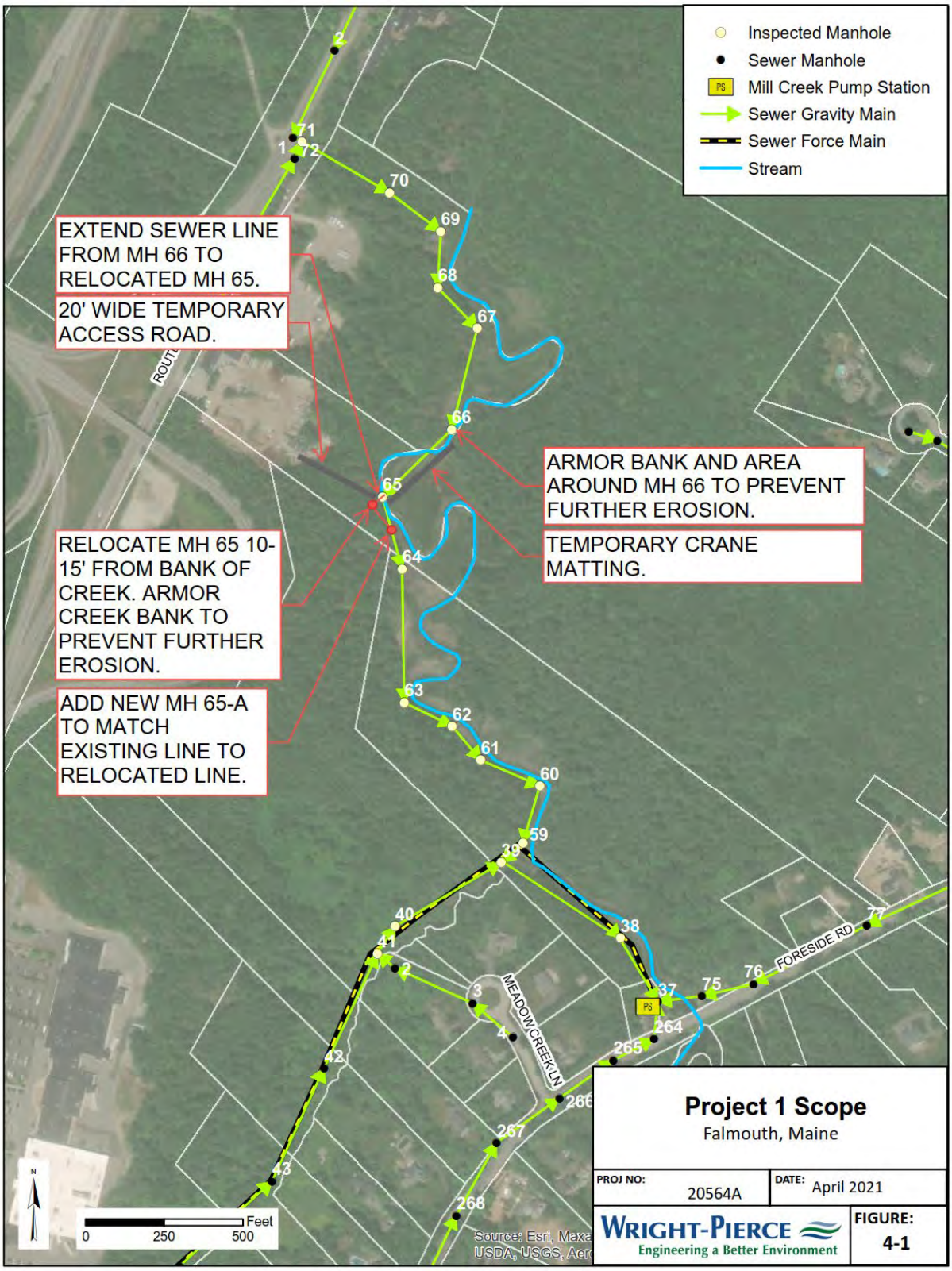
- Clearing, grubbing, and constructing a temporary gravel access road from Gnome Landscaping to the area just south of manhole 65. This will require temporary construction easements. The Town could consider making this a permanent access road, but permanent easements would be required. The cost estimate reflects a temporary access road.
- Removing and replacing (or relocating) manhole 65 10-15 feet from its current location west into the woods, away from the creek.
- Connecting to and extending the interceptor from manhole 66 to the new location of manhole 65.
- Installing a second manhole (65-A), south of manhole 65's current position, and laying a new sewer pipe to connect manhole 65 in its new location to manhole 64.
- Armoring the bank with gabion baskets along the existing manhole 65 location to prevent further erosion of the bank.
- Since work will already be taking place at the manhole, the rim of the structure should be raised above the 100-year flood elevation plus the TR-16 recommendation of BFE +2-feet. Since manhole 65 rim elevation is 9.5' compared with 100-year BFE of 9.0', raising this manhole rim elevation to 11.0' would also provide at least 6-inches of buffer for extreme sea-level predictions over the next 10-years as described in Table 2-5.

The scope of the short-term repair project for manhole 66 includes the following.

- Installing crane matting across the creek bed area from manhole 65 to manhole 66 to allow for access to manhole 66.
- Armoring manhole 66 with gabion baskets and stabilizing matting to reduce erosion.
- Since work will already be taking place at the manhole, the rim of the structure should be raised 2-feet above the 100-year BFE to 11.0 feet, which would increase the height by about 1 foot. This could be accomplished by either installing riser rings, or perhaps replacing the cone section.

