

DRAFT

MILL CREEK PUMP STATION **UPGRADE**
PRELIMINARY DESIGN REPORT
for the
TOWN OF FALMOUTH, MAINE

JANUARY 2015



January 9, 2015
W-P Project No. 12776A

Mr. Robert "Pete" Clark, Superintendent
Town of Falmouth Wastewater Department
96 Clearwater Drive
Falmouth, ME 04105

Subject: Draft Preliminary Design Report
Mill Creek Pump Station

Dear Pete,

We are pleased to provide you with 1 hard copy and 1 electronic copy of the Draft Preliminary Design Report (PDR) for the Mill Creek Pump Station for your review. This Draft PDR represents a significant effort by Wright-Pierce and the Town over the past 18 months, and we appreciate the information and time that you and the wastewater staff have provided to us.

As we discussed yesterday, we are still awaiting final pump selections, after which we will finalize the pump sizing, electrical requirements and cost estimate. You will notice a few areas with yellow highlighting that will need to be updated once we make a final pump selection. As you recall, we decided to make a change in pump selection away from traditional non-clog and away from the pump manufacturer we had originally been working with due to clogging concerns and concerns with that specific pump manufacturer. This effort was put on hold in June 2014 and restarted in December 2014. With the holidays, it has taken some time to work with the pump manufacturers.

Please review the information in this report closely and contact us with any questions. Once we have updated pump, electrical and cost sections, we will provide those to you under separate cover.

Should you have any questions in the meantime, please feel free to contact me or Kattie Collins.

Very truly yours,
WRIGHT-PIERCE



Christopher A. Dwinal, PE
Senior Project Manager

CAD/cad
Attachments

DRAFT

TOWN OF FALMOUTH, MAINE

MILL CREEK PUMP STATION UPGRADE
PRELIMINARY DESIGN REPORT

JANUARY 2015

Prepared By:

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TOWN OF FALMOUTH, MAINE
MILL CREEK PUMPING STATION UPGRADE
PRELIMINARY DESIGN REPORT

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Mill Creek Pump Station is the largest and most important pump station in Falmouth. This station accepts residential and commercial flow from the Route 88 and Route 1 areas north of the town forest, including all flow from Cumberland. It is one of three stations that pump directly to the wastewater treatment facility (WWTF) in Falmouth. Several pump stations in Falmouth pump indirectly into the Mill Creek Pump Station including Hedgerow Drive, Johnson Road, Northbrook Road, Baysite Drive, Underwood Road, Handy Boat, Old Mill Road, and Thornhurst Road Pump Stations. Figure 1-1 at the end of this Section show a site location plan for reference.

Mill Creek Pump Station was constructed and put on-line in 1971 along with six other similar Smith and Loveless “can” style pump stations in Falmouth. In 1983, a Generator Building was constructed nearby to house an emergency generator to provide backup power to the station.

The 2009 Comprehensive Pump Station Assessment¹ reported an estimated peak pumping capacity of 2.4 million gallons per day (MGD) at the pump station. This is lower than the original design capacity of 3.0 MGD, as the pumps were downsized after the original construction. This report recommended an upgrade of the Mill Creek Pump Station to increase capacity to handle current and future projected flows and to replace outdated equipment which ranges from 30 to 40 years old.

The Mill Creek Pump Station currently pumps a peak instantaneous flow of approximately 2.5 MGD, but total flow to the station is higher, because during extreme wet weather events overflows into Mill Creek from manholes upstream of the Mill Creek Pump Station have been observed. A 2013 Plant Capacity Evaluation² Memorandum also recommended the Mill Creek

¹ Comprehensive Pump Station Assessment for the Town of Falmouth, Maine; dated July 2009; by Wright-Pierce.

² Wastewater Treatment Plant Capacity Assessment and Impacts on Future Development/Growth in Falmouth and Cumberland for the Town of Falmouth; dated May 22, 2013; by Wright-Pierce.

Pump Station be upgraded to prevent further sanitary sewer overflows and to provide capacity for future growth in the sewered area. With future growth projections, the flow to this station is expected to increase to a peak hourly flow of 4.1 MGD, as will be outlined later in Section 2.3, Projected Wastewater Flows and Basis of Design.

In summary, the 30 to greater than 40 year old life of the pump station and its components, the occurrence of sanitary sewer overflows to Mill Creek during wet weather events, and the anticipated increase in flows to the pump station as a result of growth in Falmouth and Cumberland are all clear drivers for the upgrade / replacement of the station.

1.2 OBJECTIVES

The objectives of this Preliminary Design Report (PDR) are as follows:

- To document conditions which were used to develop design criteria with input from municipalities
- To identify and document options for re-use of existing pump station infrastructure and requirements for new infrastructure
- To document the basis of design of each new system
- To develop preliminary layout plans of the pump station considering site constraints, lot size and land acquisition
- To refine the estimated project costs
- To identify the expected project schedule
- To identify any pertinent permit requirements
- To obtain Town approval and regulatory agency input prior to proceeding with final design

1.3 REPORT ORGANIZATION

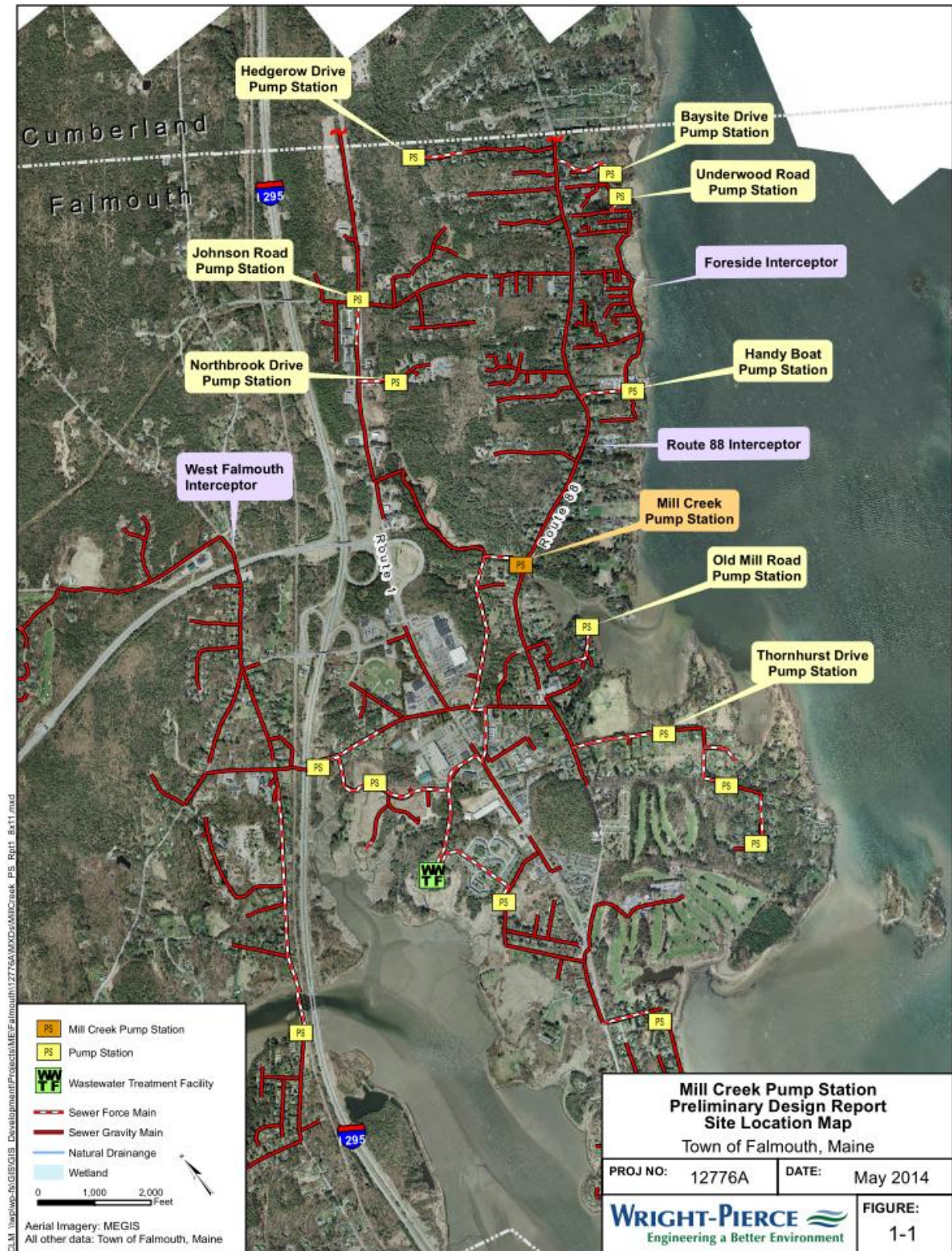
This Preliminary Design Report is divided into several sections including:

1. Introduction
2. Design Considerations

3. Design Memoranda
4. Implementation and Project Schedule
5. Preliminary Drawings
6. Engineer's Estimate of Project Cost

This report also has several appendices.

The scope of the proposed improvements reflects the results of multiple meetings and site visits held during the preliminary design period with representatives from the Town of Falmouth, Town of Cumberland, Portland Water District and Wright-Pierce. Staff from the Falmouth Water Pollution Control Department were key participants in the preliminary design effort and were instrumental in providing insight and critical information necessary to make this project a success.



SECTION 2

DESIGN CONSIDERATIONS

2.1 INTRODUCTION

This section summarizes existing conditions at the Mill Creek Pump Station site; presents projected flows and the basis of design; and summarizes design considerations and permitting needs for the proposed pump station. Specific design considerations related to civil, architectural, structural, mechanical/plumbing, electrical, instrumentation and process control are presented in individual technical memoranda in Section 3.

2.2 EXISTING CONDITIONS

2.2.1 Influent Sewers and Flows

There are three sewer interceptors that converge at a sewer manhole on-site just upstream of the wet well as shown on Drawing C-2 in Section 5. The largest interceptor, Mill Creek Interceptor, is a 24-inch asbestos cement (AC) pipe that enters the collection manhole from the north. This sewer collects flow from the Route 1 area of Falmouth as well as a small portion from Cumberland along Route 1. The Route 88 interceptor, an 18-inch AC pipe, enters the collection manhole from the east. This interceptor collects the majority of flow from Cumberland as well as all Falmouth flow for the Route 88 area north of the pump station. Additionally, a small 8-inch AC gravity sewer enters the manhole from the southwest. This sewer collects flow from the Route 88 area south of the pump station.

The average daily flow to the pump station for the period from January 2011 through July 2013 was 0.526 MGD, with approximately 60% of the flow entering through the Mill Creek interceptor and 40% entering from the Route 88 interceptors. The actual peak flow seen at the pump station is unknown, but is estimated to be around 2.6 MGD. The peak flow is unknown because during extreme wet weather events, wastewater overflows from an upstream manhole into Mill Creek.

2.2.2 Pump Station

The existing pump station consists of a “tin-can” dry well and a concrete wet well arrangement with two larger lead pumps and a smaller lag pump. The pumps draw wastewater from a two-chamber, rectangular concrete wet well. The pumping capacity of the station is 2.38 MGD with the two large pumps operating, but this capacity can increase to 2.5 MGD with high water elevations in the wet well during wet weather events. This capacity is 0.6 MGD below the original design capacity of 3.07 MGD because the original pumps were oversized for flows, and were downsized after construction. Flows travel through a 14-inch diameter AC force main to the WWTF. In addition to the “tin-can” and wet well, there is a brick building onsite that houses the back-up emergency generator and pump station control and telemetry panel.

2.2.3 Site Features and Restrictions

The Mill Creek Pump Station is located on 0.402 acres of land bounded by Route 88 on the south, a residential house lot on the west, and the Falmouth Conservation Trust (FCT) to the north and east. The site has significantly less usable space than 0.402 acres as there are a number of restrictions on the existing site related to land features, size restrictions, and City ordinance requirements.

The site contains freshwater and coastal wetlands to the west and east respectively, steep embankments to the west and south, an intermittent stream (drainage swale) to the north, Mill Creek to the east and Route 88 (Foreside Road) to the South. Refer to Figure 2-1 in this Section and Drawing C-2 in Section 5 for a site plan showing existing site features. Each of these site features / restrictions are discussed below.

2.2.3.1 Topography and Ground Cover

The existing developed portion of the site slopes downward from a Route 88 road elevation of approximately 26 feet above mean sea level down to the Generator Building with a slab elevation of around 14 feet and to the wet well cover at an elevation of around 9.4 feet, which is below the 100-year flood elevation of 10 feet. The low elevation on the property is near 5 feet,

which results in a 12% slope diagonally across the site. Along the driveway portion of the site, the slope is steeper at approximately 14%. This developed portion of the site consists of a paved drive and turnaround, mowed grass, drainage swales to the west and north and trees / forested buffer to the south and east.

2.2.3.2 Falmouth Conservation Trust (FCT) Land

While the existing developed portion of the site may appear adequate for a new pump station with the large open grassy area shown in Figure 2-1, a large portion of that area was not owned by the Town until November 2014. The existing generator building was actually located on property belonging to the FCT with only the northwestern corner of the building residing on Town property. It is unclear why the building was constructed on FCT land, however, it is assumed that the property was thought to belong to the Town during construction. Approximately 50% of the building does exist within the sewer easement for the 18" sewer from Route 88, so perhaps an attempt was made to construct the building within this easement. The Town was successful in obtaining the 7,600 square foot (sf) piece of the larger FCT lot between the town-owned pump station site and Mill Creek by eminent domain. This will allow for adequate space for the new pump station building, driveway and parking on-site.

The FCT property will increase the lot size by about 45% or 7,600 sf to a total of 0.58 acres. This is not a large lot, but rather allows for full use of the existing lot along that existing property boundary by eliminating the need for a 20 ft setback at the side property line. In addition, this extra lot provides the site width needed to fit the new pump station building with adequate room for parking and site access.

The acquisition of the FCT land was critical to the successful construction of the new pump station for several reasons discussed below. The 0.402 acre Town property is bounded on the west and northwest by a steep sloped bank area as noted above (shown as the heavily vegetated areas on the left and top of Figure 2-1). This area serves as a visual, noise and odor buffer between the pump station and an existing residential development. Further, this steep banking would make it very difficult and costly to utilize this portion of the site since it would likely



**FIGURE 2-1: SITE CONSTRAINTS
(NOT TO SCALE)**

require significant cut and fill operations, modifications to drainage patterns, and a retaining wall to retain the elevation of the adjoining homes and property. There is also an elevated wetland in this area which would likely get destroyed if this portion of the site were to be developed.

2.2.3.3 Wetlands

As part of the preliminary design, wetlands on the Town and FCT property were delineated by Penobscot Environmental Consulting, Inc. in June 2013, using the 1987 Army Corps of Engineers Wetlands Delineation Manual (updated in 2012). A Wetland Delineation Report is included in Appendix A. This report includes information regarding natural resources on-site as well as specific permitting requirements. Drawing C-2 of Section 5, along with figures in the Wetlands Report, shows the delineated boundaries of the wetlands on-site.

The site is bordered by Mill Creek on the east side. There is a coastal wetland area along Mill Creek extending westward approximately 10-15 feet due to the low elevation of the land along the bank and the seasonal high water elevation of the creek. There is also a small freshwater wetland to the west in a natural low area that collects water from the surrounding embankment. All coastal wetlands are considered Wetlands of Special Significance (WOSS)¹ by the Natural Resource Protection Act and the freshwater wetland is considered a Freshwater WOSS because of its proximity to the coastal wetland.

The Natural Resources Protection Act (NRPA) requires a 25-foot wetland setback from any disturbance to the ground surface. The existing paved driveway and portions of the existing sewers are located within 25 feet of the wetlands and those features will need to be modified as part of the upgrade; therefore, work will need to occur within the 25-foot setback. However, no wetlands will be directly impacted, modified or destroyed as part of the project. Any construction or excavation would require proper erosion control measures, and likely require sheeting and dewatering along the wetland to prevent saturated soils from falling into the excavation.

¹ WOSS as defined by the Natural Resource Protection Act (NRPA); see 38 MRSA 480-B and Chapter 310, Wetlands and Waterbodies Protection Rules.

A permitting review meeting was held with representatives from Maine Department of Environmental Protections (MDEP) and Army Corps of Engineers (ACOE) in July 2013. In April 2014, the proposed site plan was provided to MDEP and ACOE and a site visit to the pump station was conducted. During the site visit, the following was confirmed:

- The drainage ditch / intermittent stream between the hillside wetland and Mill Creek is not regulated per MDEP and ACOE. Work can occur within the stream without ACOE / NRPA permitting; although no such work is anticipated. Construction work will occur within 25 feet of the feature.
- Since no work will occur within the boundaries of the hillside wetland or the Mill Creek wetland, ACOE has no jurisdiction and an ACOE permit will not be required.
- The existing paved driveway is within 25 feet of the hillside wetland. Since the western boundary of the existing paved drive will be restored in the same location after construction, no permitting is expected or a simple permit-by-rule will be allowed. A final decision will be made once MDEP has reviewed the final site plan.
- Removal of existing pump station infrastructure will occur within 25 feet of the Mill Creek wetland. Further, new sewer pipes and manholes will also need to be constructed within the 25 foot buffer around the Mill Creek wetland. MDEP has indicated a permit-by-rule can be issued for removal / replacement of this existing infrastructure.

2.2.3.4 Subsurface Conditions

As part of the preliminary design, subsurface explorations were conducted in June 2013 and geotechnical recommendations were provided by S.W. Cole Engineering, Inc. This geotechnical report is included in Appendix B.

Two borings (B-101 and B-102) were completed on-site. B-101 is located immediately south of the existing generator building and B-102 is located west of this location, on the other side of the access driveway (see Drawing C-2 in Section 5 for specific locations). These borings, along with additional testing and analysis, were used to establish groundwater depths; depths to bedrock;

and recommendations for site / subgrade preparation, excavation, dewatering, bracing, foundation bearing, foundation drainage, slab design, backfill and compaction.

The subsurface investigation on-site found substantial bedrock in the area. Bedrock was found at depths of 16.0 and 27.0 feet below grade for B-101 and B-102 respectively. In addition to bedrock, the geotechnical report noted that the existing fill soils above the bedrock are unsuitable for structure support. The report recommends replacement backfill (compacted structural fill) under any new structure.

Excavation in the project area will encounter groundwater, due to the relatively high perched water table noted in the borings and report (indicated to be about 5-feet below grade). The report recommends installing a sump in the excavation and pumping groundwater to maintain a ground water level at least 1-foot below planned excavation depths. Excavation for the deeper structures will require sheeting and shoring pinned to the bedrock to support the excavation.

2.2.3.5 Floodplain

A portion of the Mill Creek Pump Station site is located within the 100-year flood plain. The FEMA 100-year flood elevation in the area is elevation 10.0. Under existing conditions, the top of the wet well and the main collector manhole are within the 100-year flood plain.

The Falmouth floodplain ordinance requires a flood hazard development permit to be obtained from the code enforcement officer before any construction can begin. The first applicable sections of the floodplain ordinance include 19-35(f)(2) which indicates a permit and floodproofing certificate is required for non-residential structures. The second applicable sections is 19-36(g)(1)a, b & c which requires the new construction to be watertight to 1-foot above the base flood elevation, be designed to structurally resist loads from high waters and that the design be certified by a registered professional engineer.

2.2.3.6 Town of Falmouth Site Plan Review and Ordinances

The Town of Falmouth has a zoning and site plan review ordinances that pertain to redevelopment of the Mill Creek Pump Station site, including Section 3 Establishment of Districts, Section 4 General Provisions, 7 Shoreland Zoning and Section 9 Planning Board Site Plan Review.

The site is located in zoning district Residential A District (RA), which requires a minimum lot size of 20,000 SF as described in Section 3. The full property meets this requirement, including the existing lot (17,494 SF) and the former FCT lot (9,820 SF) for a total land area of 27,214 SF (0.627 AC) and 2,250 SF of area within the waters of Mill Creek.

Section 4, General Provisions on property setbacks allows for Sewage Pump Stations to be exempt from any structural setbacks outlined in Section 3, with the provision that facilities attempt to meet setbacks to greatest extent possible.

The entire existing lot is within the Resource Protection area of the Shoreland Zone (defined in Section 7 as any land area within 250 feet of the normal high water line of any designated great pond, river or salt water body). Therefore, work on the site is subject to Planning Board review and approval. The project is considered an Essential Service, and thus is considered differently than a non-essential service, such as a home. The current ordinance allows for an essential services exception to shoreland zoning rules provided Planning Board review and approval is obtained.

2.2.4 Existing Utilities

There is a potable water connection entering the south side of the generator building that supplies water for cooling to the generator on-site. Potable water to the site is provided by the Portland Water District.