Figure 4-1 illustrates the proposed scope for the short-term repair projects at manholes 65 and 66.

Figure 4-1 Short-Term Repair Project Scope



A breakdown of the estimated construction and total project costs are presented below in Table 4-1.

Table 4-1 Short-Term Repair Project Estimated Construction Costs

Item	Estimated Cost
General	
Mobilization/Demobilization	$20,000
Erosion & Sedimentation Control	$10,000
Clearing & Grubbing	$10,000
Installation of Temporary Access Road (Type D Gravel)	$75,000
Site Restoration	$50,000
Manhole 65 Restoration	
Installation of Two Manholes	$30,000
Replacement of Existing Sewer Line	$15,000
Supply & Installation of Gabion Baskets	$10,000
Sewer Bypass Pumping	$25,000
Manhole 66 Restoration	
Supply and Use of Crane Matting	$20,000
Additional Erosion and Sedimentation Control	$5,000
Raise Rim of Manhole	$5,000
Supply & Installation Gabion Baskets	$10,000
Subtotal, Construction Cost	**$285,000**
Contingency (20%)	$57,000
Total Construction Cost Budget	**$342,000**
Engineering Services/Design and Permitting (25%)[1,2]	$86,000
Total Project Cost	**$428,000**

1. Engineering Services include preparing plans and specifications for bidding, bidding services, and construction administration services. Permitting work to be completed under this task includes scheduling and Wright-Pierce attendance at one pre-application meeting with representatives from Army Corps and Maine DEP. This pre-application meeting will assist in confirming permitting needs which are anticipated to involve an Individual Permit from Maine DEP Natural Resources Protection Act, as well as a Category I permit from the Army Corps Maine Programmatic General Permit. Wright-Pierce will also consult with the Maine Natural Areas Program (MNAP), Maine Historic Preservation Commission (MHPC), and Tribal Historic Preservation Officers (THPO) for review of the project and potential impacts to protected areas. In support of the permit applications, Wright-Pierce will also develop plan and cross-section views of the proposed improvements. This will consist of using LiDAR contours as well as available tidal data to calculate impacts to

land below Mean High Water (MHW). Wright-Pierce will also respond to one round of comments from both Army Corps and DEP and incorporate their comments in the bidding documents.

2. Legal and survey work for easement not included.

The clearing & grubbing and installation costs for the temporary access road in Table 4-1 above include clearing a 20-foot-wide path from Gnome Landscaping to the area south of manhole 65. A culvert may be required for this temporary access road. If needed, the size and location of the culvert will be determined in final design. A temporary construction easement would be required for this work. Legal and survey work for a temporary easement were not included in the engineering services budget. Access to manhole 66 includes installing temporary matting across the creek bed from manhole 65 to manhole 66, see Figure 4-1.

Site restoration in Table 4-1 above includes removing the temporary access road gravel (if desired by the landowner granting the easement), loaming and seeding down the impacted area, and replanting trees as required by Maine DEP. The Town could consider maintaining the temporary access road as a permanent easement. This would reduce site restoration costs but would most likely require permanent easements from the landowners.

In conclusion, the total project cost for the short-term repair project is estimated to be $428,000 (ENR 12112, June 2021) .

4.4 Recommended Alternative

In lieu of a short-term fix that would involve installing an expensive access corridor to move at-risk manholes further away from the creek and armor the bank, the Town has elected to immediately move forward with a study that will evaluate long-term replacement options for the MCI. Following completion of the long-term options study, the Town plans to move forward with design and construction of the recommended long-term solution to alleviate both the short-term risks associated with problem areas along the MCI as well as address the long-term needs of the Town to convey flows form the Route 1 are of Falmouth and Cumberland to the Wastewater Treatment Facility. In the meantime, the Town as part of its O&M program will regularly check the at-risk areas for additional erosion.

Appendix A
Overview of Manhole Inspection Observations

Manhole defects observed during the manhole inspections are photographed below. A list of defects observed are presented below in Table A-1.

TABLE A-1
OBSERVED MANHOLE DEFECTS

Manhole Number	Depth[1] (feet)	Component	Code	Grade[2]	Location 1[3]	Location 2[3]
38	10	Bench	Deposits Attached Rags	1	12	12
39	12	Channel	Deposits Attached Grease	1	6	9
40	1	Chimney Exterior	Broken	4	12	12
41	4	Wall Interior	Deposits Attached Rags	1	2	4
41	1	Chimney Exterior	Crack Multiple	3	12	3
59	5	Chimney Interior	Deposits Attached Rags	1	12	12
60	5	Wall Interior	Deposits Attached Rags	1	2	4
61	1	Chimney Exterior	Crack Multiple	3	12	12
63	5	Chimney Interior	Infiltration Dripper	3	12	12
64	9	Wall Interior	Infiltration Dripper Barrel	3	12	12
64	1	Chimney Exterior	Crack Longitudinal	2	12	12
67	0	Frame	Fracture Longitudinal	3	4	4
68	9	Wall Interior	Infiltration Dripper	3	1	3
69	2	Chimney Interior	Infiltration Dripper	3	12	12
69	9	Stub Connection	Infiltration Dripper	3	3	3

1. Observation depths are measured from the rim of the manhole down to the defect.
2. Grades are given in a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.
3. MACP inspections use clock positions to locate observations. The outlet pipe of a manhole is always at the 6 o'clock position. For example, a defect from 12 to 3 would be equivalent to 25% of the manhole circumference.