The existing electrical service provides a 3 phase, 480V service to the site via a pole mounted transformer and then travels underground across the site from west to east into the Generator Building. Underground electrical service also runs below grade from the Generator Building to the Pump Station “tin-can”. Service is provided through Central Maine Power (CMP).

2.3 PROJECTED WASTEWATER FLOWS AND BASIS OF DESIGN

Current and projected wastewater flows at the pump station are outlined in Appendix C in the memorandum from Chris Dwinal and Kattie Collins of Wright-Pierce to Pete Clark of the Town of Falmouth titled *Mill Creek Pump Station Upgrade – Preliminary Design Existing and Future Flows* dated September 16, 2013. Table 2-1 (excerpt from memorandum) outlines current and future flows expected at the Mill Creek Pump Station. Based upon the evaluation of current and projected future flows, a 4.1 MGD (2,850 GPM) capacity is recommended. Approximately 55.5% of the peak flow is expected to come from Falmouth, with 44.5% of the total projected peak flow from Cumberland.

**TABLE 2-1
MILL CREEK PUMP STATION: PROPOSED CAPACITY**

| | Current (2013) | | | Sewered Growth | | | Design (2033) |
|-------------------|-----------------------|-----|--------------------|-----------------------|-----|--------------------|--------------------|
| | Average Flow (MGD) | PF | Peak Flow (MGD) | Average Flow (MGD) | PF | Peak Flow (MGD) | Peak Flow (MGD) |
| Falmouth | 0.314 | 5.0 | 1.571 | 0.259 | 3.0 | 0.703 | 2.274 |
| Cumberland | 0.212 | 5.0 | 1.059 | 0.256 | 3.0 | 0.768 | 1.827 |

Mill Creek Pump Station Design Capacity: 4.102

2.4 PROPOSED MILL CREEK PUMP STATION

The following sections describe the proposed new Mill Creek Pump Station. Refer to the end of this section for the proposed Master Equipment List for the new pump station and Section 5 for a preliminary pump station layout. A project nomenclature list will be developed during final design of this project.

2.4.1 Pump Station Upgrade Options

Over the past several years, Wright-Pierce has evaluated several different options for upgrading the Mill Creek Pump Station. Options for upgrade included the following:

- New submersible station
- New suction lift station
- New wet well / dry pit station
- New station (all options) with the re-use of the existing Generator Building

The 2009 Comprehensive Pump Station Evaluation recommended a suction-lift style pump station to avoid large submersible pumps and to reduce costs compared to a wet well / dry pit station. However, early in this preliminary design effort, concern was expressed by all parties about the use of suction-lift pumps for this application and it was determined that the cost to construct such a station would not be appreciably less than the wet well / dry pit option. Due to the depth of existing sewer lines and limitations in the suction lift capabilities of the pumps, a mid-level would need to be constructed to house the suction lift pumps versus installing them at grade. Further, due to lower efficiencies, the suction-lift pumps would require larger motors and more energy to pump the same volume of water. Thus, a suction-lift style station was eliminated from consideration early in the preliminary design.

With the elimination of the suction-lift station from consideration, efforts were focused on the wet well / dry pit pump station and submersible pump station options. The Towns of Falmouth and Cumberland as well as the Portland Water District favored the wet well / dry pit station option, and Wright-Pierce recommended this option early in the preliminary design. The primary concern with the submersible option was the lack of experience / familiarity with submersible stations of this size and the concern with removal and maintenance of submersible pumps from the wet well versus pumps that are installed in a dry, accessible room.

Despite the clear preference for the wet well / dry pit station option by all parties, layouts, cost estimates and a list of pros and cons were developed for the wet well / dry pit and submersible

pump station options and is included in Table 2-2. Wright-Pierce used some of the listed criteria that were most important to the Town to create a rating score for both options. Scoring criteria included net present worth, industry / Town standard, pump station and generator maintenance working environment, ease of local approval, limited buried pipe, limited or no confined spaces, and aesthetics. The final rating scores were close, with the wet well / dry pit option scoring slightly higher than the submersible option.

**TABLE 2-2
PUMP STATION OPTIONS**

| PROS | CONS |
|--|---|
| SUBMERSIBLE PUMP STATION – RATING SCORE 82 | |
| Least costly alternative | Not industry standard for this size pump station |
| Shallower wet well | Undesirable working environment for pump maintenance |
| Further away from front property line (setback) | Exterior generator or re-use of existing generator building |
| WET WELL / DRY PIT PUMP STATION – RATING SCORE 86 | |
| Industry standard for this size pump station | Higher cost option |
| Clean, dry environment for pump maintenance | Closer to front property line (setback) |
| Emergency generator inside new building | Deeper wet well |
| Valves and flow meters more accessible and not in confined space | Larger building size |
| Better site aesthetics | |
| Energy efficiency | |

While the submersible station had a lower projected construction cost, the Town was not in favor of the less desirable working conditions for pump maintenance and the lower pump efficiencies. Therefore, this option was also eliminated and the wet well / dry pit option was selected for further advancement in this preliminary design effort.

Re-use of the existing generator building was considered feasible only for the submersible pump option. Given the small area to construct a new station onsite and the depth of excavation, the existing generator building could not easily remain. In addition, the building was too small to house a new, larger generator. Reuse of the building for electrical controls was considered, but did not result in appreciable savings over incorporating the controls into a new building. As such,

reuse of the existing 30+ year old generator building was eliminated from consideration and it will be demolished as part of the pump station upgrade project.

Details on the station and site design follow.

2.4.2 Pump Station Site Layout

Drawing C-2 of Section 5 shows the existing site plan. A demolition plan will be incorporated into the plan set during final design and will outline demolition of the existing generator building, temporary use of the existing vault and wet well during construction, and final demolition of those structures after the new pump station is on-line. It will also include the demolition of portions of existing sewer lines, manholes, water service and electrical service.

Drawing C-3 shows the proposed site plan for a completely new pump station. Due to the size of the new structure, and the site constraints outlined in Section 2.2, the building had to be located closer to the road (Route 88) than previously allowed by Town ordinance. However, the Town updated its ordinance in July of 2014 to allow wastewater pumping stations an exception from structural and property setbacks since it is an essential service to the community. The proposed layout currently shows the southern corner of the building approximately 7 feet away from the right-of-way for Route 88.

The access drive will essentially remain in the same footprint as the existing access drive, with a small expansion on the southeast portion to allow for a wider turning radius and additional site parking. Maintaining the access drive in its existing location is one way to reduce impacts to the adjacent wetland, since rehabilitation of existing facilities is allowed within the 25-foot wetland setback. Due to the steep slope between the proposed pump station and roadway, a retaining wall will be situated just south of the building on the other side of the access walkway.

Extensive excavation, including sheeting pinned to bedrock, blasting, and dewatering will be required for the construction of the pump station. The bottom of the excavation will be approximately 30 feet below grade.

The proposed finished floor elevation (FFE) of the pump station lower pump room and bottom of the wet well is -13.25, as shown on A-2 and PR-3 in Section 5. With a two-foot thick slab and one foot of stone bedding, the bottom of the excavation would be -16.25. Based on boring B-101, the boring closest to the proposed building location, the approximate elevation of bedrock in this area is -1.0. If the boring results of B-101 are consistent across the excavation, then approximately 15 vertical feet of bedrock will need removed in the wet well and lower pump room locations.

Drawing A-1 in Section 5 shows the first floor plan of the pump station building, the majority of the ground floor of the pump station (includes Pump Access Room, Generator Room and Electrical Room) will be set at elevation 16.0 or 6 feet above the 100-year flood elevation.

Any other new structures constructed on-site, such as manhole covers, will need to be at least one foot above the 100-year flood elevation, or at EL 11.0, to meet Town of Falmouth ordinances. The site grading and catch basins shown on Drawing C-3 will divert stormwater runoff to the existing drainage ditches/swales and Mill Creek after construction is complete. During construction, industry standard best management practices (BMPs) will be implemented to prevent contaminated runoff from leaving the site.

2.4.3 Design Pumping Rate

Based on the flows described in Section 2.3, the proposed Mill Creek Pump Station will be designed with four equally sized pumps (lead/lag/lag-lag/standby configuration) discharging into a new 14-inch diameter force main. The pumps will be installed with variable frequency drives (VFD) to optimize energy efficiency and reduce “spikes” in wastewater flow to the wastewater treatment facility downstream. The range of each pump with its VFD is expected to be

approximately 350 gallons per minute (GPM) to 950 GPM each (total of 2,850 GPM with 3 pumps operating).

Preliminary hydraulic models were developed for the proposed pumping system and force main and the following design points were selected:

- Minimum Flow: 350 GPM at 44 ft of total dynamic head (TDH) (one pump running at lowest speed)
- Duty Point: 950 GPM at 59 ft of total dynamic head (TDH)
- Maximum Flow: XX GPM at XX ft of total dynamic head (TDH) (one pump running at highest speed)
- Current Peak Flow: 1,757 GPM at 110 ft TDH (two pumps operating to equal 2.530 MGD)
- Future Peak Flow: 2,849 GPM at 149 ft TDH (three pumps operating at full speed to equal 4.10 MGD)

2.4.4 Pump Type

Dry pit submersible pumps were selected by the Town as the technology of choice for the pump station. The benefits of dry pit submersible pumps are: 1) seal water is not required and 2) the Flygt N-pumps, HOMA GRP series and KSB KRT series have options for built-in cutter system to minimize the potential for clogging / ragging since a screenings facility is not proposed at the new station (existing pump station does not currently have a screenings system). Should the dry well of the pump station flood, the pumps will not be damaged. Preliminary pump selections were made as part of the preliminary design. Vendor information for Flygt N-pump and KSB KRT series dry pit submersible pumps has been included in Appendix D. A pump selection was also originally obtained from Flowserve, however, due to significant operational issues at other pump stations, the Flowserve dry pit submersible pump line has been dropped by the local manufacturer's representative and this manufacturer is no longer recommended by Wright-Pierce.

2.4.5 Piping System / Flowpath

As described earlier in Section 2, the pump station receives wastewater from three district interceptors that all discharge into the main collector manhole north of the existing generator building. In order to facilitate construction and delivery of flow to both the existing wet well and the new wet well, three new manhole structures and new sewer pipes will be required as shown on Drawings C-3. Demolition of the existing sewer manhole and portions of the existing 8-inch, 18-inch and 24-inch sewer pipes will be required.

After the wastewater leaves the new SMH-2, the influent wastewater will flow into one of two wet wells (Wet Well No. 1 or Wet Well No. 2) located underground on the northwest end of the pump station building. Gates will be provided to select which wet well receives flow and to isolate the wet wells as shown on Drawing PR-3. The four pumps will be located in the adjacent pump room and each will be provided with dedicated 8-inch diameter suction piping with a 90-degree bell-mouth elbow into the wet well as shown on Drawing PR-3. All Pump Room and Wet Well piping will be Class 53 flanged, ductile iron pipe. Each suction pipe will also be provided with a gate valve. Each individual pump discharge will have a 6-inch diameter flanged discharge connection. The discharge pipe of each pump will be provided with a plug valve and a swing check valve. Pressure gauges will also be provided on the suction and discharge piping to each pump. The discharge piping from each pump will converge into a common 12-inch diameter discharge header. A 10-inch diameter flow meter will be included on the discharge force main with a 12-inch by 10-inch reducer and a 10-inch by 14-inch increaser before and after the meter, respectively. Following the flow meter, the 14-inch diameter piping will exit the Pump Room and connect to the force main. A new pig launcher/bypass pumping connection with the associated valves will be included, and detailed further in final design. Drawing C-3 shows the approximate location of this connection.

Table 2-3 summarizes the anticipated pipe velocities at various design flows.

**TABLE 2-3
PIPE VELOCITIES AT VARIOUS FLOW RATES**

| | Velocity at 350 GPM Min Flow 1 pump | Velocity at 950 GPM Max Flow of 1 pump | Velocity at 1,757 GPM Flow of 2 pumps | Velocity at 2,849 GPM Flow of 3 pumps |
|--------------------------|--|---|--|--|
| | Velocity in feet per second (fps) | | | |
| 8-inch suction | 2.2 | 6.1 | - | - |
| 6-inch discharge | 4.0 | 10.8 | - | - |
| 12-inch discharge | 1.0 | 2.7 | 5.0 | 8.1 |
| 14-inch discharge | 0.7 | 2.0 | 3.7 | 5.9 |

At flows less than 950 GPM, the velocity in the 14-inch diameter force main will be less than the required 2 feet per second velocity (required to prevent solids deposition in the pipe). However, it is likely that higher flows at the pump station will be seen on a regular basis, and that these flows would re-suspend solids and prevent any appreciable solids deposition over the long-term. If solids deposition becomes an issue, then during periods of low flows, the Town may need to shut down the pumps and allow for the wet well to fill up then operate the pumps at a higher speed to achieve velocities of 3 fps (equivalent to a flow of 1,440 GPM in the 14-inch force main) or greater to clean the force main of any settled material.

2.4.6 Force Main

A separate analysis of force main alternatives to replace the existing AC force main was prepared congruent to this report and is attached in Appendix E. The existing 14-inch force main is over 40 years old, and is routed through sensitive areas in Falmouth. There is concern that with increased flow and pressures, this pipe may fail. The force main alternative report presented several new force main routes for the Town of Falmouth to select; as well as replacing the existing pipe within its current alignment.

Eight alternatives were evaluated, and Alternative 2 and 5 (see Figures 2 and 5 in Force Main Replacement Alternatives Memorandum located in Appendix E) were selected for further action by the Town. The preferred route to reduce headloss (elevation and pipe length) is Alternative 2. However, the Town is continuing discussions with private landowners about temporary and permanent easements. As such, for the purposes of this report, the worst-case force main route

alternative (highest elevation, longest length), Alternative 5, was selected to determine pump data points. A decision on the force main route will need to occur prior to final design.

2.4.7 Pump Station Odor Control

There is no existing odor control system at the Mill Creek Pump Station and no reports to date of odor complaints by neighbors or travelers along Route 88. There are no proposed facilities for pretreatment or screening, which would typically be a main source of odors at a pump station. The other potential source for odors is the influent sewers and wet well. As the existing sewers and wet wells have not been a significant source of odors or the cause of odor complaints to date, there is no justification for odor control at the pump station at this time.

2.4.8 Pump Station Building Systems

The following sections briefly describe the proposed building systems for the new Mill Creek Pump Station. More information can be found in the technical memoranda for each building discipline in Section 3 of this PDR.

2.4.8.1 Architectural

The Mill Creek Pump Station building will have masonry bearing walls with brick veneer and a wood truss pitched roof with architectural shingles. The building dimensions will be approximately 50 feet long by 30 feet wide. There will be an Electrical Room, Generator Room, Pump Access Room with pump removal hatches, and a Rest Room located on the first (ground) floor. A stairwell will be provided to the basement where the Pump Room will be located at the same elevation as Wet Well No. 1 and Wet Well No. 2. The wet wells will be provided with access hatches (with safety nets) outside of the building.

2.4.8.2 Structural

The foundation and below grade walls will consist of 4,500 psi concrete in accordance with the 2009 International Building Code, ASCE and ACI standards. The Electrical Room and Generator Room will include slab-on-grade design with frost walls. Design loadings for the building and tanks are summarized in the Structural preliminary design memorandum in Section 4.

2.4.8.3 Mechanical

Electric heat will be provided in all building spaces, except perhaps the Electrical Room, the transformers and VFDs may provide enough waste heat to heat the room (this will be confirmed during final design). Air conditioning will be required in the Electrical Room during the summer period. The process areas of the pump station will be mechanically ventilated with both supply and exhaust fans at rates dictated by the 2012 International Mechanical Code and NFPA 820. The Pump Room will be equipped with a duplex sump pump to discharge any process or drain water to the wetwell. A new potable water service will be required to supply water to the rest room and for maintenance.

2.4.8.4 Electrical

A 600 amp service entrance will be provided to the new pump station to provide 480/277 V, 3 phase, 4 wire service to the facility. The station will also be equipped with a 350 kW diesel emergency generator. The generator is sized to operate three of the 85 HP pumps and the other required ancillary equipment. An automatic transfer switch (ATS) will be installed to start the generator upon loss of service. Motor control centers, VFDs, lighting, controls and alarms will be coordinated with the proposed instrumentation for the pump station.

The pole-mounted electrical service to the site will need to be modified and / or relocated in order to feed the new pump station building location. These electrical service modifications will need to be coordinated with Central Maine Power during final design and construction.

2.4.8.5 Instrumentation

A PLC-based (Allen Bradley) Master Control Panel complete with a color operator interface terminal will be provided to control and monitor the wastewater pumps, wet well level, and generator; provide equipment status (i.e. sump pumps, etc.); and convey alarms to a telemetry system. The telemetry system, which will be incorporated into the Master Control Panel, will allow the operators to remotely monitor and control the pump station from the WWTF SCADA system.

2.5 BASIC DESIGN DATA

2.5.1 Design Capacity Determination Criteria

PUMPING SYSTEM BASIS OF DESIGN

| | |
|-----------------------|---------------------------------|
| CLIENT NAME: | Town of Falmouth, Maine |
| PROJECT NAME: | Mill Creek Pump Station Upgrade |
| PROJECT NO.: | 12776A |
| TECHNICAL DISCIPLINE: | PROCESS |
| Date Developed: | 12/30/14 |
| Developed by: | BMD/KMC |
| Reviewed by: | CAD |

PURPOSE: Four new, equally-sized dry pit submersible pumps will be installed in the new Mill Creek Pump Station in the below-grade Pump Room to pump raw wastewater from the station to the Water Pollution Control Facility (WPCF). The pumps will be designed to operate in a Lead/Lag/Lag-Lag/Stand-by configuration.

DESIGN CRITERIA:

| | |
|------------------------|---|
| Current Flows | |
| Minimum Instantaneous: | 0.05-0.10 MGD |
| Average Day: | 0.53 MGD |
| Maximum Day: | 2.42 MGD |
| Peak Hour: | 2.46 MGD ² |
| Future Influent Flows | |
| Average Day: | 1.04 MGD |
| Peak Hour: | 4.10 MGD |
| Number of Units | 4 pumps (PUMP-1, PUMP-2, PUMP-3, PUMP-4) |
| Pump Type: | Dry-Pit Submersible, with cutter assembly |
| Control: | VFD |

² During the storm event during which the peak instantaneous flow rate occurred, there was a significant sanitary sewer overflow (SSO) to Mill Creek of unknown volume. Refer to the Existing and Future Flows memorandum included in Appendix C for additional information.

Pumping Capacity:

| | |
|-----------------------------|---|
| One Pump Minimum Speed: | 400 GPM at 45 ft. TDH |
| One Pump Full Speed: | 950 GPM at 67 ft. TDH (list one pump running alone) |
| Two Pumps Full Speed: | 3,400 GPM at 129 ft. TDH |
| Three Pumps Full Speed: | 3,815 GPM at 153ft. TDH |
| Motor Size: | 85 HP |
| Solids Handling Capability: | 3 in. |

ACCEPTABLE MANUFACTURERS:

- 1) Xylem/Flygt
- 2) KSB
- 3) Homa
- 4) Or equal

AUXILIARY EQUIPMENT:

- 1) Motor High Temperature Switches
- 2) Seal Failure Switches

ASSOCIATED INSTRUMENTATION:

- 1) Flow Meter
- 2) Submersible Pressure Transmitter
- 3) Float Switches

CONTROLS:

Refer to instrumentation memorandum in Section 3.