Manhole 38
Bench - Deposits Attached Rags

Manhole 39
Channel - Deposits Attached Grease

Manhole 40
Chimney Exterior - Broken

Manhole 41

Wall Interior - Deposits Attached Rags

Chimney Exterior - Crack Multiple

Manhole 59
Chimney Interior - Deposits Attached Rags

Manhole 60
Wall Interior - Deposits Attached Rags

Manhole 61
Chimney Exterior - Crack Multiple

Manhole 63
Chimney Interior - Infiltration Dripper

Manhole 64
Chimney Exterior - Crack Longitundinal

Manhole 67
Frame - Fracture

Manhole 68
Wall Interior - Infiltration Dripper

Manhole 69

Chimney Interior - Infiltration Dripper

Stub Connection - Infiltration Dripper

Appendix B
Overview of Sewer Line CCTV Observations

Pipe defects observed during the CCTV inspections are photographed below. A list of defects observed are presented below in Table B-1.

TABLE B-1
OBSERVED PIPE SEGMENT DEFECTS

Pipe Segment	Description	Grade[1]	Direction[2]	Distance[3] (feet)	Clock 1[4]	Clock 2[4]
38 - 37	Deposits Settled Fine	3	Downstream	7	6	
38 - 37	Deposits Settled Gravel	2	Upstream	102.0-209.8	6	
38 - 37	Deposits Attached Grease	2	Upstream	0-50.3	4 & 8	
39 - 38	Deposits Settled Fine	4	Downstream	157.3	8	12
39 - 38	Deposits Settled Fine	3	Upstream	2.8	6	
39 - 38	Deposits Settled Fine	2	Downstream	80.1-156.8	6	
40 - 39	Infiltration Runner Joint	4	Downstream	63.3	7	11
40 - 39	Deposits Attached Encrustation	2	Downstream	63.3	7	5
40 - 39	Deposits Attached Other	2	Downstream	359	8	
40 - 39	Deposits Attached Grease	2	Downstream	0-400.2	4 & 8	
43 - 42	Infiltration Dripper Joint	3	Downstream	147.4	11	
43 - 42	Deposits Settled Fine	3	Downstream	78.1-222.3	6	
43 - 42	Deposits Settled Fine	3	Downstream	222.3-265.2	6	
43 - 42	Deposits Attached Encrustation	2	Downstream	147.4	7	11
43 - 42	Deposits Attached Grease	2	Downstream	195.3-222.3	8	
44 - 43	Deposits Attached Grease	2	Downstream	100.4-176.8	5 & 7	
45 - 44	Deposits Settled Fine	2	Downstream	368.8-400.7	6	
46 - 45	Infiltration Runner Joint	4	Upstream	306.9	4	
46 - 45	Infiltration Dripper Joint	3	Upstream	306.9	2	
46 - 45	Obstruction Rocks	3	Upstream	392.7	6	
46 - 45	Deposits Settled Fine	2	Upstream	5.4-321.8	6	
46 - 45	Deposits Attached Encrustation	2	Upstream	20.1	9	
46 - 45	Deposits Attached Encrustation	2	Upstream	306.9	2	
46 - 45	Infiltration Stain Joint	1	Upstream	20.1	9	
46 - 45	Infiltration Stain Joint	1	Upstream	176.1	9	
60 - 59	Deposits Settled Fine	5	Downstream	0	8	12
60 - 59	Joint Separated Medium	3	Upstream	71.1	6	
61 - 60	Deposits Settled Fine	3	Downstream	109	6	
61 - 60	Deposits Settled Fine	3	Upstream	0	6	
65 - 64	Crack Longitudinal	2	Downstream	3.7	4	
65 - 64	Deposits Attached Grease	2	Downstream	154.7-174.7	6	
66 - 65	Deposits Settled Fine	2	Downstream	21.8-39.3	6	
66 - 65	Deposits Settled Fine	2	Downstream	47.3	6	
66 - 65	Deposits Settled Fine	2	Downstream	334.1	6	
67 - 66	Deposits Attached Other	2	Downstream	15.1-57.8	11	1
67 - 66	Deposits Attached Grease	2	Downstream	287.4-332.4	5 & 7	

Pipe Segment	Description	Grade[1]	Direction[2]	Distance[3] (feet)	Clock 1[4]	Clock 2[4]
68 - 67	Deposits Settled Fine	3	Downstream	32.1-87.3	6	
68 - 67	Deposits Settled Fine	2	Downstream	11.0-32.1	6	
68 - 67	Deposits Settled Fine	2	Downstream	117.1-200.0	6	
69 - 68	Deposits Settled Fine	2	Downstream	54.3-159.8	6	
71 - 70	Deposits Settled Fine	3	Downstream	210.6	6	
71 - 70	Deposits Attached Encrustation	2	Downstream	114.5	2	
71 - 70	Deposits Settled Fine	2	Downstream	1.0-54.3	6	
71 - 70	Deposits Attached Grease	2	Downstream	30.9-54.3	5	7
71 - 70	Deposits Settled Fine	2	Downstream	73.5-210.6	6	
71 - 70	Deposits Settled Fine	2	Upstream	52.9-85.5	6	
71 - 70	Infiltration Stain Joint	1	Downstream	114.5	1	

1. Grades are given in a 1 to 5 scale, with 5 being the most severe and 1 being the least severe.

2. The direction of the survey is noted as either upstream or downstream. In this situation the downstream manhole is always the lowered number manhole (e.g. A survey in pipe segment 38-37 going downstream would start from manhole 38).