2.7.2 MASTER EQUIPMENT LIST

PROJECT NAME: MILL CREEK PUMP STATION, TOWN OF FALMOUTH, ME

PHASE: PRELIMINARY DESIGN

PROJECT NO: 12776A

MASTER EQUIPMENT LIST

REVISION: 1

DATE REVISED: 01/28/14

| EQUIPMENT NAME | EQUIPMENT TAG | NO. OF UNITS | | | | SIZE | | ELECTRICAL INFORMATION | | | | | | TYPICAL MANUFACTURER | SPEED CONTROL |
|----------------------------------|--------------------|--------------|------------------|---------------|------------------------|-----------|-------|------------------------|-------|--------|------------------------|--------------------|-------------------------|-------------------------|------------------|
| | | | | | | PARAMETER | UNITS | TOTAL HP | | | | POWER (VOLTAGE) | EXP. PROOF MOTORS | | |
| | | NO. TOTAL | NO. OPERATING | NO. FUTURE | ON STANDBY POWER | | | EACH | OPER. | FUTURE | ON STANDBY POWER | | | | |
| | | | | | | | | | | | | | | | |
| PUMP ROOM | | | | | | | | | | | | | | | |
| Sewage Pumps (Vertical Non-Clog) | P-1, P-2, P-3, P-4 | 4 | 3 | 0 | 3 | 4.1 | MGD | 60 | 180 | 0 | 180 | 460V, 3Ø 60 Hz | C1/D2 | Fairbanks Morse | VFD |
| Sump Pumps | SP-1, SP-2 | 2 | 1 | 0 | 1 | 20 | GPM | 0.5 | 0.5 | 0 | 0.5 | 460V, 3Ø 60 Hz | C1/D2 | Zoeller | CONSTANT |
| Unit Heaters | UH-X, UH-X | 2 | 2 | 0 | 2 | 20 | kW | - | - | - | - | 460V, 3Ø 60 Hz | C1/D2 | Trane | - |
| Exhaust Fan | EF-X | 1 | 1 | 0 | 1 | - | - | 0.5 | 0.5 | 0 | 0.5 | 460V, 3Ø 60 Hz | C1/D2 | Cook | - |
| Supply Fan | SF-X | 1 | 1 | 0 | 1 | - | - | 0.5 | 0.5 | 0 | 0.5 | 460V, 3Ø 60 Hz | C1/D2 | Cook | - |
| | | | | | | | | | | | | | | | |
| GENERATOR ROOM | | | | | | | | | | | | | | | |
| Generator | GEN-1 | 1 | 0 | 0 | 1 | | kW | - | - | - | - | 460V, 3Ø 60 Hz | N | | - |
| Unit Heater (Electric) | UH-X | 1 | 1 | 0 | 1 | 5 | kW | - | - | - | - | 120V, 1Ø 60 Hz | N | Trane | - |
| Transfer Fan | TF-X | 1 | 1 | 0 | 1 | - | - | 0.2 | 0.2 | 0 | 0.2 | 120V, 1Ø 60 Hz | N | Cook | - |
| | | | | | | | | | | | | | | | |
| PUMP ACCESS ROOM | | | | | | | | | | | | | | | |
| Unit Heater (Electric) | UH-X | 1 | 1 | 0 | 1 | 5 | kW | - | - | - | - | 460V, 3Ø 60 Hz | C1/D2 | Trane | - |
| Transfer Fan | TF-X | 1 | 1 | 0 | 1 | - | - | 0.2 | 0.2 | 0 | 0.2 | 120V, 1Ø 60 Hz | C1/D2 | Cook | - |
| | | | | | | | | | | | | | | | |
| RESTROOM | | | | | | | | | | | | | | | |
| Unit Heater | UH-X | 1 | 1 | 0 | 1 | 5 | kW | - | - | - | - | 120V, 1Ø 60 Hz | C1/D2 | Trane | - |
| Exhaust Fan | EF-X | 1 | 1 | 0 | 1 | - | - | 0.5 | 0.5 | 0 | 0.5 | 460V, 3Ø 60 Hz | C1/D2 | Cook | - |
| Water Heater | WH-1 | 1 | 1 | 0 | 1 | 1.5 | kW | - | - | - | - | 120V, 1Ø 60 Hz | C1/D2 | Cook | - |
| | | | | | | | | | | | | | | | |
| ELECTRICAL ROOM | | | | | | | | | | | | | | | |
| Air Conditioning Unit | AC-1 | 1 | 1 | 0 | 1 | 3 | TON | - | - | - | - | 460V, 3Ø 60 Hz | N | Trane | - |
| | | | | | | | | | | | | | | | |
| TOTALS | | | | | | | | | 182.4 | 0 | 182.4 | | | | |

SECTION 3

DESIGN MEMORANDA

3.1 CIVIL AND PERMITTING

| | | | |
|----------|---|--------------|----------|
| TO: | File | DATE: | 12/30/14 |
| FROM: | Bryanna Denis | PROJECT NO.: | 12776A |
| SUBJECT: | Town of Falmouth, Maine Mill Creek Pump Station Upgrade Site Work Design Considerations Summary | | |

The following is a brief summary of the design considerations with regard to site work for the pump station property and associated pump station capacity upgrade.

Site Work Associated with the Pump Station

- Obtain adjacent property owned by Falmouth Conservation Trust and bounded by Town property, Mill Creek and Route 88 to increase the amount of usable space available and increase buffer distance to natural resources.
- Demolish existing brick faced Generator Building on-site, as well as existing “tin-can” pump station and existing concrete wetwell.
- Grade a portion of the site, such that building entrance and access drive are above the 100-year flood level elevation of 10.0. Proposed first floor elevation of 16.0.
- Provide positive drainage away from the building on all four sides with a maximum grade of 3:1. On south side of building, a retaining wall will likely be necessary against the slope, provide drainage swale such that runoff drains to Mill Creek or alternately to the drainage ditch on south western side of the site. (This will be further illustrated during final design with a detailed drainage plan).
- Re-grade and re-paving of existing access drive (located within the 25-foot wetland buffer). Approximate grade of 12% to match existing.
- Maintain 2% min cross slopes on all paved surfaces.
- Maintain 2% min slope along access drive, maintain or decrease existing maximum slope.
- Maintain 8% max / 2% min slope along all walkways and parking areas.
- Perform various site improvements including re-grading, loaming and seeding over the top of the demolished structures; paving; landscaping and drainage improvements.
- Grade, and provide loam and seed over the wetwell area next to Mill Creek to provide a visual buffer. Wetwell shall have two access manholes.

Site Permitting

A wetland delineation report was completed by Penobscot Environmental Consulting, Inc. of Camden, Maine on August 14, 2013.

- The site includes a coastal wetland along Mill Creek, and a freshwater wetland on the western portion of the site.
- Due to the small size of the site, the Shoreland zone encompasses the entire usable space of the property and presents problems with the proposed work anywhere on site. The Town of Falmouth updated its Shoreland Ordinance in July 2014 to exempt wastewater pumping stations from Shoreland zoning rules since these are essential services. All wastewater pumping station improvements will still require only planning board approval with the exception of underground distribution and collection pipes which require code enforcement officer approval.
- The proposed building shall be situated as far as possible (likely 30 feet) from Mill Creek's annual high water location; this distance is the maximum that the site will allow. Buffer distances to the wetlands and intermittent stream will also be slightly greater than 25 feet.
- The coastal wetland is considered a "Wetland of Special Significance (WoSS)" as defined by Maine's NRPA regulations. The freshwater wetland is also considered a "WoSS" due to its being within 250 feet of the coastal wetland onsite. A NRPA permit-by-rule will be required for this project due to the close proximity to a "WoSS" as defined by the Maine Department of Environmental Protection requiring a Natural Resources Protection Act permit for any alternation of the wetlands. (Natural Resources Protection Act Chapter 310).
 - A MEDEP NRPA permit-by-rule will be required for work. A pre-permitting meeting was held in July 2013 along with subsequent emails and telephone conversations between Chris Dwinal of Wright Pierce and Mr. Bill Bullard of MDEP. MDEP also conducted a site visit in April 2014. MDEP has indicated the following:
 - Re-paving and re-grading of the existing access drive (within the 25-foot setback) will be allowed under a permit-by-rule (PBR).
 - Site excavation for new building and wetwell must be greater than 25 feet from the resource, which is achievable.
 - Work on existing utilities within the 25 foot buffer is allowed with a PBR.
 - Demolition of the existing wetwell and tin-can pump station is allowed with a PBR even though within 25 feet of a resource because they are existing utilities.
 - In order for the building to remain outside the 25 foot buffer from resources, the front setback of 25 feet will need to be waived by the Planning Board.
- The freshwater wetland, and the coastal wetland along Mill Creek are regulated by Army Corp. of Engineers (ACOE). A permit is only required for direct impact to these resources. Since no direct impact is proposed, a permit is not required. This has been confirmed by Mr. Jay Clement of ACOE.

- A flood hazard development permit will be required from the local code enforcement officer for the pump station construction work to be in accordance with the Town of Falmouth Floodplain Ordinance. The permit will include floodproofing measures and certification for any areas that are below 1-foot above the 100-year flood level.

Impact to Protected Natural Resources

- A site review by ME division of Inland Fisheries and Wildlife, ME Natural Areas Program, US Fish and Wildlife Services and ME Department of Marine Resources has not been submitted. A request for site review shall be sent out once the Town of Falmouth has accepted the site layout.
- This property is bounded on 2 sides by protected natural resources. There will be no direct impact to any of these resources; however, because of the small size of the property, there may be disturbance within 25 feet of the resources. However, actions will be taken to prevent any erosion, surface runoff, and/or detrimental effects to these areas. Erosion control and Best Management Practices will be utilized to their fullest extent during construction of this project.
- It is important to note that this project will be increasing the capacity of the Pump Station, and upgrading the facilities thereby decreasing the risk of CSO events in the sewer-shed. Overall surface water quality and public health in the sewer-shed will be improved as a result of this project.

Town Ordinance Impacts

The Town of Falmouth Ordinances have been amended in July of 2014 to exempt structural setbacks for essential services structures and are only encouraged to meet setbacks to the greatest extent possible. There was no amendment to the normal height above finish grade.

- Structural setback goals are: 25 foot front, 20 foot side and 40 foot back setback from all property lines
- 2.5 stories or maximum 28 feet from normal average finish grade

The proposed building location is approximately 6-feet from the front property setback, 60 feet from the east side, 88 feet from the west side and 89 feet from the back property boundary. This configuration allows for the best use of the site in regard to depth of the lot, proximity of abutting uses, slope of the land, potential for soil erosion, type and amount of vegetation to be removed, the proposed building elevation in regards to floodplain and proximity to wetlands.

Regarding building height: it is likely that the building will be kept at less than the 28 foot height required by the ordinance.

3.2 NFPA 820

| | | | |
|----------|--|--------------|-----------------|
| TO: | Pete Clark | DATE: | January 8, 2014 |
| FROM: | Chris Dwinal, Kattie Collins | PROJECT NO.: | 12776A |
| SUBJECT: | Town of Falmouth, Maine Mill Creek Pump Station Upgrade – Preliminary Design NFPA 820 Memorandum | | |

The National Fire Protection Association Standard for Fire Protection in Wastewater Treatment and Collection Facilities (specifically NFPA 820, 2012 version) provides guidance on safeguarding against the fire and explosion hazards specific to wastewater treatment and collection facilities. Compliance with NFPA 820 is required by the National Electric Code (NEC). NFPA 820 is applicable to new installations.

Table 1 below, lists each of the new spaces within the proposed Mill Creek Pump Station as well as the space classification, NEMA rating and a reference to the applicable section of NFPA 820.

TABLE 1
NFPA 820 SPACE RATINGS

| Space Name | Classification | NEMA Rating | NFPA 820 Reference |
|-----------------------|-----------------------------|-------------|--------------------|
| Wet Well Nos. 1 and 2 | Class I/Division 1, Group D | 7 | Table 4.2, 16a |
| Pump Room | Class I/Division 2, Group D | 7 | Table 4.2, 17b |
| Pump Access Room | Unclassified | 4X | Table 4.2, 18 |
| Electrical Room | Unclassified | 12 | Table 4.2, 18 |
| Generator Room | Unclassified | 12 | Table 4.2, 18 |
| Restroom | Unclassified | 1 | Table 4.2, 18 |

3.3 ARCHITECTURAL

| | | | |
|----------|---|--------------|--------------|
| TO: | Chris Dwinal, Kattie Collins | DATE: | June 2, 2014 |
| FROM: | Cathy Michaud | PROJECT NO.: | 12776A |
| SUBJECT: | Mill Creek Pump Station, Falmouth, Maine Architectural Preliminary Design Report | | |

General Description

The architectural components of the project involve new pump station to replace the existing Mill Creek pump station that is to be demolished.

Governing Codes

| | |
|---------------|---|
| General | International Building Code 2009 (IBC) International Energy Conservation Code 2009 (IEBC) NFPA 101 NFPA 820 |
| Accessibility | Not applicable The building will not normally be occupied, but the access to non-equipment spaces and the Restroom will be in accordance with accessibility standards. |

Use Group Classification

| | |
|-----------------------------|---|
| International Building Code | Factory F-2 |
| NFPA 101 | Industrial |
| NFPA 820 | Class 1, Division 2 @ Lower Level Pump Room |

Building Size

| | |
|-------------------------------|-------------------------|
| Below Grade (excluding tanks) | 620 S.F. |
| First Floor | 1500 S.F. |
| Total building | 2125 S.F. |
| Height | 13'-4" feet to the eave |

Occupant Load

Equipment Spaces 2125 S.F. @ 300 S.F/Person = 7
The building will not normally be occupied.

Construction Type

5B

Building Materials

| | |
|----------------|---|
| Substructure | Concrete tank wall, foundation walls and floors. New concrete frost walls and slab on grade. |
| Roof Structure | Wood Trusses |
| Exterior: | |
| Walls | Insulated masonry bearing walls with brick veneer, including the gable ends. |
| Roofing | Architectural Asphalt Shingles |
| Windows | Insulated aluminum windows and translucent panels. |
| Louvers | Kynar finished aluminum louvers. |
| Doors | Painted hollow metal insulated doors. |
| Metals | Aluminum railings, hatches, plates, grating, ladders, etc... |
| Interior: | |
| Walls | Painted masonry walls. |
| Doors | Hollow metal doors and frames at equipment rooms. |
| Stairs | Concrete filled metal pan stairs and painted steel railings. |
| Floors | Concrete floors with hardeners in equipment rooms. |
| Ceilings | FRP faced plywood in the Pump Access Room. Painted gypsum wallboard in dry equipment spaces (Generator Room, Electrical Room, and Restroom). |
| Finishes | Paint all exposed masonry, gypsum wallboard and steel. Concrete walls below grade shall be left unfinished and get a concrete sealer. |

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Room List and Function

Basement

| | |
|-----------|----------------------------------|
| Pump Room | Room to house the various pumps. |
| Stair | Egress |

First Floor

| | |
|------------------|--|
| Pump Access Room | Space containing hatches for removal of pumps below. Contains monorail and access to the loading dock. |
| Stair | Egress |
| Generator Room | Contains the emergency generator |
| Electrical Room | Electrical equipment room. |
| Toilet Room | Bathroom for operators. |

SPECIALS

| | |
|------------------------|---|
| Existing Building Demo | The existing pump station will be fully demolished. |
|------------------------|---|

| | |
|-------------------|---|
| Equipment Removal | Hatches are provided for equipment removal from the below grade pump room. All hatches will be provided with integral FRP or Aluminum safety grating. |
|-------------------|---|

A monorail is provided to guide pumps from the pump access room to the outside loading area.

3.4 STRUCTURAL

| | | | |
|----------|--|--------------|--------------|
| TO: | Chris Dwinal, Kattie Collins | DATE: | May 28, 2014 |
| FROM: | Jason Powell | PROJECT NO.: | 12776A |
| SUBJECT: | Mill Creek Pump Station, Falmouth, Maine Structural Preliminary Design Report | | |

The purpose of this memo is to identify the structural components, governing Codes and Standards, and anticipated materials for the Subject Project.

STRUCTURAL SCOPE OF WORK

- Provide the Structural components of the new Wastewater Pump Station.

GOVERNING CODES AND STANDARDS

- Maine Uniform Building and Energy Code (MUBEC)
- International Building Code 2009
- ASCE 7-05 Minimum Design Loads for Buildings and Other Structures
- ACI 318-08 - Building Code Requirements for Reinforced Concrete
- ACI 350-06 - Code Requirements For Environmental Engineering Concrete Structures
- AISC Manual Of Steel Construction - 9th Edition
- Aluminum Association - Specifications for Aluminum Structures
- ACI 530/530.1-08 - Building Code Requirements and Specification for Masonry Structures and Related Commentaries
- Occupational Safety and Health Administration

DESIGN CRITERIA

MATERIAL PROPERTIES

- Concrete
 - f'_c - 4,500 psi
 - f_y - 60,000 psi (Reinforcing steel)
 - Max W/C ratio - 0.41
 - Air Content - 6 +/- 1.5%
- Structural Steel
 - Structural Shapes - ASTM A992 Grade 50 (wide flange beams) and ASTM A36 Grade 36 ("S" type beams, channels and angles)
 - Anchor Bolts - ASTM F1554, grade 55

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- Bolts - ASTM A325
 - Finish - Hot-dipped galvanized or painted
 - Welding - E70XX electrodes
- Structural Aluminum
 - Shapes/Plates - ASTM B308 Alloy 6061-T6
 - Bolts - Stainless Steel Type 316
 - Finish - Mill or clear anodized
- Masonry
 - f'_m - 1,500 psi
 - CMU Block - ASTM C90 Type N-1 - 2,000 psi
 - Mortar - ASTM C270 Type S - 1,800 psi
 - Grout - ASTM C476 - 2,000 psi

LIVE LOADS

In accordance with the IBC and ASCE 7
Occupancy Category III

Building:

- Floor Live Load - Uniformly distributed load based on equipment weights and expected usage
- Ground Snow Load - 60 psf
- Basic Wind Speed - 100 mph
- Seismic Design Factors:
 - $S_s = 0.317$
 - $S_1 = 0.078$
 - Site Soil Class C

Foundations:

- Freezing index = 1300 +/-
- Frost Depth = 50" +/- , Use 4'-6"
- Lateral earth pressures:
 - Above groundwater table - 65 psf / ft
 - Below groundwater table - 95 psf / ft
- Lateral surcharge pressures:
 - Lateral surcharge resulting from a 300 psf surcharge loading from construction vehicles
- Flotation resistance - Dead weight of structure as required, engage soil wedge over base slab extension

STRUCTURE DESCRIPTION

- The scope of the project includes structural design of a 30' x 50' masonry superstructure with a wood truss roof, as well as a multi-celled reinforced concrete substructure.

GENERAL SOIL DESCRIPTION

A geotechnical exploration was performed and a report was produced by S.W. Cole Engineering, Inc. Subsurface exploration encountered fill soils overlying brown medium dense silty clay with sand overlying medium dense glacial till overlying bedrock at a depth of 31 to 33 feet.

Sheeting and dewatering will be required during excavation.
It is also likely that ledge excavation/blasting will also be required.

GROUNDWATER

Seasonal groundwater depth is unknown, however it will be monitored following the installation of wells during the geotechnical exploration.

Groundwater levels will be relative to the water level in Mill Creek, which is tidally influenced and brackish.

SW Cole has reported that it is likely that groundwater perches atop the clay layer.

3.5 MECHANICAL

TO: Chris Dwinal, Bryanna Denis DATE: 5/15/14
FROM: Nat Balch PROJECT NO.: 12776A
SUBJECT: Falmouth, Maine - Mill Creek Pump Station
Mechanical Systems Memorandum

PROPOSED PUMP STATION-MECHANICAL SYSTEMS

General

Construction of a new pump station is under consideration. Mechanical systems serving the proposed facility will be based on the following:

Codes and Standards

NFPA 101 Life Safety Code
NFPA 820 Standards for fire protection in waste water treatment and collection facilities
ASHRAE American Society of Heating, Refrigeration and Air-conditioning Engineers
Maine State Internal Plumbing Code
IMC 2012 International Mechanical Code with Amendments

Design Parameters

| | |
|-----------------------------------|-------------------------------|
| Outside Design Temperature Winter | -3°F |
| Outside Design Temperature Summer | 86°F DB/71°F WB |
| Inside Design Temperature Winter | |
| Electrical Room | 72°F |
| Generator Room | 72°F |
| Rest Room | 72°F |
| Stair | 60°F |
| Pump Room | 60°F |
| Pump Access Room | 60°F |
| Inside Design Temperature Summer | |
| All spaces except Electrical Room | Ambient |
| Electrical Room | 80°F |
| Ventilation Rates | |
| Electrical Room | N/A (AC unit) |
| Generator Room | As req. for generator cooling |
| Rest Room | 70 cfm per flushing fixture |
| Stair | N/A |
| Pump Room | 6 AC/HR |
| Pump Access Room | N/A |

Electrical Room

The Electrical Room will be heated by the waste heat generated in the space by the pump VFD's and transformer. The space will be evaluated to see if additional electrical heat is required to maintain space temperature in the winter. The space will be cooled by a 3/4 ton ductless split system air conditioning/condensing unit assembly to maintain a maximum interior temperature of 80°F during the summer months. The condensing unit for the system will be located outside on a concrete pad near the Electrical Room. The unit will need to be located near the electrical room but far enough away from the building to prevent falling ice and snow from damaging the unit.

Generator Room

The Generator Room will be heated by a 5 KW electric unit heater. The generator will be ventilated by two motor-operated damper assemblies, both powered closed. One damper assembly will open to provide ventilation air into the facility. The other damper assembly will circulate exhaust air from the generator. Both damper assemblies shall be normally closed, and shall open when the emergency generator operates, or on loss of power.

Rest Room

A 500 watt electric fin tube baseboard radiation heater will be provided for heat in the Rest Room. A ceiling exhaust fan will be provided for ventilation of this space.

The Rest Room area will have a service sink and a water closet. A point of use electric water heater will provide hot water to the service sink. Water service for the building will be provided with a water meter and a reduced pressure zone backflow preventer.