3. Distance is the measured length from the manhole where the survey began. Distance 0 is at the starting manhole wall. Distances given in ranges are continuous defects over that range.

4. MACP inspections use clock positions to locate observations. 6 o'clock is at the bottom invert of the pipe. A defect with two clock positions spans that section of pipe.

38 - 37 Deposits Settled Fine

38 - 37 Deposits Settled Gravel

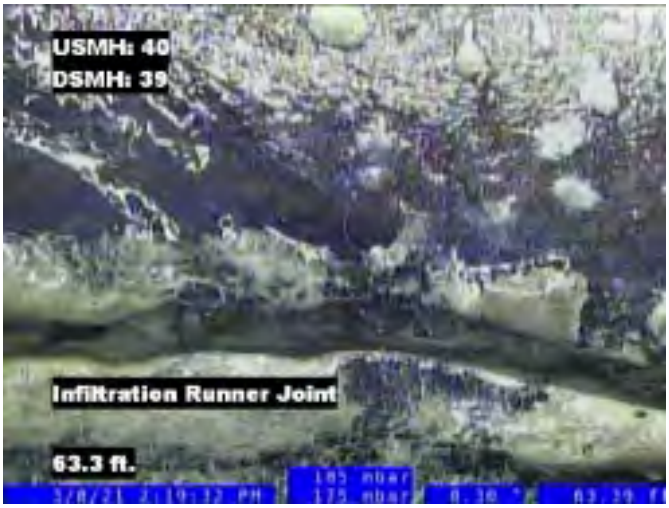
38 - 37 Deposits Attached Grease

39 - 38 Deposits Settled Fine

39 - 38 Deposits Settled Fine

39 - 38 Deposits Settled Fine

40 - 39 Infiltration Runner Joint

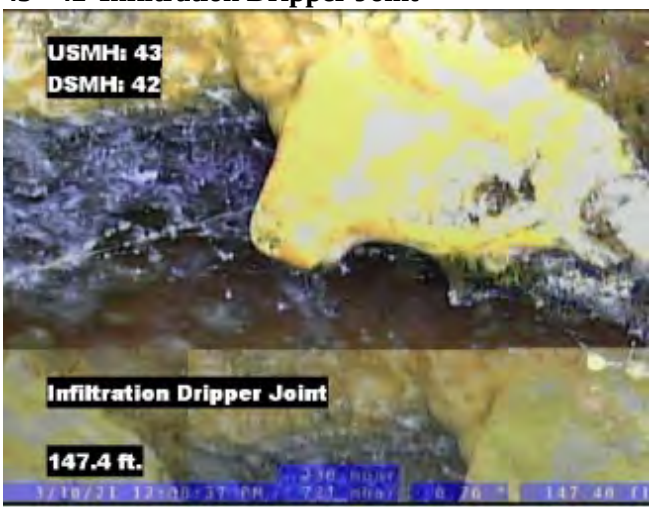


40 - 39 Deposits Attached Encrustation

40 - 39 Deposits Attached Other

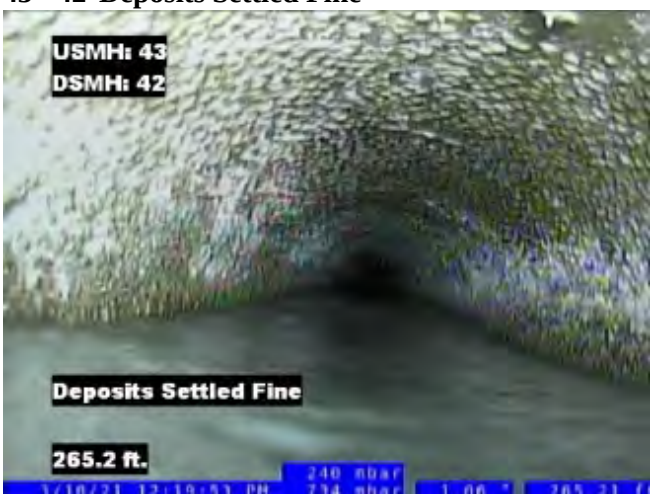
40 - 39 Deposits Attached Grease

43 - 42 Infiltration Dripper Joint



43 - 42 Deposits Settled Fine

43 - 42 Deposits Settled Fine



43 - 42 Deposits Attached Encrustation

43 - 42 Deposits Attached Grease

44 - 43 Deposits Attached Grease

45 - 44 Deposits Settled Fine

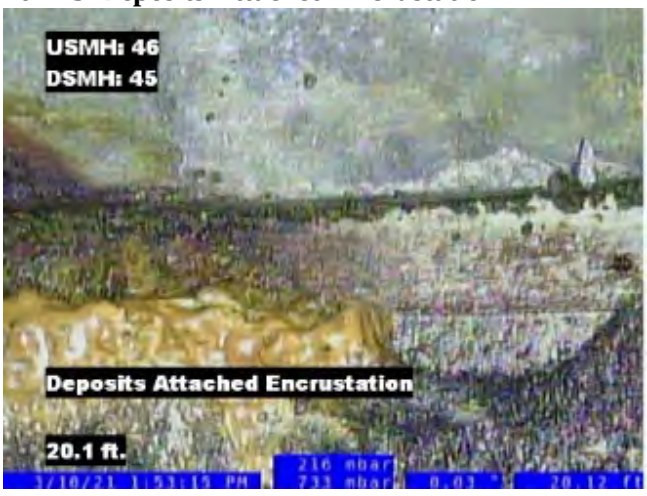
46 - 45 Infiltration Runner Joint

46 - 45 Infiltration Dripper Joint

46 - 45 Obstruction Rocks

46 - 45 Deposits Settled Fine

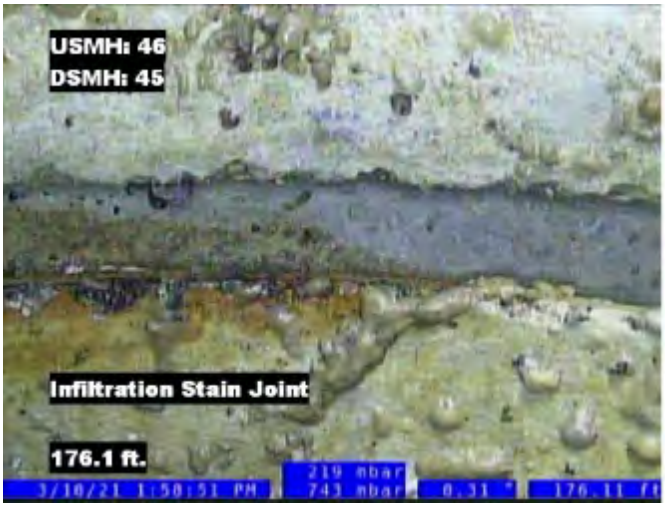
46 - 45 Deposits Attached Encrustation



46 - 45 Deposits Attached Encrustation

46 - 45 Infiltration Stain Joint

46 - 45 Infiltration Stain Joint



60 - 59 Deposits Settled Fine

60 - 59 Joint Separated Medium

61 - 60 Deposits Settled Fine

61 - 60 Deposits Settled Fine

65 - 64 Crack Longitudinal

65 - 64 Deposits Attached Grease

66 - 65 Deposits Settled Fine

66 - 65 Deposits Settled Fine

66 - 65 Deposits Settled Fine

67 - 66 Deposits Attached Other

67 - 66 Deposits Attached Grease

68 - 67 Deposits Settled Fine

68 - 67 Deposits Settled Fine

68 - 67 Deposits Settled Fine

69 - 68 Deposits Settled Fine

71 - 70 Deposits Settled Fine

71 - 70 Deposits Attached Encrustation

71 - 70 Deposits Settled Fine

71 - 70 Deposits Attached Grease

71 - 70 Deposits Settled Fine

71 - 70 Deposits Settled Fine

71 - 70 Infiltration Stain Joint

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B

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Appendix B
Flow Analysis

Appendix B - Flow Analysis

			Notes (*Source of data from Town)
Johnson Rd Pump Station - Current			
Average Hourly Flow (1/2020-11/2022)	33.0	GPM*	From pump run time and drawdown results provided by Town
Estimated Peaking Factor	6	(TR-16 Figure 2-1)	
Total Peak Hourly Flow	198.0	GPM	
Pump Station Designed for 315 GPM	315.0	GPM	Drawdown testing done 11/22/21 by Town resulted in 313.7 gpm
Northbrook Pump Station - Current			
Average Hourly Flow (2020-2021)	7.0	GPM*	From pump run time and drawdown results provided by Town
Estimated Peaking Factor	6	(TR-16 Figure 2-1)	
Total Peak Hourly Flow	42.0	GPM	
Pump Station Designed for 120 GPM	120.0	GPM	Drawdown tests by Town in Jan 2022 resulted in 166 and 198 gpm
Johnson Rd Pump Station - Future Growth			
Lot U62-001 (Falmouth)	70200	GPD*	50 Acre lot. Assumes 9 units/acre at 156 gpd/unit
Route 1 (Cumberland)	1290	HCF/month*	Various Lots (From Bill Shane in Cumberland 11/30/22)
Sum Total Average Daily Flow	102364	GPD	
Sum Total Average Daily Flow	71.1	GPM	
Estimated Peaking Factor	6	(TR-16 Figure 2-1)	
Total Future Growth Peak Hourly Flow	426.5	GPM	
Current Peak Hourly Flow	198.0	GPM	
Total Future Design Peak Hourly Flow	624.5	GPM	
Pump Station Designed for 315 GPM	315.0	GPM	Pump Station would require upgrade to accommodate future flow
Northbrook Pump Station - Future Growth			From Ethan Croce in Falmouth
Lot U59-011	12480	GPD*	Assumes 40 acres developed @ 2 units/acre
Estimated Average Hourly Flow	8.7	GPM	and assumes 156 gpd/unit
Estimated Peaking Factor	6	(TR-16 Figure 2-1)	
Total Future Growth Peak Hourly Flow	52.0	GPM	
Current Peak Hourly Flow	42.0	GPM	
Total Future Design Peak Hourly Flow	94.0	GPM	
Pump Station Designed for 120 GPM	120.0	GPM	
Inflow/Infiltration (I/I)			
			750 ft south of MCI on Rt. 1, then 2500 ft north on Route 1. Installed 1969.
8" Gravity Pipe Length	3250	feet	
I/I estimate: 400 gpd per inch mile of pipe	4000	GPD/inch*mile	TR-16 Recommendation 250-500 GPD/inch*mile for new pipe.
Estimated Average Hourly Flow	13.7	GPM	No peaking factor associated with I/I flows
Gravity Flow Along Route 1 in Falmouth			
			Lots (12): U15-001-B, U53-002, U15-001-A, U13-001, U15-004, U53-003-001, U59-009-A, U59-009, U54-028,
12 Lots with Existing Buildings	25668.8	GPD	U54-028-002, U54-003, U54-002-002,
12 Lots with Existing Buildings	17.8	GPM	523 gallons per acre (2017 West Falmouth Sewer Master Plan)
Estimated Peaking Factor	6	(TR-16 Figure 2-1)	
Estimate Peak Hourly Flow	107.0	GPM	
Total Estimate Current Flow Through Mill Creek Interceptor (MCI)			
Johnson Rd Pump Station - Current Design	198.0	GPM	
Northbrook Pump Station - Current Design	42.0	GPM	
Inflow/Infiltration (I/I)	13.7	GPM	
Gravity Flow	107.0	GPM	
Total MCI Current Peak Hourly Flow	360.6	GPM	0.52 MGD
Total Estimate Future Flow Through Mill Creek Interceptor (MCI)			
Johnson Rd Pump Station - Future Design	624.5	GPM	
Northbrook Pump Station - Future Design	94.0	GPM	
Inflow/Infiltration (I/I)	13.7	GPM	
			Current average estimate accounts for future development
Gravity Flow	107.0	GPM	on partially developed parcels
Total MCI Future Peak Hourly Flow	839.1	GPM	1.21 MGD