Pump Room

The Pump Room will be heated with explosion proof unit heaters in accordance with NFPA 820 space electrical classification of Class I, Div. 2. Ventilation will be provided at a rate of 6 AC/HR with supply and exhaust fans whenever the space is occupied. The Pump Room drainage will be provided by a duplex sump pump set with spark-proof motors and will discharge into the Wet well.

Pump Access Room

The Pump Access Room will be provided with an electric unit heater to maintain space temperature.

Stair

The stairwell will be provided with an electric unit heater to maintain space temperature.

3.6 ELECTRICAL

| | | | |
|----------|--|--------------|---------|
| TO: | Chris Dwinal, Bryanna Denis | DATE: | 5/22/14 |
| FROM: | Chris Abell | PROJECT NO.: | 12776A |
| SUBJECT: | Falmouth, Maine - Mill Creek Pump Station Electrical Systems Memorandum | | |

Existing Conditions

The electrical service for the facility originates from a pole mounted transformer mounted on CMP Pole No.180. The service enters the site overhead through several riser poles before transitioning underground to the main circuit breaker in the Generator Building. The current and potential transformers are mounted on a riser pole. The rating of the main circuit breaker is 480V, 600 Amperes. The power distribution equipment is manufactured by Federal Pacific and consists of a 10KVA 120/240 Volt transformer, and a small lighting panel within the building. There are also unit heaters and a radio telemetry control panel located within the building. There is a 200 KW, 480 volt diesel generator fed through a Westinghouse automatic transfer switch used to supply power to the pump station during an interrupt in service from the utility company.

The underground pump station's back up emergency power is fed underground from the Generator Building. The three pumps are operated on variable frequency drives (one 20 HP and two 50 HP) which are all located within the underground pump station.

Findings

The metering for the facility no longer meets Central Main Power's metering standards and needs to be updated to a self-contained meter or a metering cabinet depending on the size of service. The electrical distribution equipment in the Generator Building, with the exception of the radio telemetry control panel, is beyond its useful life expectancy, and it is recommended to be replaced. The lighting in the building is adequate; however, the fixtures are not energy efficient and should be replaced. The 120 V circuitry is fed from a single phase transformer. We recommend a three phase 120 V transformer to aid in balancing the utility transformer for the facility. The electrical equipment in the below-grade pump station should be replaced and be moved above ground to the existing Generator Building or a new building on-site.

Preliminary Design

New electrical distribution equipment, lighting systems, motor controls, instrumentation, and ancillary systems, along with all associated conduit and wiring systems as required, will be provided for the new Pump Station as described below. The pump room will be designed to be able to operate under a flood condition so no local disconnects or emergency stop pushbuttons will be installed. The national electric code requires a disconnecting means within sight of the equipment. Exception 1 to the NEC article 430.102(B)(2) is being used since the equipment

could get damaged under a flooded condition. The lockable disconnecting means will be located at the Variable Frequency Drive located in the Pump Access Room.

Governing Codes

- 1) National Electrical Code (NEC)
- 2) Local Electrical Codes
- 3) NFPA Fire & Safety Codes

Basic Materials

- 1) Power Wiring - XHHW insulated copper, 600 volt.
- 2) Control Wiring - THHN/THWN insulated copper, 600 volt.
- 3) Instrumentation Wiring - 2 or 3 conductor twisted pair shielded copper, 600 volt.
- 4) Data Wiring - Fiber optic cable network to be installed underground in duct bank between buildings as required. Ethernet CAT 6 network cabling within each location between PLC's (Programmable Logic Controllers) and SCADA computers, as required.
- 5) Conduit:
 - Underground - PVC Schedule 40 or 80, concrete encased in duct bank.
 - Pump Room - PVC-Coated Rigid Steel Conduit or Aluminum conduit.
 - Electrical Room/Generator Room - Aluminum or EMT conduit above hung ceiling as applicable. PVC Schedule 40 concrete encased within or below slab. EMT conduit within concrete block walls.
 - Pump Access Room – PVC-Coated Rigid Steel Conduit or Aluminum conduit.
- 6) Enclosures:
 - General use (Electrical Room/Generator Room) NEMA-12.
 - Classified Areas (Pump Access Room/Pump Room) – Class 1, Div. 2. GR D (Stainless steel or aluminum).

Utility Transformers

- New Transformer - New transformer (s) to be mounted on pole.

Power Distribution Equipment

- Utility Metering - New utility meter and metering cabinet as required by the power company. To be located on outside of building
- Distribution Equipment - 480/277 volt, 3 phase, 4 wire, 600 amp main circuit breaker to new Main Distribution Panel.

4 - 60 HP Variable Frequency Drives with Line Reactor and Harmonic Filter Control Panels as manufactured by Toshiba.

600A Automatic Transfer Switch
- Motors/Large Process Loads - 480 volt, 3 phase, 3 wire supply to each motor, with local disconnecting means and local control stations located in the Pump Access Room.
- Miscellaneous Power and Lighting Loads - 120/208 volt, 3 phase 4 wire lighting panelboard and dry-type transformer.
- Standby Power 350 KW diesel indoor generator with integral fuel tank to operate for 24 hours.
- Receptacles Convenience receptacles will be provided in all area. Only 1 will be installed in the Pump Room.

Conduit Runs

Interior – New finished spaces, concealed in walls and above ceilings wherever possible. Combination of exposed conduit and cable tray in the Pump Room to drop power cable to each motor.

Exterior – underground in concrete encased duct banks.

Illumination

Interior:

Scope - New lighting throughout new building.

Type – Fluorescent with energy-saving ballasts and lamps in electrical room. Either LED or Metal Halide HID fixtures in high-bay areas in Pump Access Room and Pump Room.

Memo: Mill Creek Pump Station – Electrical Systems Memorandum
5/22/14
Page 4

| | | |
|---------------------|------------------|----|
| Footcandle Levels – | Electrical Room | 50 |
| | Generator Room | 50 |
| | Pump Access Room | 40 |
| | Pump Room | 40 |

Exterior:

Type – Either LED or Metal Halide HID fixtures, wall mounted, with motion detector to operate fixture above main door. All other fixtures will be operated via a light switch located inside the main entrance.

Emergency and Exit Lights

Provided in new building as required: Emergency Lights (battery packs and remote heads, for building egress) and Exit Signs (self-powered with battery back-up, LED type).

Fire Alarm System, Security System, Telephone (Optional)

The new pump station is not required to have a Fire Alarm installed. A security system is not anticipated to be installed.

3.7 INSTRUMENTATION AND PROCESS CONTROL

| | | | |
|----------|--|--------------|--------------|
| TO: | Chris Dwinal, Bryanna Denis | DATE: | May 15, 2014 |
| FROM: | Scott Hinckley, PE/CSE | PROJECT NO.: | 12776A |
| SUBJECT: | Mill Creek Pump Station, Falmouth Maine Instrumentation and Controls System Preliminary Design Report | | |

General

The existing pump station will be replaced with a new Mill Creek Pump Station to convey raw wastewater to the treatment plant. The station will have a dry well side to house the pumps, controls, generator and electrical gear. A divided wet well will be constructed adjacent to the pump station. The level in each side of the wet well will be monitored by a submersible pressure transducer and float switches.

Four new dry-pit submersible type, centrifugal, wastewater pumps will be installed in the pump station with independent suction lines extending into the wet well. These are submersible type pumps that will be installed and operated under dry conditions, however, provision will be made to allow the pumps to operate in the event that the Pump Room floods to the ground floor level. The NFPA 820 classification of the below grade Pump Room and ground floor Pump Access Room will be considered Class I Division 2 for all control and electrical devices.

Pump Station Flow Rate

The discharge from each pump will be connected to a common header which will connect to a new 14 inch diameter force main. The flow rate in the header will be measured by a new 10 inch diameter electromagnetic type flow meter.

Wet Well Monitoring

The level in each side of the wet wells will be measured by a new submersible pressure transducer with a range of 0-15 feet. The submersible pressure transducer will be connected to a new Wet Well Level Indication Panel located in the Pump Access Room. The panel will include a NEMA 4X stainless steel enclosure with two LCD level indicators which will display the level in each wet well in feet.

In addition to the transducers, two level floats will be installed on each side of wet well. The HIGH-HIGH float will activate an alarm and start designated backup pumps. The LOW-LOW float will activate an alarm and shut down the backup pumps. The active set of floats and backup pumps will be selected at the Pump Control Panel. Each float will be connected to an intrinsically safe circuit.

Pump Station Monitoring

The pump control system will include field instrumentation and auxiliary contacts to monitoring the following:

- Pump Access Room Temperature
- Electrical Room Temperature
- Dry Well Flood Float and Alarm
- Exhaust Fan Run and Fault
- Generator Run and Fault
- Generator Fuel Tank Level
- ATS Normal and Emergency Power status
- Station Occupancy through door contacts

Local Controls

Each pump will have a disconnect switch and local control station (LCS) located on the wall in the Pump Access Room. The disconnect and LCS will be stainless steel and rated for Class I Division 2. The disconnect will include an auxiliary contact to shut down the variable frequency drives (VFDs).

The LCS will include the following hand controls:

- RUN light (red)
- HAND-OFF-AUTO (HOA) switch
- SPEED potentiometer
- ESTOP switch

In the HAND position, the pump will be started and the operator will be able to control speed of the pump using the SPEED potentiometer. In the OFF position, the pump will not be activated. In the AUTO position, the pump will be automatically controlled by the Pump Control Panel. The Pump Control Panel will monitor the AUTO position of the HOA switch and the ESTOP.

Interlocks

Each pump will include an integral high motor temperature switch and a seal leak sensor. These will be connected a specialized relay which will shut down the pump and activate a HIGH TEMP and SEAL LEAK alarm. The interlocks will be located at the VFDs.

Motor Control

Each pump motor will be connected to a new 85 HP VFD. The VFD will vary the operating speed and subsequent flow rate from each pump. Controls of the front of each VFD will include:

- RUN light (red)
- Elapse Time Meter
- VFD Fault Light (yellow)
- High Temp alarm (yellow)
- Seal Leak alarm (yellow)
- Reset pushbutton
- VFD HMI terminal
- VFD through the door type disconnect switch

The VFDs will not include bypass contactors.

Mill Creek Pump Control Panel

A new Mill Creek Pump Control Panel (MC-PCP) will be installed in the Electrical Room. The panel will include a NEMA 12 steel enclosure approximately 36 inch wide by 18 inch deep and 72 inch in height with a three point latching system. The MC-PCP will contain an Allen Bradley Compact Logix series Programmable Logic Control (PLC) with matching I/O modules and power supply.

A new Operator Interface Terminal (OIT) will be mounted on the front of the panel along with the following hand controls:

POWER light (green)

UPS Power Light (yellow)

PLC Fail light (red)

General Alarm Light (red)

RESET pushbutton

Wet Well 1 HIGH-HIGH level Alarm (yellow)

Wet Well 1 LOW-LOW level Alarm (yellow)

Wet Well 2 HIGH-HIGH level Alarm (yellow)

Wet Well 3 LOW-LOW level Alarm (yellow)

Float Selector Switch (Wet Well 1 or 2)

Backup Pump ON-OFF Selector Switch for each pump (P1, P2, P3, P4).

The OIT will be an Allen Bradley 10 inch color touchscreen with Ethernet communication port. A licensed copy of the OIT and PLC programming software will be provided to the Owner along with spare PLC parts.

Telemetry

The PLC in the Pump Control Panel will communicate with the existing SCADA system at the treatment plant using a new cellular radio modem. The modem and antenna will be the same as

installed at the other pump stations in Falmouth. The SCADA screens will be similar to the screens developed for the existing pump stations but will include additional pump control functions. Expanding the existing SCADA licenses and providing an addition network node through Verizon Wireless will be provided by the Owner.

Pump Control Method

The pumps are activated based on the levels in the selected wet well and Lead-Lag1-Lag2 pump assignments by the operators. The operator will select each pump as either LEAD, LAG1, LAG2, STANDBY or OUT OF SERVICE (OOS) through the OIT. The pumps will be activated based on the START and STOP wet well levels. A STANDBY PUMP will replace any pump that fails or faults. OOS pumps will not operate.

The common speed will be used for all active pumps. The speed will be proportional from the MIN PUMP SPEED LEVEL to the MAX PUMP SPEED LEVEL in the wet well. If the operator sets the PUMP MIN SPEED to 75% and the MAX SPEED to 100%, the PLC will vary the speed signal to the pump from 75% to 100% as the level in the wet well rises from MIN SPEED LEVEL (feet) to the MAX SPEED LEVEL (feet).

Proposed OIT and SCADA Functions

P-1, P-2, P-3 and P-4 RUN/STOPPED status
P-1, P-2, P-3 and P-4 IN AUTO status
P-1, P-2, P-3 and P-4 ESTOP pushed alarm
P-1, P-2, P-3 and P-4 HAND-OFF-AUTO control
P-1, P-2, P-3 and P-4 Totalized Run Time (hours)
P-1, P-2, P-3 and P-4 SPEED control (0-100%)
P-1, P-2, P-3 and P-4 VFD FAULT
P-1, P-2, P-3 and P-4 FAIL
P-1, P-2, P-3 and P-4 HIGH TEMP alarm
P-1, P-2, P-3 and P-4 SEAL LEAK alarm
P-1, P-2, P-3 and P-4 SPEED Feedback (0-100%)
P-1, P-2, P-3 and P-4 AMPS Feedback (amps)
P-1, P-2, P-3 and P-4 LOW AMP Alarm
*P-1, P-2, P-3 and P-4 LOW AMP Alarm setpoint, enable and delay
P-1, P-2, P-3 and P-4 HIGH AMP Alarm
P-1, P-2, P-3 and P-4 LEAD-LAG1-LAG2-Standby-OOS selection
*P-1, P-2, P-3 and P-4 Minimum Pump Speed (0-100%), set at 15% design flow rate
*P-1, P-2, P-3 and P-4 Maximum Pump Speed (0-100%), typically 100%
Wet Well 1 LOW-LOW Level Alarm
Wet Well 2 LOW-LOW Level Alarm

Wet Well 2 HIGH-HIGH Level Alarm
Wet Well 2 HIGH-HIGH Level Alarm
Wet Well 1 Level (feet and %)
Wet Well 2 Level (feet and %)
Wet Well Level Disagreement Alarm
*Wet Well Level Disagreement Alarm setpoint, enable and delay
Wet Well Level Control Selection (Wetwell 1- Wetwell 2)
Wet Well Low Level Alarm
*Wet Well Low Level Alarm Setpoint, enable/disable and delay
Lead Pump Start and Stop Levels (0.00 to 15.00 feet)
Lag1 Pump Start and Stop Levels (0.00 to 15.00 feet)
Lag2 Pump Start and Stop Levels (0.00 to 15.00 feet)
Minimum Pump Speed Level (0.00 to 15.00 feet)
Maximum Pump Speed Level (0.00 to 15.00 feet)
Wet Well High Level Alarm
*Wet Well High Level Alarm setpoint, enable and delay
Mill Creek Flow Rate (gpm and MGD)
Totalized Flow Rate (MGD)
Low Flow Alarm
*Low Flow Alarm Setpoint (1 pump running)
*Low Flow Alarm Setpoint (2 pumps running)
*Low Flow Alarm Setpoint (3 pumps running)
*Low Flow Alarm enable and delay
Loss of Control Power alarm
Loss of Communication Alarm
Dry Well Flood Alarm
Pump Access Room Temperature (def F)
Pump Access Room Low Temperature Alarm
*Pump Access Room Low Temperature Alarm setpoint, enable and delay
Electrical Room Temperature (def F)
Electrical Room Low Temperature Alarm
*Electrical Room Low Temperature Alarm setpoint, enable and delay
ATS Normal-Generator status
Generator Run status
Generator Fault status
Generator Fuel Level (gallons)
Generator Low Fuel Alarm
*Generator Low Fuel Alarm setpoint, enable and delay
Exhaust Fan Run Status
Exhaust Fan O/L alarm
*functions only available at the OIT

SECTION 4

IMPLEMENTATION AND PROJECT SCHEDULE

4.1 PERMITTING

There are a number of local and state design reviews and/or permits that will be required for this project. The reviewing agencies that are anticipated to be involved with the project review/permitting are as follows:

- Town of Falmouth, Maine Wastewater Department, Planning Board, Code Enforcement Officer
- Town of Cumberland, Maine
- Portland Water District
- State of Maine Maine Department of Environmental Protection
- Falmouth Conservation Trust (Town to comment on whether FCT has stake)

Copies of the preliminary and final design documents will be provided to the above agencies for review prior to project construction. Agency review and approval periods have been assumed when developing the preliminary project schedule, which is presented in Section 4.2 below.

4.2 SCHEDULE

The preliminary project schedule is presented below and Figure 4-1 at the end of this section shows a bar chart version of the schedule.

| | |
|--|--------------|
| Submit Draft Preliminary Design Report (PDR) | January 2015 |
| Receive All Comments on PDR / PDR Meeting | January 2015 |

| | |
|---------------------------------------|----------------------------------|
| Issue Final PDR | February 2015 |
| Prepare Planning Board Application | <i>Februrary-March 2015</i> |
| Final Design / Permitting | <i>March-September 2015</i> |
| Begin permitting | <i>March 2015</i> |
| Begin Final Design | <i>March 2015</i> |
| Submit 50% Design to Town | <i>May 2015</i> |
| Submit 90% Design to Town and MDEP | <i>July 2015</i> |
| Submit 100% Design | <i>September 2015</i> |
| Advertise for Bidding | <i>September 2015</i> |
| Bid Opening | <i>October 2015</i> |
| Award Construction Contract | <i>November 2015</i> |
| Construction of New Pump Station | <i>December 2015 – June 2017</i> |
| Construction – Substantial Completion | <i>June 2017</i> |
| Construction – Final Completion | <i>July 2017</i> |
| 1-Year Warranty Period Expires | <i>July 2018</i> |

**Dates in italic above are based upon assumed review periods*

SECTION 5

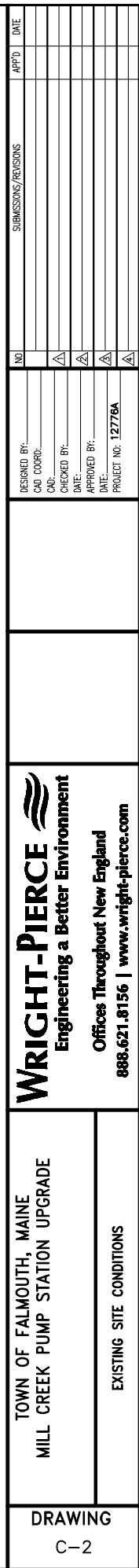
PRELIMINARY DRAWINGS

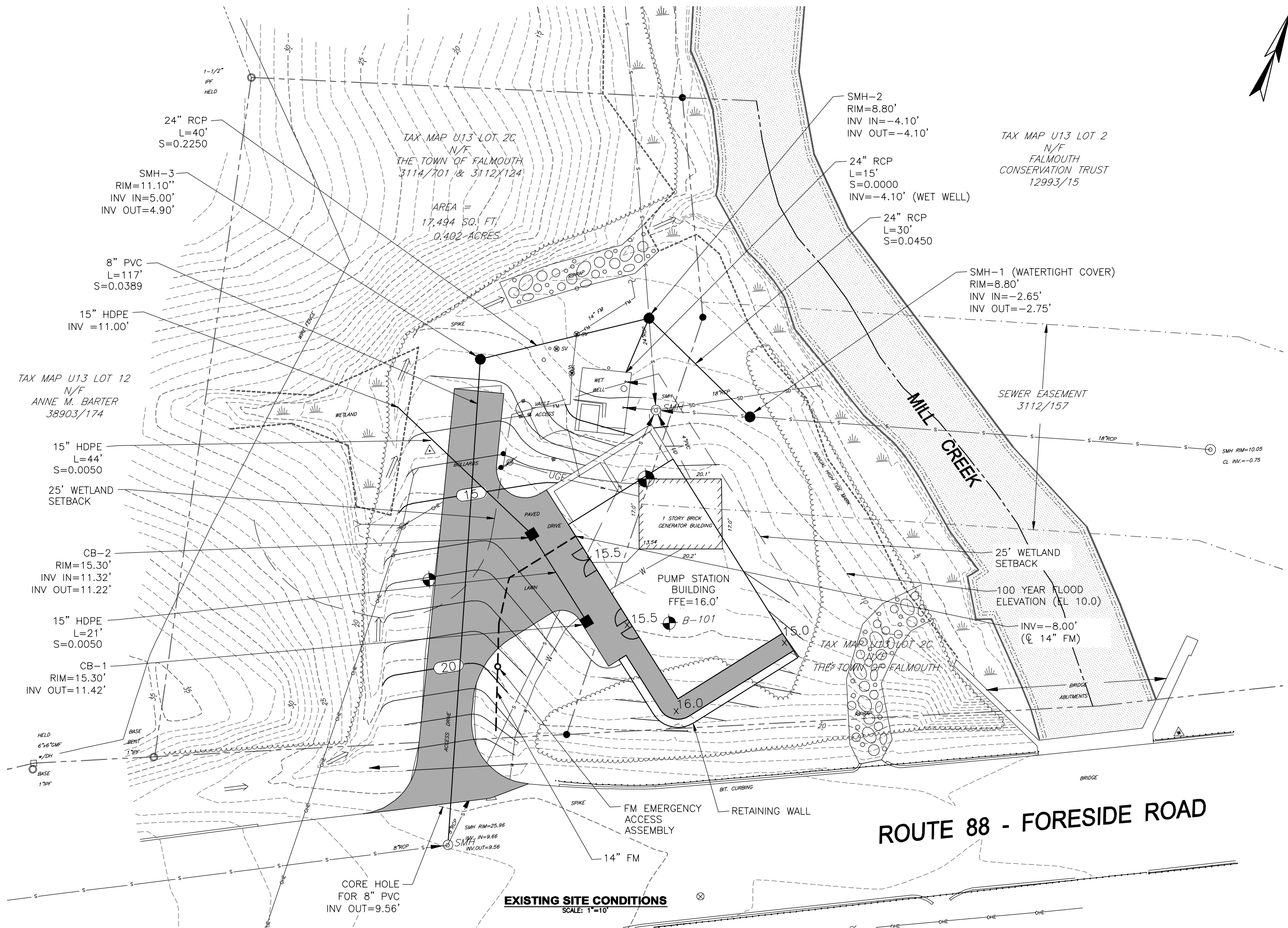
5.1 EXISTING PLAN (DRAWING C-2)