*Source of data from Town (Falmouth/Cumberland)

Units:

HCF =	Hundred Cubic Feet
GPD =	Gallons Per Day
GPM =	Gallons Per Minute

Gravity Flow Along Route 1 in Falmouth Summary

Lot	Acres	Flow (GPD) /Acre	Total Flow (GPD)
U-15-001-B	12.4	523	6485
U53-002	4.39	523	2296
U15-001-A	2.4	523	1255
U13-001	6.3	523	3295
U15-004	2.37	523	1240
U53-003-001	2.58	523	1349
U59-009-A	0.92	523	481
U59-009	1.78	523	931
U54-028	6.48	523	3389
U54-028-002	4.89	523	2557
U54-003	2.05	523	1072
U54-002-002	2.52	523	1318
		sum=	25668.8 GPD

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Appendix C
Project and Construction Cost Estimates

TOWN OF FALMOUTH
LONG TERM REPLACEMENT OPTIONS FOR MILL CREEK INTERCEPTOR
W-P PROJECT NO. 20564B
ENR INDEX 12791, 3/2022
PROJECT COST SUMMARY

PROJECT COMPONENT		Do nothing COST-ALT 1A	Maintain exist. MCI COST-ALT 1B	Rt 1 to Webes COST-ALT 2	Johnson - Rt 88 COST-ALT 3A	Remove JRPS COST-ALT 3B	Route 1 to JRPS COST-ALT 3C	LRPS via Depot/Lunt COST-ALT 4A	LRPS via XC COST-ALT 4B	LRPS via Bucknam/ Legion/Depot COST-ALT 4C	Wye into Mill Creek FM COST-ALT 5	COMMENTS
CONSTRUCTION		-	$370,000	$13,078,000	$12,354,000	$13,521,000	$12,023,500	$13,463,000	$12,739,000	$13,071,000	$12,371,000	Refer to Construction Summary
CONSTRUCTION CONTINGENCY	5.0%	-	$20,000	$650,000	$620,000	$680,000	$600,000	$670,000	$640,000	$650,000	$620,000	Allowance
TECHNICAL SERVICES	25.0%	-	$93,000	$3,270,000	$3,089,000	$3,380,000	$3,006,000	$3,366,000	$3,185,000	$3,268,000	$3,093,000	
MATERIALS TESTING	1.00%	-	$4,000	$131,000	$124,000	$135,000	$120,000	$135,000	$127,000	$131,000	$124,000	Allowance
LEGAL/ ADMINISTRATIVE	2.0%	-	$7,000	$262,000	$247,000	$270,000	$240,000	$269,000	$255,000	$261,000	$247,000	Allowance
SUBTOTAL		-	$494,000	$17,391,000	$16,434,000	$17,986,000	$15,989,500	$17,903,000	$16,946,000	$17,381,000	$16,455,000	
FINANCING	1.0%	-	$5,000	$174,000	$164,000	$180,000	$160,000	$179,000	$169,000	$174,000	$165,000	Estimated interim interest
ENGINEER'S ESTIMATE OF PROJECT COST		-	$500,000	$17,570,000	$16,600,000	$18,170,000	$16,150,000	$18,080,000	$17,120,000	$17,560,000	$16,620,000	

Notes:
1) Cost estimate is based on ENR INDEX 12791, 3/2022

TOWN OF FALMOUTH
LONG TERM REPLACEMENT OPTIONS FOR MILL CREEK INTERCEPTOR
W-P PROJECT NO. 20564B
ENR INDEX 12791, 3/2022
CONSTRUCTION BID COST SUMMARY

DESCRIPTION	ESTIMATED COST ALT 2	ESTIMATED COST ALT 3A	ESTIMATED COST ALT 3B	ESTIMATED COST ALT 3C	ESTIMATED COST ALT 4A	ESTIMATED COST ALT 4B	ESTIMATED COST ALT 4C	ESTIMATED COST ALT 5
UMCPS Bid Cost (1.21 MGD for all except 3B, for 3B 0.31 MGD)	$2,034,000	$2,352,000	$2,352,000	$1,857,000	$2,039,000	$2,039,000	$2,039,000	$2,240,000
Horizontal Cost	$4,109,000	$3,067,000	$6,559,000	$1,807,000	$3,489,000	$2,765,000	$3,097,000	$3,196,000
Total UMCPS PS/FM/GS	**$6,143,000**	**$5,419,000**	**$8,911,000**	**$3,664,000**	**$5,528,000**	**$4,804,000**	**$5,136,000**	**$5,436,000**
Johnson Road PS (0.90 MGD for all except 3C, for 3C 1.21 MGD)	$1,750,000	$1,750,000	$0	$2,352,000	$1,750,000	$1,750,000	$1,750,000	$1,750,000
Johnson Road FM (1150 LF)	$575,000	$575,000	$0	$1,397,500	$575,000	$575,000	$575,000	$575,000
Total Johnson Road PS/FM	**$2,325,000**	**$2,325,000**	**$0**	**$3,749,500**	**$2,325,000**	**$2,325,000**	**$2,325,000**	**$2,325,000**
Lunt Road PS (2.13 MGD Alt 2/3/5; 3.34 MGD Alt 4A/B/C)	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$4,000,000	$4,000,000	$4,000,000	$3,000,000
Lunt Road FM (4600 LF)	$1,610,000	$1,610,000	$1,610,000	$1,610,000	$1,610,000	$1,610,000	$1,610,000	$1,610,000
Total Lunt Road PS/FM	**$4,610,000**	**$4,610,000**	**$4,610,000**	**$4,610,000**	**$5,610,000**	**$5,610,000**	**$5,610,000**	**$4,610,000**
ENGINEERS ESTIMATE OF TOTAL CONSTRUCTION BID COST	**$13,078,000**	**$12,354,000**	**$13,521,000**	**$12,023,500**	**$13,463,000**	**$12,739,000**	**$13,071,000**	**$12,371,000**

D

Appendix D
JRPS Capacity Assessment

WRIGHT-PIERCE
Engineering a Better Environment

Technical Memorandum

Date: 2/7/2023

Project No.: 20564B/WWME

To: Dan Marks, Town of Falmouth

From: Bryanna Denis and Brody Campbell, Wright-Pierce

Subject: Johnson Road Pump Station Capacity Assessment

Introduction

As part of the Mill Creek Interceptor Long Term Replacement Options Study the JRPS capacity was evaluated. Past evaluation reports for the JRPS including the March 2015 report by Sevee & Maher (S&M) and the July 2009 CPSA report by Wright-Pierce were reviewed and analyzed against recent pump run time data and pump drawdown test results provided by the Town.

Existing Conditions

JRPS accepts gravity flow from portions of Johnson Road, several side streets off Johnson Road, and flow from Route 1 north of Johnson Road, including flow from Cumberland. It pumps to the gravity sewer in Route 1 via a 4-inch diameter, 1150-foot-long force main which eventually flows to Mill Creek Pump Station via the Mill Creek Interceptor. The sewer users in the drainage area are characterized as residential and commercial.

Flow Assessment

Existing JRPS weekly pump run times from January 2020 through November 2022 were evaluated to determine current flow conditions. The existing pumps, which are designed to operate in a lead/lag arrangement, are sized for 315 GPM and the Town completed a pump drawdown test on both pumps to verify the flow rate. The drawdown test resulted in flow rates of 314 GPM for both pumps. Based on the average hourly flow data provided by the Town and the pump drawdown test results the average hourly flow for the pump station is 33 GPM. A peaking factor of 6 was used to estimate the existing peak flow of 198 GPM.

Pump run time hours from January 2020 through November 2022 show an average combined pump run time of 17.7 hours per week or 2.5 hours per day. This is significantly less than the 2009 CPSA report by Wright-Pierce which indicated combined pump run times of around 9 hours per day.

A cursory review of the 2015 Sevee & Maher report was completed to confirm the flow estimate are consistent with industry standards. S&M used local GIS mapping and water usage data from Portland Water District to estimate existing flows. When peak flow numbers were not available, a 6.0 Peaking factor was used, which is the TR-16 industry standard for flows of this magnitude. The comparison table below includes the S&M estimates for existing peak hour flow and Wright-Pierce's estimate of peak hour flows based on 2020-2022 operating data and pump drawdown tests. As you can see, values are similar, but have increased slightly since the 2015 estimate.

Table 1 Total Estimated Sewerage Flow to Johnson Road Pump Station

	MGD	GPD	GPM
Average daily Flow (ADF) to JRPS **(Sevee & Maher Estimate 2015)**	0.035	35,200	24.5
Peak Hour Flow (PHF) to JRPS **(Sevee & Maher Estimate 2015)**	0.216	216,300	150.0
Current Average daily Flow (ADF) to JRPS **(Wright-Pierce Estimate 2022)[1]**	0.048	47,520	33.0
Current Peak Hour Flow (PHF) to JRPS **(Wright-Pierce Estimate 2022)[2]**	0.285	285,120	198.0

Notes:

1. Based on weekly pump run times from January 2020 through November 2022 and pump drawdown tests completed by the Town 11/22/21.
2. Estimated peaking factor of 6.0 was used in accordance with TR-16 industry standards.