5.2 PROPOSED SITE PLAN (DRAWING C-3)

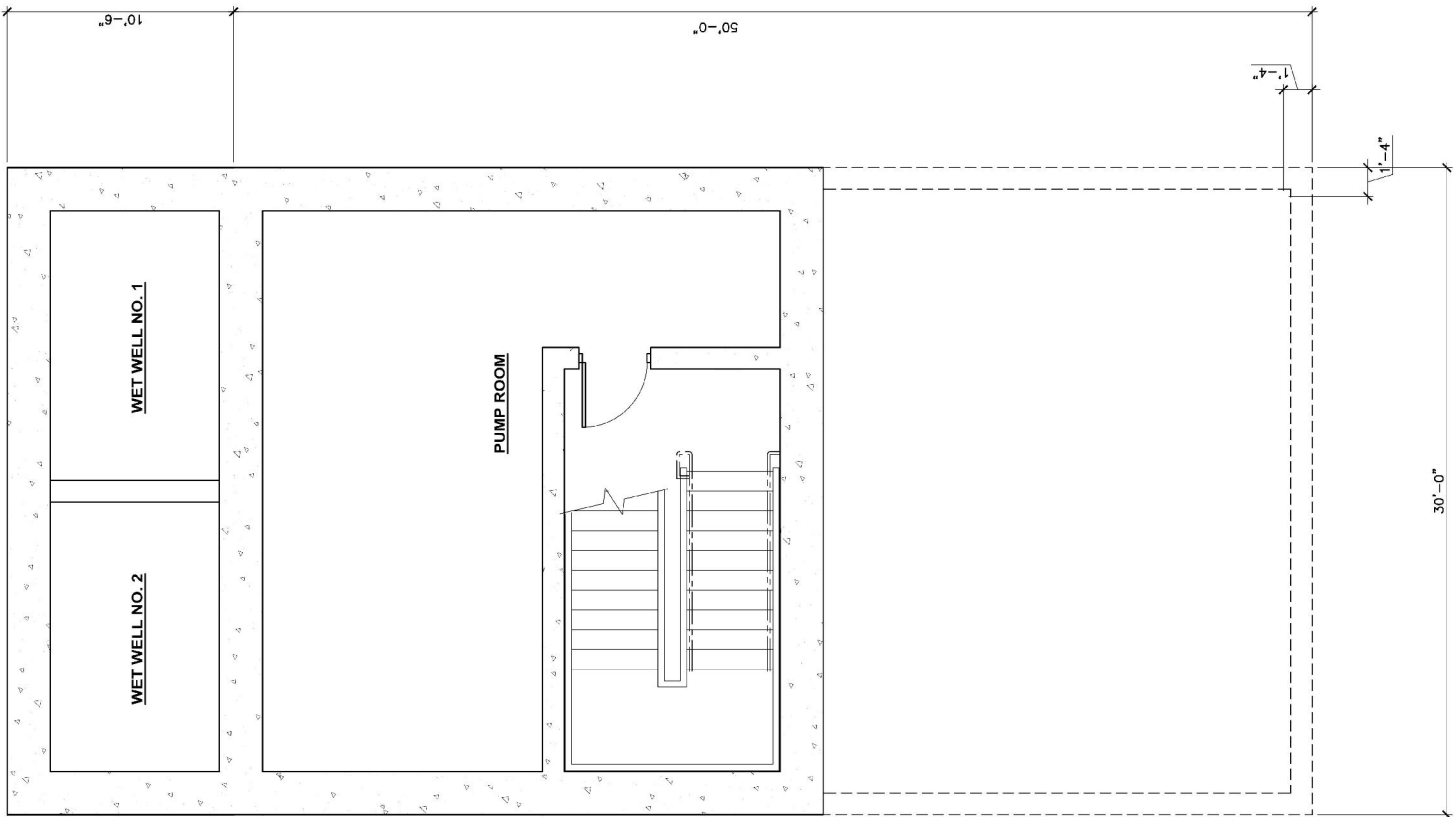
5.3 PRELIMINARY PLAN AND ELEVATIONS (DRAWINGS A-1 AND A-2)

5.4 PRELIMINARY PUMP AND PIPING LAYOUT (DRAWING PR-3)

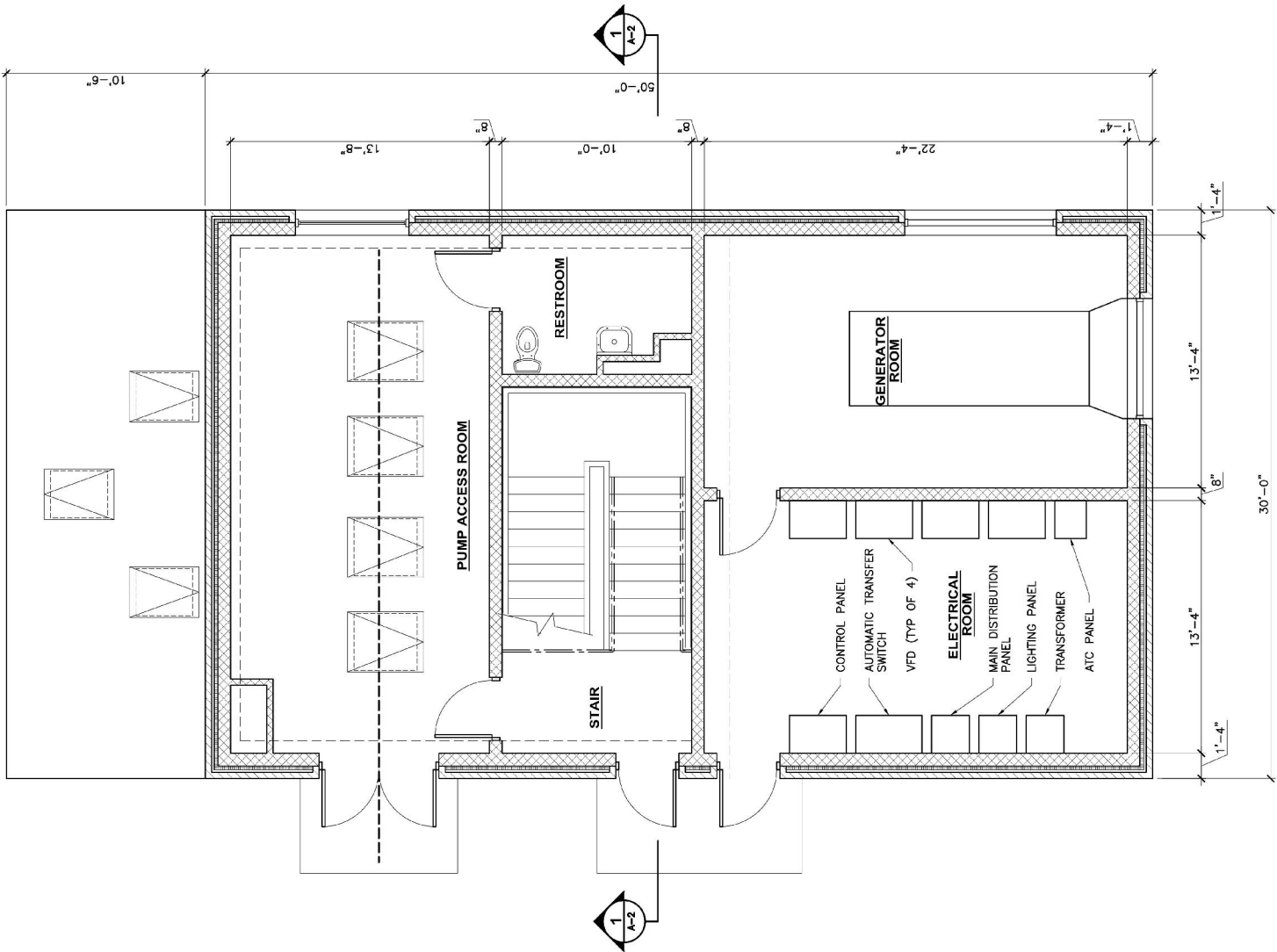




SCALE: 1/4"=1'-0"



SCALE: 1/4"=1'-0"



DRAWING
A-2

TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION UPGRADE

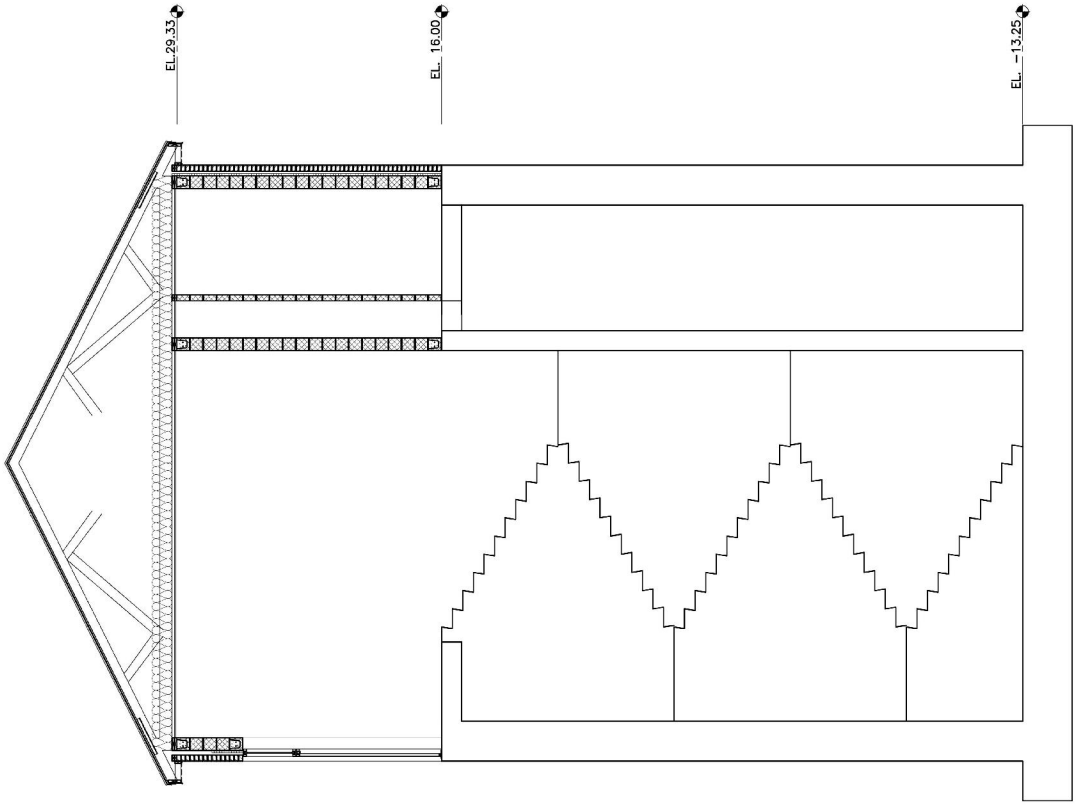
BUILDING SECTION

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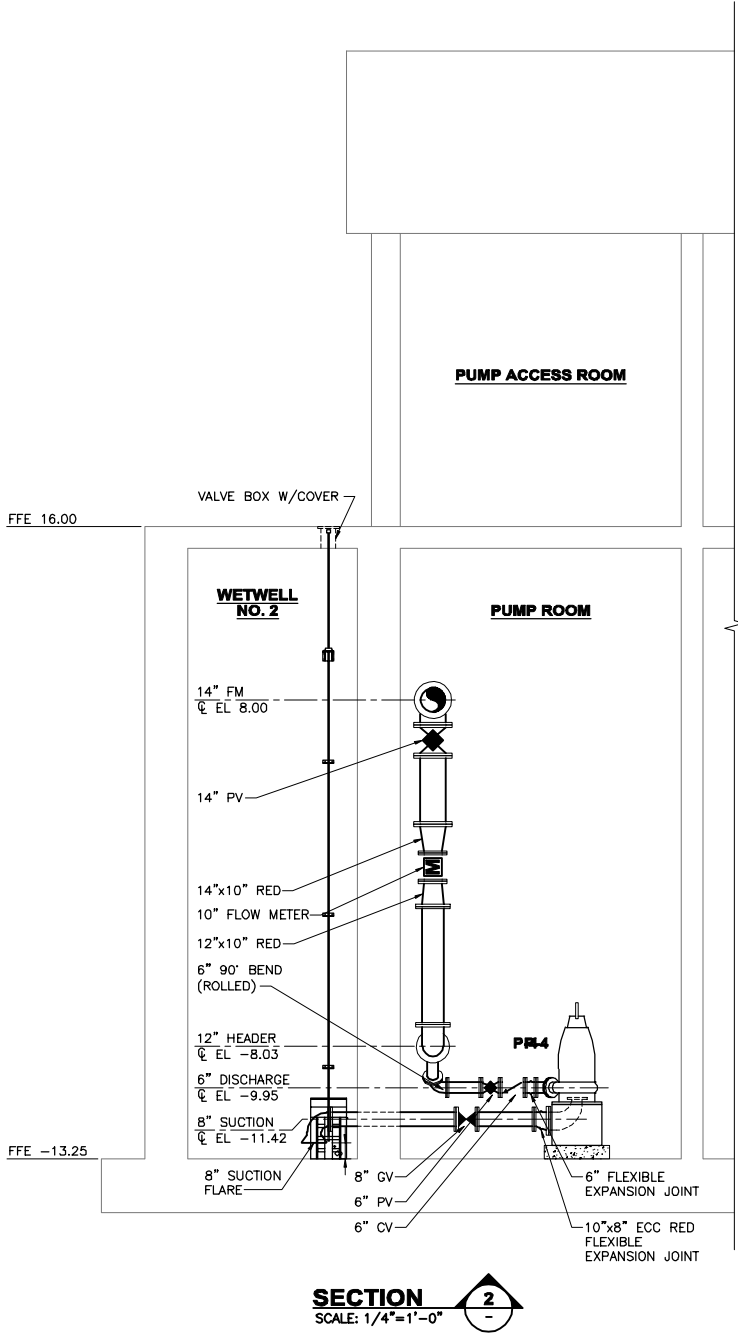
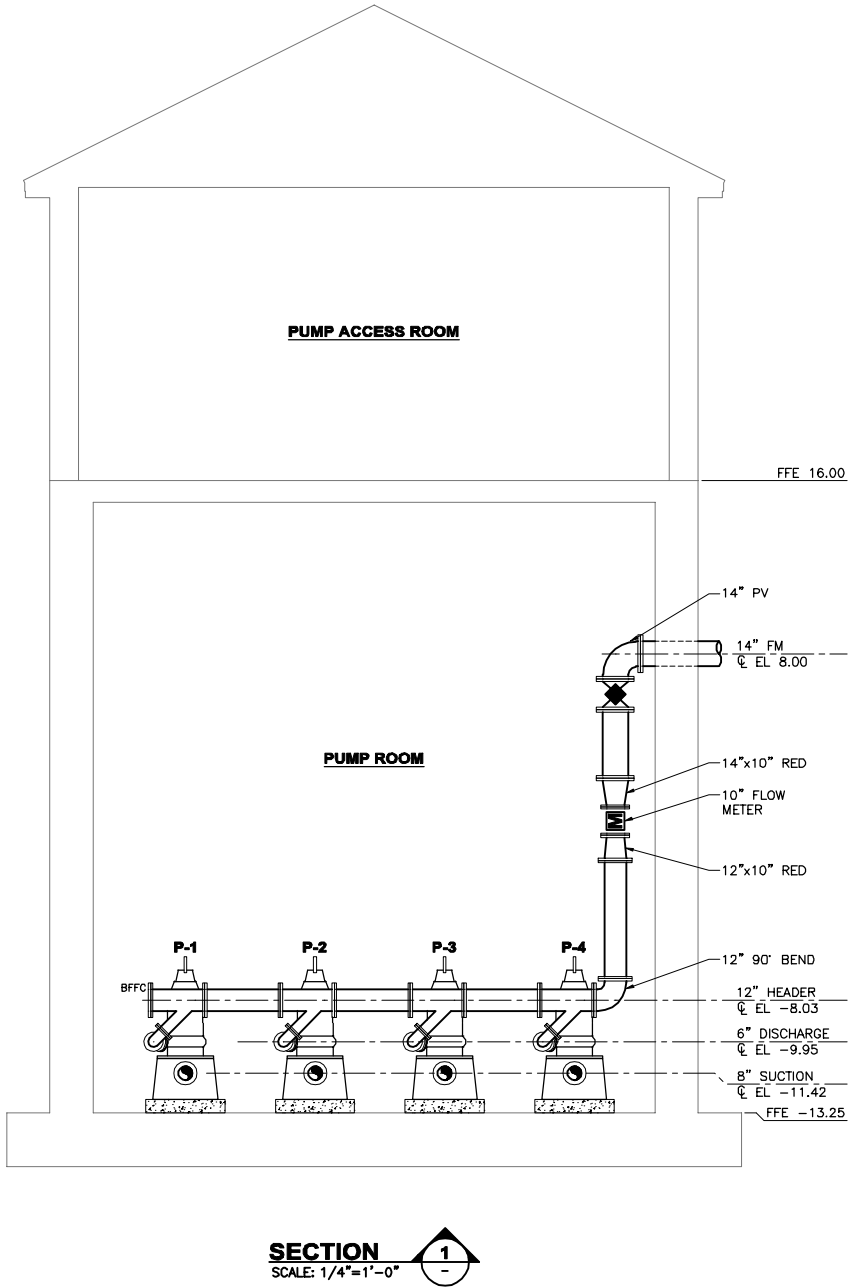
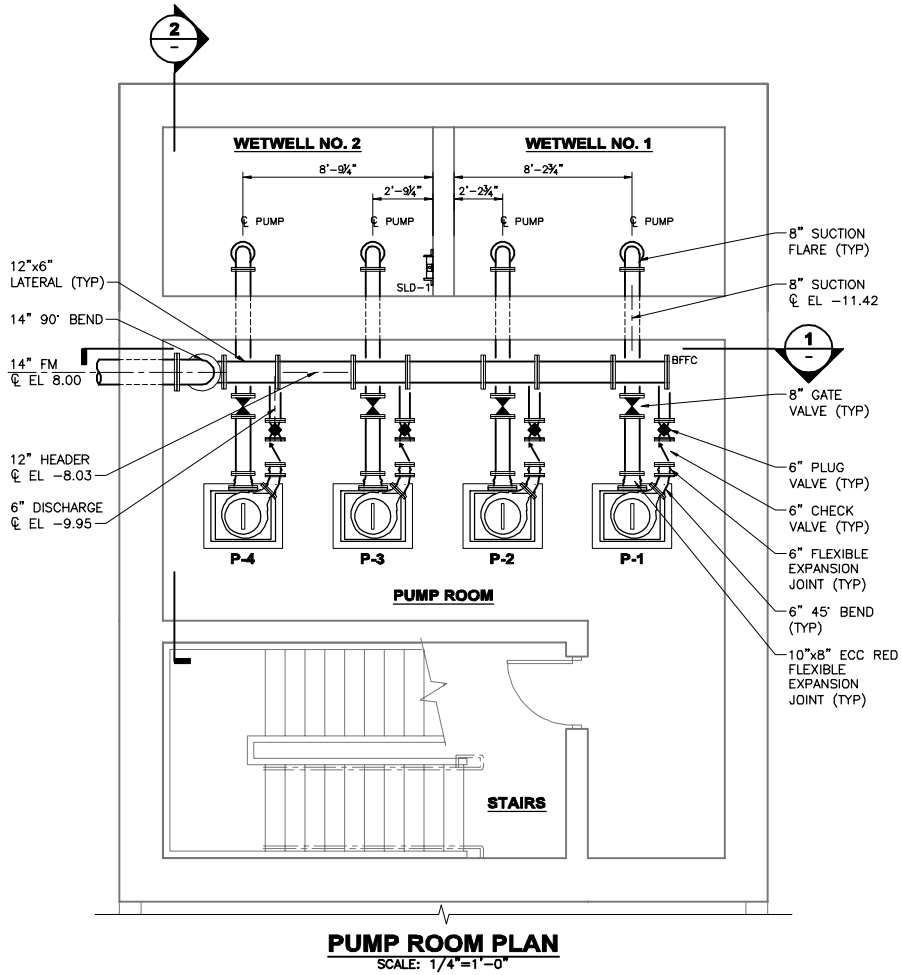
DESIGNED BY: **CBM**
CAD COORD: _____
CHECKED BY: _____
DATE: _____
APPROVED BY: _____
DATE: _____
PROJECT NO: **12776A**

SUBMISSIONS/REVISIONS

| NO | DATE | APP'D |
|----|------|-------|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |



SECTION 1
SCALE: 1/4"=1'-0"



| SUBMISSIONS/REVISIONS | | APP'D | DATE |
|-----------------------|---------------------|-------|------|
| NO. | DESCRIPTION | | |
| 1 | DESIGNED BY: KMC | | |
| 2 | CAD COORD: CAD: BBB | | |
| 3 | CHECKED BY: DATE: | | |
| 4 | APPROVED BY: DATE: | | |
| 5 | PROJECT NO: 12776A | | |

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TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION UPGRADE

WET WELL/DRY WELL PUMP STATION
PLAN & SECTIONS

DRAWING
PR-3

SECTION 6

ENGINEER'S ESTIMATE OF PROJECT COST

6.1 PRELIMINARY COST ESTIMATE

A preliminary cost estimate was developed for the work described in this Report. The estimated cost to construct the proposed facilities was developed using standard cost estimating procedures utilizing preliminary design layouts, equipment quotations and unit cost information. Where appropriate, recent construction cost data was incorporated. This cost estimate was based on an ENR Index of 9936 (December 2014). The preliminary design construction cost estimate, project cost estimate and financing summary are presented as Table 6-1 on the next page. The total construction cost is the engineer's best estimate for construction bid prices for the project and includes the following:

- Construction contingency (5%)
- Technical Services (18%)
- Materials Testing (0.6%)
- Financing Fees (2%)
- Principal Forgiveness (\$100,000).

The cost estimate does not include any legal fees, land acquisitions and/or easements.

This project, as outlined in the Report will be funded by a Clean Water State Revolving Loan Fund (CWSRF) with a term of 20-years. The Town will receive a minimum of \$100,000 in principal forgiveness for the project through the CWSRF program.

**TABLE 6-1: ENGINEERS PLANNING LEVEL COST ESTIMATE
(WET WELL – DRY PIT PUMP STATION)**

Town of Falmouth, Maine
Mill Creek Pump Station Upgrade
12776A
Preliminary Design
ENR INDEX 9936 - December 2014
12/30/14 - PROJECT COST ESTIMATE

| PROJECT COMPONENT | | | 9936 |
|-------------------------------------|-------|--|-------------|
| CONSTRUCTION | | | \$3,274,025 |
| CONSTRUCTION CONTINGENCY | 5.0% | | \$164,214 |
| TECHNICAL SERVICES | 18.0% | | \$589,119 |
| MATERIALS TESTING | 0.6% | | \$19,500 |
| ASBESTOS & LEAD PAINT ABATEMENT | | | |
| DIRECT EQUIPMENT PURCHASE | | | |
| LAND ACQUISITION/ EASEMENTS | | | |
| LEGAL/ ADMINISTRATIVE | 0.0% | | |
| SUBTOTAL | | | \$4,046,860 |
| FINANCING | 2.0% | | \$80,937 |
| PRINCIPAL FORGIVENESS | | | \$100,000 |
| ENGINEER'S ESTIMATE OF PROJECT COST | | | \$4,025,306 |

APPENDIX A
WETLAND DELINEATION REPORT

Town of Falmouth, Maine Mill Creek Pump Station Wetland Delineation Report

November 26, 2013



*Prepared for
Wright-Pierce
Topsham, Maine*

*Prepared by
Penobscot Environmental Consulting, Inc.
Camden, Maine*

Table of Contents

Introduction 1

Methods 1

Results 1

Applicable Regulations..... 2

- Attachments Wetland Delineation Data Forms
- Wetland Delineation Maps
- Soils Report

Introduction

The Town of Falmouth, Maine, maintains several pump stations and associated underground utility lines as part of its municipal wastewater collection and treatment system. Mill Creek Pump Station is the largest and most important pump station in Falmouth and accepts all flow from the Route 88 and Route 1 areas north of the Town Forest and all flow from the Town of Cumberland. It is one of three stations that pump directly to the Town's wastewater treatment facility. Several pump stations, including Hedgerow Drive, Johnson Road, Northbrook Road, Baysite Drive, Underwood Road, Handy Boat, Old Mill Road, and Thornhurst Road Pump Stations pump to Mill Creek Pump Station. Constructed in 1971, the facility is now in need of capacity upgrades and other related maintenance improvements¹.

Capacity upgrades for the facility will require replacing equipment and constructing a larger building to house the necessary pumps and related infrastructure. In support of this effort, wetlands and other regulated natural resources were delineated for the site, as reported below.

Methods

Maine Office of GIS files were downloaded into ArcMap (v.10.1) to identify potential regulated natural resources, such as Significant Wildlife Habitat, Essential Wildlife Habitat, wetlands, and flood zones. A site visit was then conducted with engineers from Wright-Pierce to gain an understanding of the potential proposed site alterations. Wetlands were then delineated using the 1987 Corps of Engineers *Wetland Delineation Manual*, as modified by the 2012 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (v.2.0). Wetland delineation flags were surveyed by conventional ground survey by Maine Licensed Professional Surveyors. As part of the wetland delineation effort, a search was also conducted for potential vernal pools.

Corps of Engineers (Corps) and Maine Department of Environmental Protection (MDEP) staff were consulted regarding wetland and stream jurisdictional matters and a pre-application meeting with Corps and DEP staff was held on July 30, 2013, at MDEP's Portland office.

Results

Review of Maine Office of GIS files did not reveal any known occurrences of Significant Wildlife Habitat or Essential Wildlife Habitat. In addition, site surveys did not result in the identification of any potential vernal pools. Regulated natural resources for the site, therefore, are primarily focused on coastal wetlands associated with Mill Creek, a small freshwater wetland on the hillside adjacent to the developed portion of the parcel, and a small intermittent stream (see Figure 1). Additional regulated resources, however, include flood zones and the Town of Falmouth's Shoreland Zone for Mill Creek.

¹ *Comprehensive Pump Station Assessment for the Town of Falmouth, Maine. July 2009.* Wright-Pierce, Topsham, Maine. 242 pp.



Photo 1. Mill Creek and adjacent salt marsh, looking downstream toward Route 88.

The pump station is adjacent to tidally-influenced Mill Creek, which flows into Mussel Cove, a part of Casco Bay. The tidally-influenced portion of Mill Creek in the vicinity of the pump station is narrow and includes a thin strip of salt marsh dominated by *Spartina patens* and *S. alterniflora*² (see Photo 1).

The boundary of the coastal wetland was determined based on soils, plants, and observable wetland hydrology indicators such as wrack lines. In some areas this delineation was refined based on surveyed elevations of known annual high water events, as noted on

Wright-Pierce engineering design plans for the project.

The Town of Falmouth's Shoreland Zone in the project area is tied to the annual high water mark of Mill Creek and the 250-foot zone encompasses the entire pump station project area. Much of the developed portion of the property also falls within the Town's Resource Protection portion of the Shoreland Zone.



Photo 2. Man-made ditch that conveys a regulated intermittent stream.

A small freshwater wetland and associated intermittent stream are located on the hillside immediately west of the developed portion of the property. The intermittent stream joins a man-made ditch (see Photo 2) and Corps and DEP staff have both confirmed that the portion of the ditch that conveys the intermittent stream is a regulated natural resource (see Figure 1).

Applicable Regulations

The coastal wetland, freshwater wetland, and intermittent stream are subject to Maine's Natural Resources Protection Act (NRPA; see 38 MRSA 480-B and Chapter 310, Wetlands and Waterbodies Protection Rules). The coastal wetland, as defined by the flagged wetland boundary or the surveyed flood elevation - whichever is higher - is a Wetland of Special Significance according to Maine's NRPA regulations. The freshwater wetland is a Freshwater Wetland of Special Significance due to its being within 250 feet of a coastal wetland. Certain areas adjacent to these regulated resources (i.e., generally

² Plant taxonomy follows Haines, A. 2011. *Flora novae angliae - a manual for the identification of native and naturalized higher vascular plants of New England*. New England Wildflower Society and Yale University Press.

within 75') are also subject to NRPA regulation. Depending on the final design of the project, an individual NRPA permit may be required from the MDEP. MDEP has indicated, however, that the project may be eligible for the Utility Crossing permit-by-rule (PBR) or other PBRs, depending on the final design of the project (see below).

The applicant for a PBR must file notice of the activity with the MDEP prior to beginning work on the activity. The notification must be on a form provided by the MDEP and must include any submissions required in this chapter. The applicant must keep a copy to serve as the permit.

The notification form must be sent to the MDEP by certified mail (return receipt requested), or hand delivered to the MDEP and date stamped by the department. By signing the notification form, the applicant is representing that the activity will meet the applicability requirements and standards of the rule. In addition, by signing the notification form the applicant represents that the applicant has sufficient title, right, or interest in the property where the proposed activity is to take place.

The PBR becomes effective 14 calendar days after MDEP receives the notification form, unless MDEP approves or denies the PBR prior to that date. If MDEP does not speak with or write to the applicant within this 14-day period regarding the PBR notification, the applicant may proceed to carry out the activity.

Portions of the project may qualify for the PBR related to *Activities Adjacent to Protected Natural Resources*, which can include areas adjacent to, but not in, coastal wetlands and streams. The PBR does not apply to work within the 75-foot setback if there is a practicable alternative location on the parcel that would result in less environmental impact. Activities presumed to have no practicable alternative include planting vegetation to control erosion or create a buffer, removal or replacement of underground storage tanks, replacement of a structure or foundation for a legally existing structure that is not closer to the protected natural resource that has been approved by the municipality, and access ways such as footpaths, stairways, or steps to the resource. Except for these activities, a 25-foot setback must be maintained between the normal high water line or upland edge of the protected natural resource and the activity. Areas that have slopes of 3H:1V or steeper do not count toward the 25-foot setback.

The PBR related to *Outfall Pipes* may be relevant to any work related to the abandoned outfall pipe found within the coastal wetland. The PBR applies to the installation and maintenance of permanent outfall pipes and MDEP may conclude that maintenance activities include the removal or permanent plugging of a pipe. To qualify for this PBR, any activity occurring in tidal waters must include approval of the timing of the activity from the Maine Department of Marine Resources (i.e., the approval must be filed with the PBR notification form).

In the pre-application meeting (see above), MDEP suggested that the PBR related to *Crossings (Utility Lines, Pipes, and Cables)* might be most appropriate for the proposed project. The PBR can apply to the installation, maintenance, and replacement of a submerged utility line across a coastal wetland or other regulated natural resources. To qualify for the PBR, the project must conform to the local Shoreland Zoning Ordinance.

MDEP should be consulted regarding the ultimate applicability of PBRs once project design plans approach final form.

The Corps of Engineers regulates both the coastal wetland and the freshwater wetland as well as the intermittent stream. A permit is only required, however, for direct impacts to these resources (i.e., the Corps does not regulate areas adjacent to wetlands).

As noted above, the entire parcel is within the Town of Falmouth's Shoreland Zone and much of the developed portion of the parcel is within the Resource Protection portion of the Shoreland Zone. Planning Board approval, therefore, may be required for the proposed improvements to the pump station.

ATTACHMENTS

WETLAND DELINEATION DATA FORMS

WETLAND DELINEATION FIGURE

SOILS REPORT

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Mill Creek Pump Station City/County: Falmouth/Cumber. Sampling Date: 6/24/13
 Applicant/Owner: Town of Falmouth State: ME Sampling Point: U1
 Investigator(s): M.E. Thompson (PWS 831) Section, Township, Range: _____

Landform (hillslope, terrace, etc.): SLOPE Local relief (concave, convex, none): NONE Slope (%): 8

Subregion (LRR or MLRA): LRR R Lat: 43°43'30.39" N Long: 70°13'22.24" W Datum: WGS84

Soil Map Unit Name: DISTURBED / MISCELLANEOUS NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---------------------------------|-----------------------|---|-----------------------|
| Hydrophytic Vegetation Present? | Yes _____ No <u>✓</u> | Is the Sampled Area within a Wetland? | Yes _____ No <u>✓</u> |
| Hydric Soil Present? | Yes _____ No <u>✓</u> | If yes, optional Wetland Site ID: _____ | |
| Wetland Hydrology Present? | Yes _____ No <u>✓</u> | | |

Remarks: (Explain alternative procedures here or in a separate report.)

GRADED HILL FOR PUMP STATION; COMPACTED; SEVEN TO EIGHT FEET DEEP; RECEIVES RUNOFF FROM ROUTE 88.

HYDROLOGY

| Wetland Hydrology Indicators: | | Secondary Indicators (minimum of two required) |
|---|---|--|
| Primary Indicators (minimum of one is required; check all that apply) | | |
| <input type="checkbox"/> Surface Water (A1) | <input type="checkbox"/> Water-Stained Leaves (B9) | <input type="checkbox"/> Surface Soil Cracks (B6) |
| <input type="checkbox"/> High Water Table (A2) | <input type="checkbox"/> Aquatic Fauna (B13) | <input type="checkbox"/> Drainage Patterns (B10) |
| <input type="checkbox"/> Saturation (A3) | <input type="checkbox"/> Marl Deposits (B15) | <input type="checkbox"/> Moss Trim Lines (B16) |
| <input type="checkbox"/> Water Marks (B1) | <input type="checkbox"/> Hydrogen Sulfide Odor (C1) | <input type="checkbox"/> Dry-Season Water Table (C2) |
| <input type="checkbox"/> Sediment Deposits (B2) | <input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3) | <input type="checkbox"/> Crayfish Burrows (C8) |
| <input type="checkbox"/> Drift Deposits (B3) | <input type="checkbox"/> Presence of Reduced Iron (C4) | <input type="checkbox"/> Saturation Visible on Aerial Imagery (C9) |
| <input type="checkbox"/> Algal Mat or Crust (B4) | <input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6) | <input type="checkbox"/> Stunted or Stressed Plants (D1) |
| <input type="checkbox"/> Iron Deposits (B5) | <input type="checkbox"/> Thin Muck Surface (C7) | <input type="checkbox"/> Geomorphic Position (D2) |
| <input type="checkbox"/> Inundation Visible on Aerial Imagery (B7) | <input type="checkbox"/> Other (Explain in Remarks) | <input type="checkbox"/> Shallow Aquitard (D3) |
| <input type="checkbox"/> Sparsely Vegetated Concave Surface (B8) | | <input type="checkbox"/> Microtopographic Relief (D4) |
| | | <input type="checkbox"/> FAC-Neutral Test (D5) |

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____
 Water Table Present? Yes ✓ No _____ Depth (inches): 96"
 Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

OPEN SOIL BORE HOLE WITH WATER AT 8' (96").

SOIL

Sampling Point: 41

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

[illegible]¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.²Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- | | |
|---|--|
| <input type="checkbox"/> Histosol (A1) | <input type="checkbox"/> Polyvalue Below Surface (S8) (LRR R, |
| <input type="checkbox"/> Histic Epipedon (A2) | MLRA 149B) |
| <input type="checkbox"/> Black Histic (A3) | <input type="checkbox"/> Thin Dark Surface (S9) (LRR R, MLRA 149B) |
| <input type="checkbox"/> Hydrogen Sulfide (A4) | <input type="checkbox"/> Loamy Mucky Mineral (F1) (LRR K, L) |
| <input type="checkbox"/> Stratified Layers (A5) | <input type="checkbox"/> Loamy Gleyed Matrix (F2) |
| <input type="checkbox"/> Depleted Below Dark Surface (A11) | <input type="checkbox"/> Depleted Matrix (F3) |
| <input type="checkbox"/> Thick Dark Surface (A12) | <input type="checkbox"/> Redox Dark Surface (F6) |
| <input type="checkbox"/> Sandy Mucky Mineral (S1) | <input type="checkbox"/> Depleted Dark Surface (F7) |
| <input type="checkbox"/> Sandy Gleyed Matrix (S4) | <input type="checkbox"/> Redox Depressions (F8) |
| <input type="checkbox"/> Sandy Redox (S5) | |
| <input type="checkbox"/> Stripped Matrix (S6) | |
| <input type="checkbox"/> Dark Surface (S7) (LRR R, MLRA 149B) | |

Indicators for Problematic Hydric Soils³:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
☐ Dark Surface (S7) (**LRR K, L**)
☐ Polyvalue Below Surface (S8) (**LRR K, L**)
☐ Thin Dark Surface (S9) (**LRR K, L**)
☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
☐ Red Parent Material (F21)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ~ / s

Depth (inches): _____

Hydric Soil Present? Yes No ☒

Remarks:

Soils throughout the entire project area are misclassified as tidal marsh. Soils surrounding the pump station appear to be PLM / GMAH.

VEGETATION – Use scientific names of plants.

Sampling Point: 01

| Tree Stratum (Plot size: <u>N/A</u>) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | | | |
|---|---------------------|-------------------|---------------------|--|-------------------|--------------|----------------------|-------------|-----------------------|-------------|-------------------|-------------|--------------------|-------------|-------------------|-------------|----------------------|---------------------|--------------------------------|--|
| 1. _____ | _____ | _____ | _____ | Dominance Test worksheet: Number of Dominant Species That Are OBL, FACW, or FAC: <u>0</u> (A) Total Number of Dominant Species Across All Strata: <u>1</u> (B) Percent of Dominant Species That Are OBL, FACW, or FAC: <u>0</u> (A/B) | | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 7. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | Prevalence Index worksheet: <table style="width:100%;"> <tr> <td style="width:50%;">Total % Cover of:</td> <td style="width:50%;">Multiply by:</td> </tr> <tr> <td>OBL species <u>0</u></td> <td>x 1 = _____</td> </tr> <tr> <td>FACW species <u>0</u></td> <td>x 2 = _____</td> </tr> <tr> <td>FAC species _____</td> <td>x 3 = _____</td> </tr> <tr> <td>FACU species _____</td> <td>x 4 = _____</td> </tr> <tr> <td>UPL species _____</td> <td>x 5 = _____</td> </tr> <tr> <td>Column Totals: _____</td> <td>(A) _____ (B) _____</td> </tr> <tr> <td colspan="2" style="text-align: center;">Prevalence Index = B/A = _____</td> </tr> </table> | Total % Cover of: | Multiply by: | OBL species <u>0</u> | x 1 = _____ | FACW species <u>0</u> | x 2 = _____ | FAC species _____ | x 3 = _____ | FACU species _____ | x 4 = _____ | UPL species _____ | x 5 = _____ | Column Totals: _____ | (A) _____ (B) _____ | Prevalence Index = B/A = _____ | |
| Total % Cover of: | Multiply by: | | | | | | | | | | | | | | | | | | | |
| OBL species <u>0</u> | x 1 = _____ | | | | | | | | | | | | | | | | | | | |
| FACW species <u>0</u> | x 2 = _____ | | | | | | | | | | | | | | | | | | | |
| FAC species _____ | x 3 = _____ | | | | | | | | | | | | | | | | | | | |
| FACU species _____ | x 4 = _____ | | | | | | | | | | | | | | | | | | | |
| UPL species _____ | x 5 = _____ | | | | | | | | | | | | | | | | | | | |
| Column Totals: _____ | (A) _____ (B) _____ | | | | | | | | | | | | | | | | | | | |
| Prevalence Index = B/A = _____ | | | | | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | | | | | | | | | | | | | | | | | |
| Sapling/Shrub Stratum (Plot size: <u>N/A</u>) | | | | | | | | | | | | | | | | | | | | |
| 1. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 7. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | Hydrophytic Vegetation Indicators: <input checked="" type="checkbox"/> 1 - Rapid Test for Hydrophytic Vegetation <input type="checkbox"/> 2 - Dominance Test is >50% <input type="checkbox"/> 3 - Prevalence Index is ≤3.0 ¹ <input type="checkbox"/> 4 - Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | | | | | | | | | | | | | | | | | |
| Herb Stratum (Plot size: <u>5'</u>) | | | | | | | | | | | | | | | | | | | | |
| 1. <u>POA PROLIFENSIS</u> | <u>95</u> | <u>Y</u> | <u>FACU</u> | | | | | | | | | | | | | | | | | |
| 2. <u>PRUNELLA VULGARIS</u> | <u>1</u> | <u>N</u> | <u>FAC</u> | | | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 7. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 8. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 9. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 10. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 11. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 12. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | Definitions of Vegetation Strata: Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall. Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall. Woody vines – All woody vines greater than 3.28 ft in height. | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | | | | | | | | | | | | | | | | | |
| Woody Vine Stratum (Plot size: _____) | | | | | | | | | | | | | | | | | | | | |
| 1. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | |
| | | | _____ = Total Cover | | | | | | | | | | | | | | | | | |
| Hydrophytic Vegetation Present? Yes _____ No <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | |
| Remarks: (Include photo numbers here or on a separate sheet.) <u>MOIST LOW DOMINATED BY BLUEGRASS WITH</u> <u>OCCASIONAL WOODS AND BARE SPOTS</u> | | | | | | | | | | | | | | | | | | | | |

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Mill Creek Pump Station City/County: Falmouth/Cumber. Sampling Date: 6/24/13
 Applicant/Owner: Town of Falmouth State: ME Sampling Point: W1
 Investigator(s): M.E. Thompson (PWS 831) Section, Township, Range: _____
 Landform (hillslope, terrace, etc.): SALT MARSH Local relief (concave, convex, none): FLAT Slope (%): 02
 Subregion (LRR or MLRA): LRR R Lat: 43°43'30.39" N Long: 70°13'22.24" W Datum: WGS84
 Soil Map Unit Name: TIDAL MARSH NWI classification: U1S1 MARSH

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No _____ (If no, explain in Remarks.)
 Are Vegetation ☒, Soil ☒, or Hydrology ☒ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No _____
 Are Vegetation ☒, Soil ☒, or Hydrology ☒ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | |
|--|--|
| Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No _____ | Is the Sampled Area within a Wetland? Yes <input checked="" type="checkbox"/> No _____ |
| Hydric Soil Present? Yes <input checked="" type="checkbox"/> No _____ | If yes, optional Wetland Site ID: _____ |
| Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No _____ | |

Remarks: (Explain alternative procedures here or in a separate report.)
SALT MARSH ADJACENT TO TIDAL CREEK. UPLAND EDGE
NORMAL U1S1 WETLAND LINE (STATIONED BY EASING);
DETENTION, AS WELL, BY WETLAND LINE, SALT MARSH.