The existing wetwell is 8.5 feet in diameter and is 22 feet deep. However, the invert elevation of the influent sewer is only 4.75-feet above the wet well invert (about 2-feet above the top of the pumps). This greatly reduces the operating range of the wet well without surcharging the influent sewer. Under existing peak hour flow conditions (198 GPM) the operating range volume of the wet well should be around 1,000 gallons (with 20 minute pump cycles). This results in 2.4 vertical feet of wetwell operating range required, which is available with minimum surcharging of the influent sewer. Any increase to the pump station peak flow conditions would result in increased influent sewer surcharging or require more frequent pump cycles to handle the flow.

Future Considerations

Significant growth is anticipated in the JRPS sewershed area. The future design hourly flow for JRPS was determined to be 624.5 GPM. Refer to the table below for a detailed breakdown of the JRPS future flow conditions assuming full buildout of specific lots identified by Towns of Cumberland and Falmouth.

Table 2 Total Estimated Future Sewerage Flow to Johnson Road Pump Station

		MGD	GPD	GPM
A	Current Average daily Flow (ADF) to JRPS **(Wright-Pierce Estimate 2022)[1]**	0.048	47,520	33.0
B	Current Peak Hour Flow (PHF) to JRPS **(Wright-Pierce Estimate 2022)[2]**	0.285	285,120	198.0
C	Projected additional PHF to JRPS due to future growth in Falmouth **(Wright-Pierce Estimate 2022)[3]**	0.421	421,200	292.5
D	Projected additional PHF to JRPS due to future growth in Cumberland **(Wright-Pierce Estimate 2022)[4]**	0.193	192,960	134.0
E	Projected Total additional PHF to JRPS due to future growth (row C+D)	0.614	614,160	426.5
F	Projected Total PHF to JRPS (future design PHF, row B+E)	0.899	899,280	624.5

Notes:

1. Based on weekly pump run times from January 2020 through November 2022 and pump drawdown tests completed by the Town 11/22/21.
2. Estimated peaking factor of 6.0 was used in accordance with TR-16 industry standards.
3. Tax lot U62-01 in Falmouth. 50 acre lot assuming 9 units/acre at 156 GPD/unit.
4. Various lots in Cumberland along Route 1. Estimate unit numbers and associated flow projections provided by Cumberland (215 units at 6 hundred cubic feet (HCF) per month average flow). Note that 6 HCF/month equates to 150 GPD/unit.

This projected future flow rate includes a 215% growth factor based on the projected growth in Falmouth and Cumberland. This growth would necessitate upgrades to the JRPS including new wetwell, pumps, and force main to accommodate the additional flow, including:

- The existing wetwell is 8.5 feet in diameter and is 22 feet deep. However, the invert elevation of the influent sewer is only 4.75-feet above the wet well invert (about 2-feet above the top of the pumps). This greatly reduces the operating range of the wet well without surcharging the influent sewer. At 625 GPM, future peak flow, the operating range volume of the wet well should be around 3,200 gallons (with 20 minute pump cycles) to avoid excessive start/stop sequences with the pumps. In this situation (maintaining the existing wetwell at a future flow of 625 GPM) the pump cycle could be reduced to around 5-minutes which results in an operating range of 800-gallons. An 8.5-foot diameter wet well has a volume of 425-gallons per vertical foot. To maintain this diameter wetwell at a 20-minute pump cycle time, approximately 7.5 feet of operating range would be needed. Without significantly upsizing the diameter of the wetwell or installing a deeper structure, the influent gravity sewer will be surcharged regularly, and pump cycle time would be less than is desirable. If sizing a new wetwell for future flow conditions, and assuming roughly the same overall depth as the existing wetwell, a 16-foot diameter structure would be desirable to provide adequate working volume (3,200 gallons) with 20-minute pump cycles.

- The existing 4-inch diameter, 1,150 linear foot force main should be upsized to an 8-inch DR 17 HDPE IPS force main. This would result in a flow velocity in the force main of 4.3 ft/s.
- The existing 315 GPM pumps should be upsized to 625 GPM pumps. Electrical and instrumentation upgrades would be required to operate the larger pumps.
- Refer to the next section for a discussion on the impacts to the JRPS force main receiving gravity sewer along Route 1.

Discussion of Previous Report Recommendations.

The 2015 S&M report evaluated an additional 100-units of single-family housing to the Route 1 sewer that is a tributary to JRPS. Based on GIS mapping data available in the area at the time, 38 single family units were estimated to generate an average daily flow of 7,200 GPD (190 GPD/single family unit). Therefore, they claimed an additional 100-units in the area would results in 19,000 GPM (190GPD/unit x 100 units). This is a reasonable assumption given the data at the time. For the Long-Term Solutions study WP assumed 156 GPD/single family unit, which was the value used in the 2017 West Falmouth Sewer Master Plan completed by Wright-Pierce. The value from that 2017 report was based on the 2002 Wastewater Facility Study Update for the Town of Falmouth and water use date for Falmouth residents in 2007.

The existing 8-inch PVC gravity sewer that transfers the discharge of the JRPS force main to the Mill Creek Interceptor has a minimum slope of 0.4% based on 1983 as-built drawings. The maximum capacity of 8-inch PVC sewer with a minimum slope of 0.4% is about 0.49 MGD (~343 GPM) assuming full pipe flow. The 2015 S&M report gave a similar maximum capacity of 0.48 MGD. Based on the projected future flow estimates for the JRPS (624.5 GPM), the gravity sewer along route 1 would have to be upsized to a 12-inch pipe at the same slope to handle peak flow events if and when the future growth occurs.

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