HYDROLOGY

| | | | |
|--|---|--|--|
| Wetland Hydrology Indicators: | | Secondary Indicators (minimum of two required) | |
| Primary Indicators (minimum of one is required; check all that apply) | | | |
| <input checked="" type="checkbox"/> Surface Water (A1) | <input type="checkbox"/> Water-Stained Leaves (B9) | <input type="checkbox"/> Surface Soil Cracks (B6) | |
| <input checked="" type="checkbox"/> High Water Table (A2) | <input type="checkbox"/> Aquatic Fauna (B13) | <input type="checkbox"/> Drainage Patterns (B10) | |
| <input checked="" type="checkbox"/> Saturation (A3) | <input type="checkbox"/> Marl Deposits (B15) | <input type="checkbox"/> Moss Trim Lines (B16) | |
| <input checked="" type="checkbox"/> Water Marks (B1) | <input checked="" type="checkbox"/> Hydrogen Sulfide Odor (C1) | <input type="checkbox"/> Dry-Season Water Table (C2) | |
| <input checked="" type="checkbox"/> Sediment Deposits (B2) | <input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3) | <input type="checkbox"/> Crayfish Burrows (C8) | |
| <input checked="" type="checkbox"/> Drift Deposits (B3) | <input type="checkbox"/> Presence of Reduced Iron (C4) | <input type="checkbox"/> Saturation Visible on Aerial Imagery (C9) | |
| <input type="checkbox"/> Algal Mat or Crust (B4) | <input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6) | <input type="checkbox"/> Stunted or Stressed Plants (D1) | |
| <input type="checkbox"/> Iron Deposits (B5) | <input type="checkbox"/> Thin Muck Surface (C7) | <input type="checkbox"/> Geomorphic Position (D2) | |
| <input type="checkbox"/> Inundation Visible on Aerial Imagery (B7) | <input type="checkbox"/> Other (Explain in Remarks) | <input type="checkbox"/> Shallow Aquitard (D3) | |
| <input type="checkbox"/> Sparsely Vegetated Concave Surface (B8) | | <input type="checkbox"/> Microtopographic Relief (D4) | |
| | | <input type="checkbox"/> FAC-Neutral Test (D5) | |

| | | |
|--|--------------------------|--|
| Field Observations: | | Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No _____ |
| Surface Water Present? Yes _____ No <input checked="" type="checkbox"/> | Depth (inches): _____ | |
| Water Table Present? Yes _____ No <input checked="" type="checkbox"/> | Depth (inches): _____ | |
| Saturation Present? (includes capillary fringe) Yes <input checked="" type="checkbox"/> No _____ | Depth (inches): <u>0</u> | |

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: PUBLISHED ANNEX
U1S1 WETLAND BOUNDARY WITH SITE TAP SURVEY.

Remarks:

SOIL

Sampling Point:

61

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

[illegible]¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.²Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- | | |
|---|--|
| <input type="checkbox"/> Histosol (A1) | <input type="checkbox"/> Polyvalue Below Surface (S8) (LRR R, |
| <input type="checkbox"/> Histic Epipedon (A2) | MLRA 149B) |
| <input type="checkbox"/> Black Histic (A3) | <input type="checkbox"/> Thin Dark Surface (S9) (LRR R, MLRA 149B) |
| <input checked="" type="checkbox"/> Hydrogen Sulfide (A4) | <input type="checkbox"/> Loamy Mucky Mineral (F1) (LRR K, L) |
| <input type="checkbox"/> Stratified Layers (A5) | <input type="checkbox"/> Loamy Gleyed Matrix (F2) |
| <input type="checkbox"/> Depleted Below Dark Surface (A11) | <input type="checkbox"/> Depleted Matrix (F3) |
| <input type="checkbox"/> Thick Dark Surface (A12) | <input type="checkbox"/> Redox Dark Surface (F6) |
| <input type="checkbox"/> Sandy Mucky Mineral (S1) | <input type="checkbox"/> Depleted Dark Surface (F7) |
| <input type="checkbox"/> Sandy Gleyed Matrix (S4) | <input type="checkbox"/> Redox Depressions (F8) |
| <input type="checkbox"/> Sandy Redox (S5) | |
| <input type="checkbox"/> Stripped Matrix (S6) | |
| <input type="checkbox"/> Dark Surface (S7) (LRR R, MLRA 149B) | |

Indicators for Problematic Hydric Soils³:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
☐ Dark Surface (S7) (**LRR K, L**)
☐ Polyvalue Below Surface (S8) (**LRR K, L**)
☐ Thin Dark Surface (S9) (**LRR K, L**)
☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
☐ Red Parent Material (F21)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ~121

Depth (inches): _____

Hydric Soil Present? Yes ☒ No ☐

Remarks:

Typical soft water soils

VEGETATION – Use scientific names of plants.

Sampling Point: 61

| Tree Stratum (Plot size: <u>~1/2</u>) | Absolute % Cover | Dominant Species? | Indicator Status | |
|--|------------------|-------------------|------------------|--|
| 1. _____ | _____ | _____ | _____ | Dominance Test worksheet: Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A) Total Number of Dominant Species Across All Strata: _____ (B) Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B) |
| 2. _____ | _____ | _____ | _____ | |
| 3. _____ | _____ | _____ | _____ | |
| 4. _____ | _____ | _____ | _____ | |
| 5. _____ | _____ | _____ | _____ | |
| 6. _____ | _____ | _____ | _____ | |
| 7. _____ | _____ | _____ | _____ | |
| _____ = Total Cover | | | | Prevalence Index worksheet: Total % Cover of: _____ Multiply by: _____ OBL species _____ x 1 = _____ FACW species _____ x 2 = _____ FAC species _____ x 3 = _____ FACU species _____ x 4 = _____ UPL species _____ x 5 = _____ Column Totals: _____ (A) _____ (B) Prevalence Index = B/A = _____ |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| _____ = Total Cover | | | | Hydrophytic Vegetation Indicators: <input checked="" type="checkbox"/> 1 - Rapid Test for Hydrophytic Vegetation <input type="checkbox"/> 2 - Dominance Test is >50% <input type="checkbox"/> 3 - Prevalence Index is ≤3.0 ¹ <input type="checkbox"/> 4 - Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) ¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic. |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Herb Stratum (Plot size: <u>5'</u>) 1. <u>Spartina patens</u> <u>100</u> <u>Y</u> <u>FACW</u> 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____ 11. _____ 12. _____ | | | | Definitions of Vegetation Strata: Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall. Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall. Woody vines – All woody vines greater than 3.28 ft in height. |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| _____ = Total Cover | | | | Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No _____ |
| | | | | |
| | | | | |
| | | | | |
| Woody Vine Stratum (Plot size: <u>~1/2</u>) 1. _____ 2. _____ 3. _____ 4. _____ | | | | |
| | | | | |
| | | | | |
| | | | | |
| _____ = Total Cover | | | | |
| | | | | |
| | | | | |
| | | | | |
| Remarks: (Include photo numbers here or on a separate sheet.) <u>Wetland vegetation with some trees or</u> <u>low marsh.</u> | | | | |

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Mill Creek Pump Station City/County: Falmouth/Cumber. Sampling Date: 6/24/13
 Applicant/Owner: Town of Falmouth State: ME Sampling Point: 42
 Investigator(s): M.E. Thompson (PWS 831) Section, Township, Range: _____
 Landform (hillslope, terrace, etc.): SLOPE Local relief (concave, convex, none): convex Slope (%): 20
 Subregion (LRR or MLRA): LRR R Lat: 43°43'30.39" N Long: 70°13'22.24" W Datum: WGS84
 Soil Map Unit Name: Tm (miscellaneous) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)
 Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____
 Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | |
|---|--|
| Hydrophytic Vegetation Present? Yes _____ No <u>✓</u> | Is the Sampled Area within a Wetland? Yes _____ No <u>✓</u> If yes, optional Wetland Site ID: _____ |
| Hydric Soil Present? Yes _____ No <u>✓</u> | |
| Wetland Hydrology Present? Yes _____ No <u>✓</u> | |
| Remarks: (Explain alternative procedures here or in a separate report.) | |

HYDROLOGY

| | | | |
|---|---|--|--|
| Wetland Hydrology Indicators: | | Secondary Indicators (minimum of two required) | |
| Primary Indicators (minimum of one is required; check all that apply) | | | |
| <input type="checkbox"/> Surface Water (A1) | <input type="checkbox"/> Water-Stained Leaves (B9) | <input type="checkbox"/> Surface Soil Cracks (B6) | |
| <input type="checkbox"/> High Water Table (A2) | <input type="checkbox"/> Aquatic Fauna (B13) | <input type="checkbox"/> Drainage Patterns (B10) | |
| <input type="checkbox"/> Saturation (A3) | <input type="checkbox"/> Marl Deposits (B15) | <input type="checkbox"/> Moss Trim Lines (B16) | |
| <input type="checkbox"/> Water Marks (B1) | <input type="checkbox"/> Hydrogen Sulfide Odor (C1) | <input type="checkbox"/> Dry-Season Water Table (C2) | |
| <input type="checkbox"/> Sediment Deposits (B2) | <input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3) | <input type="checkbox"/> Crayfish Burrows (C8) | |
| <input type="checkbox"/> Drift Deposits (B3) | <input type="checkbox"/> Presence of Reduced Iron (C4) | <input type="checkbox"/> Saturation Visible on Aerial Imagery (C9) | |
| <input type="checkbox"/> Algal Mat or Crust (B4) | <input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6) | <input type="checkbox"/> Stunted or Stressed Plants (D1) | |
| <input type="checkbox"/> Iron Deposits (B5) | <input type="checkbox"/> Thin Muck Surface (C7) | <input type="checkbox"/> Geomorphic Position (D2) | |
| <input type="checkbox"/> Inundation Visible on Aerial Imagery (B7) | <input type="checkbox"/> Other (Explain in Remarks) | <input type="checkbox"/> Shallow Aquitard (D3) | |
| <input type="checkbox"/> Sparsely Vegetated Concave Surface (B8) | | <input type="checkbox"/> Microtopographic Relief (D4) | |
| | | <input type="checkbox"/> FAC-Neutral Test (D5) | |
| Field Observations: | | | |
| Surface Water Present? Yes _____ No <u>✓</u> Depth (inches): _____ | Wetland Hydrology Present? Yes _____ No _____ | | |
| Water Table Present? Yes _____ No <u>✓</u> Depth (inches): _____ | | | |
| Saturation Present? Yes _____ No <u>✓</u> Depth (inches): _____ (includes capillary fringe) | | | |
| Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: | | | |
| Remarks: <u>UPLAND SLOPE ON SLOPE AS INTERMEDIATE SLOPE.</u> <u>SOILS MISCLASSIFICATION AS TERN MUCK. SOILS</u> <u>BE BELIEVED. SOILS LACKING DISTINCTIVE DISTURBANCE</u> <u>BY PWS AND USE.</u> | | | |

SOIL

Sampling Point: 02

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

[illegible]¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.²Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- | | |
|---|--|
| <input type="checkbox"/> Histosol (A1) | <input type="checkbox"/> Polyvalue Below Surface (S8) (LRR R, |
| <input type="checkbox"/> Histic Epipedon (A2) | MLRA 149B) |
| <input type="checkbox"/> Black Histic (A3) | <input type="checkbox"/> Thin Dark Surface (S9) (LRR R, MLRA 149B) |
| <input type="checkbox"/> Hydrogen Sulfide (A4) | <input type="checkbox"/> Loamy Mucky Mineral (F1) (LRR K, L) |
| <input type="checkbox"/> Stratified Layers (A5) | <input type="checkbox"/> Loamy Gleyed Matrix (F2) |
| <input type="checkbox"/> Depleted Below Dark Surface (A11) | <input type="checkbox"/> Depleted Matrix (F3) |
| <input type="checkbox"/> Thick Dark Surface (A12) | <input type="checkbox"/> Redox Dark Surface (F6) |
| <input type="checkbox"/> Sandy Mucky Mineral (S1) | <input type="checkbox"/> Depleted Dark Surface (F7) |
| <input type="checkbox"/> Sandy Gleyed Matrix (S4) | <input type="checkbox"/> Redox Depressions (F8) |
| <input type="checkbox"/> Sandy Redox (S5) | |
| <input type="checkbox"/> Stripped Matrix (S6) | |
| <input type="checkbox"/> Dark Surface (S7) (LRR R, MLRA 149B) | |

Indicators for Problematic Hydric Soils³:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
☐ Dark Surface (S7) (**LRR K, L**)
☐ Polyvalue Below Surface (S8) (**LRR K, L**)
☐ Thin Dark Surface (S9) (**LRR K, L**)
☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
☐ Red Parent Material (F21)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ~ / x

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: 02

| Tree Stratum (Plot size: <u>30'</u>) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | |
|--|---------------------|-------------------|------------------|---|-------------------|--------------|-------------------|-------------|--------------------|-------------|-------------------|-------------|--------------------|-------------|-------------------|-------------|----------------------|---------------------|
| 1. <u>Pinus strobus</u> | <u>80</u> | <u>Y</u> | <u>FACW</u> | Dominance Test worksheet: Number of Dominant Species That Are OBL, FACW, or FAC: <u>1</u> (A) Total Number of Dominant Species Across All Strata: <u>3</u> (B) Percent of Dominant Species That Are OBL, FACW, or FAC: <u>33</u> (A/B) | | | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | | | | | | | |
| 5. | | | | | | | | | | | | | | | | | | |
| 6. | | | | | | | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | | | | | | | |
| | | | | _____ = Total Cover | | | | | | | | | | | | | | |
| Sapling/Shrub Stratum (Plot size: <u>15'</u>) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | |
| 1. <u>Pinus strobus</u> | <u>30</u> | <u>Y</u> | <u>FACW</u> | Prevalence Index worksheet: <table style="width: 100%;"> <tr> <th>Total % Cover of:</th> <th>Multiply by:</th> </tr> <tr> <td>OBL species _____</td> <td>x 1 = _____</td> </tr> <tr> <td>FACW species _____</td> <td>x 2 = _____</td> </tr> <tr> <td>FAC species _____</td> <td>x 3 = _____</td> </tr> <tr> <td>FACU species _____</td> <td>x 4 = _____</td> </tr> <tr> <td>UPL species _____</td> <td>x 5 = _____</td> </tr> <tr> <td>Column Totals: _____</td> <td>(A) _____ (B) _____</td> </tr> </table> Prevalence Index = B/A = _____ | Total % Cover of: | Multiply by: | OBL species _____ | x 1 = _____ | FACW species _____ | x 2 = _____ | FAC species _____ | x 3 = _____ | FACU species _____ | x 4 = _____ | UPL species _____ | x 5 = _____ | Column Totals: _____ | (A) _____ (B) _____ |
| Total % Cover of: | Multiply by: | | | | | | | | | | | | | | | | | |
| OBL species _____ | x 1 = _____ | | | | | | | | | | | | | | | | | |
| FACW species _____ | x 2 = _____ | | | | | | | | | | | | | | | | | |
| FAC species _____ | x 3 = _____ | | | | | | | | | | | | | | | | | |
| FACU species _____ | x 4 = _____ | | | | | | | | | | | | | | | | | |
| UPL species _____ | x 5 = _____ | | | | | | | | | | | | | | | | | |
| Column Totals: _____ | (A) _____ (B) _____ | | | | | | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | | | | | | | |
| 5. | | | | | | | | | | | | | | | | | | |
| 6. | | | | | | | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | | | | | | | |
| | | | | _____ = Total Cover | | | | | | | | | | | | | | |
| Herb Stratum (Plot size: <u>85'</u>) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | |
| 1. <u>Onoclea sensibilis</u> | <u>50</u> | <u>Y</u> | <u>FACW</u> | Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 - Rapid Test for Hydrophytic Vegetation <input type="checkbox"/> 2 - Dominance Test is >50% <input type="checkbox"/> 3 - Prevalence Index is ≤3.0 ¹ <input type="checkbox"/> 4 - Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) ¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic. Definitions of Vegetation Strata: Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall. Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall. Woody vines – All woody vines greater than 3.28 ft in height. | | | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | | | | | | | |
| 5. | | | | | | | | | | | | | | | | | | |
| 6. | | | | | | | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | | | | | | | |
| 8. | | | | | | | | | | | | | | | | | | |
| 9. | | | | | | | | | | | | | | | | | | |
| 10. | | | | | | | | | | | | | | | | | | |
| 11. | | | | | | | | | | | | | | | | | | |
| 12. | | | | | | | | | | | | | | | | | | |
| | | | | _____ = Total Cover | | | | | | | | | | | | | | |
| Woody Vine Stratum (Plot size: <u>N/A</u>) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | |
| 1. | | | | Hydrophytic Vegetation Present? Yes _____ No <input checked="" type="checkbox"/> | | | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | | | | | | | |
| | | | | _____ = Total Cover | | | | | | | | | | | | | | |

Remarks: (Include photo numbers here or on a separate sheet.)
white pine stands in wetland area
historically a pasture.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Mill Creek Pump Station City/County: Falmouth/Cumber. Sampling Date: 6/24/13
 Applicant/Owner: Town of Falmouth State: ME Sampling Point: W2
 Investigator(s): M.E. Thompson (PWS 831) Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR or MLRA): LRR R Lat: 43°43'30.39" N Long: 70°13'22.24" W Datum: WGS84

Soil Map Unit Name: TM (miscellaneous) NWI classification: stream

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation ✓, Soil ✓, or Hydrology ✓ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation ✓, Soil ✓, or Hydrology ✓ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | |
|--|--|
| Hydrophytic Vegetation Present? Yes _____ No _____ | Is the Sampled Area within a Wetland? Yes _____ No _____ |
| Hydric Soil Present? Yes _____ No _____ | If yes, optional Wetland Site ID: _____ |
| Wetland Hydrology Present? Yes _____ No _____ | |

Remarks: (Explain alternative procedures here or in a separate report.)

intermittent, short stream in gully.

HYDROLOGY

| Wetland Hydrology Indicators: | | Secondary Indicators (minimum of two required) |
|---|---|--|
| Primary Indicators (minimum of one is required; check all that apply) | | |
| <input checked="" type="checkbox"/> Surface Water (A1) | <input type="checkbox"/> Water-Stained Leaves (B9) | <input type="checkbox"/> Surface Soil Cracks (B6) |
| <input checked="" type="checkbox"/> High Water Table (A2) | <input type="checkbox"/> Aquatic Fauna (B13) | <input type="checkbox"/> Drainage Patterns (B10) |
| <input checked="" type="checkbox"/> Saturation (A3) | <input type="checkbox"/> Marl Deposits (B15) | <input type="checkbox"/> Moss Trim Lines (B16) |
| <input checked="" type="checkbox"/> Water Marks (B1) | <input type="checkbox"/> Hydrogen Sulfide Odor (C1) | <input type="checkbox"/> Dry-Season Water Table (C2) |
| <input checked="" type="checkbox"/> Sediment Deposits (B2) | <input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3) | <input type="checkbox"/> Crayfish Burrows (C8) |
| <input checked="" type="checkbox"/> Drift Deposits (B3) | <input type="checkbox"/> Presence of Reduced Iron (C4) | <input type="checkbox"/> Saturation Visible on Aerial Imagery (C9) |
| <input type="checkbox"/> Algal Mat or Crust (B4) | <input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6) | <input type="checkbox"/> Stunted or Stressed Plants (D1) |
| <input type="checkbox"/> Iron Deposits (B5) | <input type="checkbox"/> Thin Muck Surface (C7) | <input type="checkbox"/> Geomorphic Position (D2) |
| <input type="checkbox"/> Inundation Visible on Aerial Imagery (B7) | <input type="checkbox"/> Other (Explain in Remarks) | <input type="checkbox"/> Shallow Aquitard (D3) |
| <input type="checkbox"/> Sparsely Vegetated Concave Surface (B8) | | <input type="checkbox"/> Microtopographic Relief (D4) |
| | | <input type="checkbox"/> FAC-Neutral Test (D5) |
| Field Observations: | | |
| Surface Water Present? Yes <u>✓</u> No _____ Depth (inches): <u>1</u> | Wetland Hydrology Present? Yes <u>✓</u> No _____ | |
| Water Table Present? Yes _____ No <u>✓</u> Depth (inches): _____ | | |
| Saturation Present? Yes <u>✓</u> No _____ Depth (inches): <u>0</u> (includes capillary fringe) | | |

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

intermittent stream with stream, flowing water open previous night's rain. stream, section closed at base of gully.

SOIL

Sampling Point: WZ

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

[illegible]

¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

²Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- | | |
|---|--|
| <input type="checkbox"/> Histosol (A1) | <input type="checkbox"/> Polyvalue Below Surface (S8) (LRR R, |
| <input type="checkbox"/> Histic Epipedon (A2) | MLRA 149B) |
| <input type="checkbox"/> Black Histic (A3) | <input type="checkbox"/> Thin Dark Surface (S9) (LRR R, MLRA 149B) |
| <input type="checkbox"/> Hydrogen Sulfide (A4) | <input type="checkbox"/> Loamy Mucky Mineral (F1) (LRR K, L) |
| <input type="checkbox"/> Stratified Layers (A5) | <input type="checkbox"/> Loamy Gleyed Matrix (F2) |
| <input type="checkbox"/> Depleted Below Dark Surface (A11) | <input type="checkbox"/> Depleted Matrix (F3) |
| <input type="checkbox"/> Thick Dark Surface (A12) | <input type="checkbox"/> Redox Dark Surface (F6) |
| <input type="checkbox"/> Sandy Mucky Mineral (S1) | <input type="checkbox"/> Depleted Dark Surface (F7) |
| <input type="checkbox"/> Sandy Gleyed Matrix (S4) | <input type="checkbox"/> Redox Depressions (F8) |
| <input type="checkbox"/> Sandy Redox (S5) | |
| <input type="checkbox"/> Stripped Matrix (S6) | |
| <input type="checkbox"/> Dark Surface (S7) (LRR R, MLRA 149B) | |

Indicators for Problematic Hydric Soils³:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
☐ Dark Surface (S7) (**LRR K, L**)
☐ Polyvalue Below Surface (S8) (**LRR K, L**)
☐ Thin Dark Surface (S9) (**LRR K, L**)
☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
☐ Red Parent Material (F21)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Dense clay

Depth (inches): 12.

Hydric Soil Present? Yes ☒ No ☐

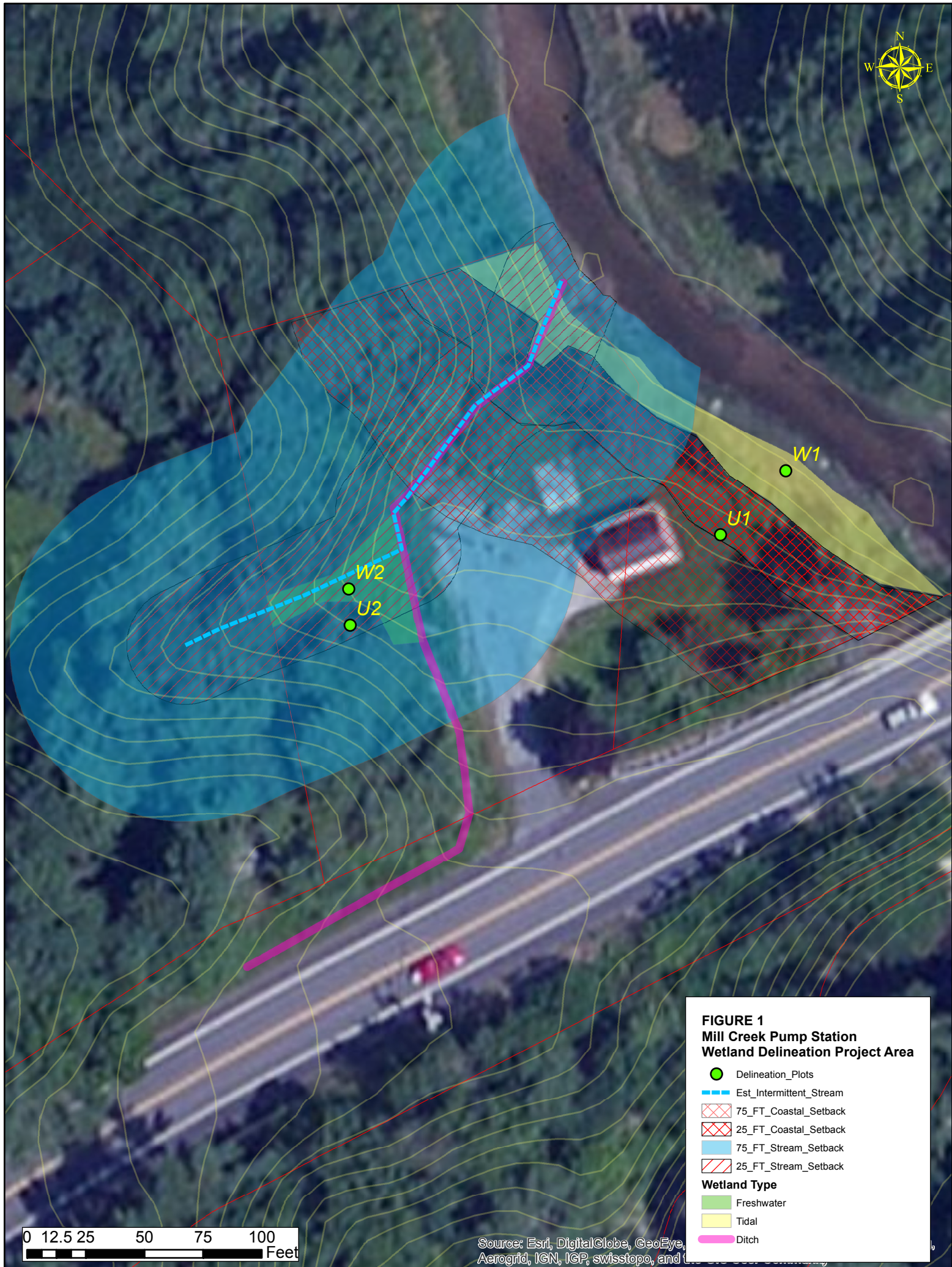
Remarks:

Secondary channel bottom

VEGETATION – Use scientific names of plants.

Sampling Point: W2

| Tree Stratum (Plot size: _____) | Absolute % Cover | Dominant Species? | Indicator Status | | | | | | | | | | | | | | | |
|---|------------------|-------------------|------------------|--|---|--------------|-------------------|-------------|--------------------|-------------|-------------------|-------------|--------------------|-------------|-------------------|-------------|--------------------------|-----------|
| 1. _____ | _____ | _____ | _____ | Dominance Test worksheet: Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A) Total Number of Dominant Species Across All Strata: _____ (B) Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B) | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 7. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| _____ = Total Cover | | | | Prevalence Index worksheet: <table style="width: 100%;"> <tr> <th>Total % Cover of:</th> <th>Multiply by:</th> </tr> <tr> <td>OBL species _____</td> <td>x 1 = _____</td> </tr> <tr> <td>FACW species _____</td> <td>x 2 = _____</td> </tr> <tr> <td>FAC species _____</td> <td>x 3 = _____</td> </tr> <tr> <td>FACU species _____</td> <td>x 4 = _____</td> </tr> <tr> <td>UPL species _____</td> <td>x 5 = _____</td> </tr> <tr> <td>Column Totals: _____ (A)</td> <td>_____ (B)</td> </tr> </table> Prevalence Index = B/A = _____ | Total % Cover of: | Multiply by: | OBL species _____ | x 1 = _____ | FACW species _____ | x 2 = _____ | FAC species _____ | x 3 = _____ | FACU species _____ | x 4 = _____ | UPL species _____ | x 5 = _____ | Column Totals: _____ (A) | _____ (B) |
| Total % Cover of: | Multiply by: | | | | | | | | | | | | | | | | | |
| OBL species _____ | x 1 = _____ | | | | | | | | | | | | | | | | | |
| FACW species _____ | x 2 = _____ | | | | | | | | | | | | | | | | | |
| FAC species _____ | x 3 = _____ | | | | | | | | | | | | | | | | | |
| FACU species _____ | x 4 = _____ | | | | | | | | | | | | | | | | | |
| UPL species _____ | x 5 = _____ | | | | | | | | | | | | | | | | | |
| Column Totals: _____ (A) | _____ (B) | | | | | | | | | | | | | | | | | |
| Sapling/Shrub Stratum (Plot size: _____) | | | | Hydrophytic Vegetation Indicators: <input checked="" type="checkbox"/> 1 - Rapid Test for Hydrophytic Vegetation <input type="checkbox"/> 2 - Dominance Test is >50% <input type="checkbox"/> 3 - Prevalence Index is ≤3.0 ¹ <input type="checkbox"/> 4 - Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) | | | | | | | | | | | | | | |
| 1. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| _____ = Total Cover | | | | Definitions of Vegetation Strata: Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall. Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall. Woody vines – All woody vines greater than 3.28 ft in height. | | | | | | | | | | | | | | |
| Herb Stratum (Plot size: <u>2'x5'</u>) | | | | | Hydrophytic Vegetation Present? Yes _____ No _____ | | | | | | | | | | | | | |
| 1. <u>Impatiens capensis</u> | <u>20</u> | <u>Y</u> | <u>Tree</u> | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 5. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 6. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| _____ = Total Cover | | | | Remarks: (Include photo numbers here or on a separate sheet.) <u>LINEAR PLOT ALONG W. CHANNEL, TREES (W. PLANT)</u> <u>ON AN OPEN BANK LOCATION AS THEY ARE IN</u> <u>DISPERSED BUT THEY ARE DISPERSED HYDROLOGIC</u> <u>SETTING.</u> | | | | | | | | | | | | | | |
| Woody Vine Stratum (Plot size: _____) | | | | | | | | | | | | | | | | | | |
| 1. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 2. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 3. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| 4. _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | |
| _____ = Total Cover | | | | | | | | | | | | | | | | | | |





United States
Department of
Agriculture



NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Cumberland County and Part of Oxford County, Maine

Mill Creek Pump Station



June 23, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://soils.usda.gov/sqi/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND






















Area of Interest (AOI)




 Area of Interest (AOI)

Soils




 Soil Map Units

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot

-  Very Stony Spot
-  Wet Spot
-  Other


Special Line Features

-  Gully
-  Short Steep Slope
-  Other






Political Features

-  Cities

Water Features

-  Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

Map Scale: 1:2,360 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cumberland County and Part of Oxford County, Maine
Survey Area Data: Version 7, Jan 8, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

| Cumberland County and Part of Oxford County, Maine (ME005) | | | |
|--|--|--------------|----------------|
| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
| BgB | Belgrade very fine sandy loam, 0 to 8 percent slopes | 4.6 | 18.9% |
| BuB | Buxton silt loam, 3 to 8 percent slopes | 2.8 | 11.3% |
| DeB | Deerfield loamy sand, 3 to 8 percent slopes | 2.1 | 8.5% |
| HfD2 | Hartland very fine sandy loam, 15 to 25 percent slopes, eroded | 0.7 | 3.0% |
| SuE2 | Suffield silt loam, 25 to 45 percent slopes, eroded | 8.0 | 32.6% |
| Tm | Tidal marsh | 5.5 | 22.2% |
| W | Water | 0.9 | 3.5% |
| Totals for Area of Interest | | 24.6 | 100.0% |

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially

where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Cumberland County and Part of Oxford County, Maine

BgB—Belgrade very fine sandy loam, 0 to 8 percent slopes

Map Unit Setting

Landscape: Lake plains

Map Unit Composition

Belgrade and similar soils: 85 percent

Description of Belgrade

Setting

Landform: Lakebeds

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Coarse-silty glaciolacustrine deposits

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 2.00 in/hr)

Depth to water table: About 18 to 30 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: High (about 9.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance

Land capability (nonirrigated): 2e

Hydrologic Soil Group: C

Typical profile

0 to 9 inches: Very fine sandy loam

9 to 18 inches: Very fine sandy loam

18 to 28 inches: Silt loam

28 to 65 inches: Silt loam

BuB—Buxton silt loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 10 to 900 feet

Mean annual precipitation: 34 to 48 inches

Mean annual air temperature: 43 to 46 degrees F

Frost-free period: 90 to 160 days

Map Unit Composition

Buxton and similar soils: 87 percent

Description of Buxton

Setting

Landform: Coastal plains

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Glaciolacustrine deposits derived from siltstone and/or fine-silty marine deposits

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Depth to water table: About 6 to 18 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: High (about 9.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance

Land capability (nonirrigated): 3w

Hydrologic Soil Group: D

Typical profile

0 to 9 inches: Silt loam

9 to 16 inches: Silty clay loam

16 to 38 inches: Silty clay loam

38 to 65 inches: Silty clay

DeB—Deerfield loamy sand, 3 to 8 percent slopes

Map Unit Setting

Elevation: 150 to 1,200 feet

Mean annual precipitation: 30 to 50 inches

Mean annual air temperature: 37 to 45 degrees F

Frost-free period: 90 to 160 days

Map Unit Composition

Deerfield and similar soils: 87 percent

Description of Deerfield

Setting

Landform: Outwash terraces

Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Sandy glaciofluvial deposits derived from granite and gneiss

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Low (about 3.2 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance

Land capability (nonirrigated): 2w

Hydrologic Soil Group: B

Typical profile

0 to 10 inches: Loamy sand

10 to 24 inches: Loamy sand

24 to 65 inches: Sand

HfD2—Hartland very fine sandy loam, 15 to 25 percent slopes, eroded

Map Unit Setting

Landscape: Lake plains

Map Unit Composition

Hartland and similar soils: 85 percent

Description of Hartland

Setting

Landform: Lakebeds

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Riser

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Coarse-silty glaciolacustrine deposits

Properties and qualities

Slope: 15 to 25 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Custom Soil Resource Report

Available water capacity: High (about 11.8 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability (nonirrigated): 4e

Hydrologic Soil Group: B

Typical profile

0 to 9 inches: Very fine sandy loam

9 to 29 inches: Silt loam

29 to 65 inches: Silt loam

SuE2—Suffield silt loam, 25 to 45 percent slopes, eroded

Map Unit Setting

Elevation: 10 to 900 feet

Mean annual precipitation: 34 to 48 inches

Mean annual air temperature: 43 to 46 degrees F

Frost-free period: 90 to 160 days

Map Unit Composition

Suffield and similar soils: 85 percent

Description of Suffield

Setting

Landform: Coastal plains

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Riser

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Fine glaciolacustrine deposits

Properties and qualities

Slope: 25 to 45 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: High (about 9.5 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability (nonirrigated): 7e

Hydrologic Soil Group: C

Typical profile

0 to 6 inches: Silt loam

6 to 23 inches: Silt loam

23 to 33 inches: Silty clay

33 to 65 inches: Silty clay

Tm—Tidal marsh

Map Unit Setting

Landscape: Shore complexes

Map Unit Composition

Tidal marsh: 85 percent

Description of Tidal Marsh

Setting

Landform: Salt marshes

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Talf

Down-slope shape: Linear

Across-slope shape: Linear

Properties and qualities

Slope: 0 to 1 percent

Drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (0.60 to 14.17 in/hr)

Depth to water table: About 0 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Available water capacity: Very high (about 14.4 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability (nonirrigated): 8w

Hydrologic Soil Group: D

Typical profile

0 to 24 inches: Mucky peat

24 to 60 inches: Very fine sandy loam

W—Water

Map Unit Composition

Water: 100 percent

Description of Water

Setting

Landform: Lakes

References

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APPENDIX B
GEOTECHNICAL REPORT

R E P O R T

July 3, 2013

13-0539 S

Geotechnical Engineering Services

Proposed Mill Creek Pump Station

Forside Road (Route 88)

Falmouth, Maine

PREPARED FOR:

Wright-Pierce

Attention: Christopher Dwinal, P.E.

99 Main Street

Topsham, Maine 04086

PREPARED BY:

S.W.COLE ENGINEERING, INC.

286 Portland Road

Gray, Maine 04039

207-657-2866



S.W.COLE
ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing*
- *GeoEnvironmental Services*
- *Ecological Services*

www.swcole.com

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13-0539 S

July 3, 2013

Wright-Pierce
Attention: Christopher Dwinal, P.E.
99 Main Street
Topsham, Maine 04086

Subject: Explorations and Geotechnical Engineering Services
Proposed Mill Creek Pump Station
Forside Road (Route 88)
Falmouth, Maine

Dear Chris:

In accordance with our Proposal, dated June 11, 2013, we have performed subsurface explorations for the subject project in Falmouth, Maine. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Attachment A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed construction. Our scope of services included the making of two test boring explorations, soils laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Proposed Construction

The site is located at the existing Mill Creek Pump Station on Forside Road (Route 88) in Falmouth, Maine. Based on the information provided by Wright-Pierce, we understand proposed construction consists of a new generator building and a new wet well. We understand the wet well will have an invert elevation of approximately -12 feet (project datum).

286 Portland Road, Gray, ME 04039-9586 • P: (207) 657.2866 • F: (207) 657.2840 • E: info@swcole.com

2.0 EXPLORATION AND TESTING

2.1 Explorations

Two test borings (B-101 and B-102) were made at the site on June 21, 2013 by Northern Test Boring, Inc. of Gorham, Maine working under subcontract to S.W. COLE ENGINEERING, INC. (SWCE). The boring locations were selected and established in the field by Wright-Pierce and SWCE using taped measurements from existing site features. The approximate exploration locations are shown on the "Exploration Location Plan" attached as Sheet 1. Logs of the explorations are attached as Sheets 2 and 3. A key to the notes and symbols used on the logs is attached as Sheet 4.

2.2 Testing

The borings were performed using cased wash-boring and rock coring techniques. The soils were sampled at 2 to 5 foot samples using Standard Penetration Testing (SPT) techniques. SPT blow counts are shown on the logs. Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. Moisture content test results are noted on the logs.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Surficial Conditions

The site is located at the existing Mill Creek Pump Station on the northern side of Foreside Road (Route 88) in Falmouth, Maine. The pump station consists of a square footprint, on-grade generator building in the eastern portion of the site and a below grade wet well and pump station with associated piping in the northern portion of the site. Based on the record drawings of the pump station, we understand the wet well and pump station are founded on bedrock at approximate elevation -10.2 feet.

Access to the site is gained by a paved driveway extending from Foreside Road. Existing grade generally slopes downward from Foreside Road and towards Mill Creek, varying from about elevation 17 feet to 5 feet within the developed area. Existing site features are shown on the "Exploration Location Plan" attached as Sheet 1.

3.2 Subsurface Conditions

The explorations generally encountered fills overlying glaciomarine sands, silts, and clays, overlying a relatively thin layer of glacial till mantling bedrock. The principal soils encountered are described below. Refer to the attached logs for more detailed descriptions of the subsurface findings.

Fill: Borings B-101 and B-102 encountered fill soils consisting of loose sand or silt with varying portions of gravel, asphalt, and organics extending to depths of about 8 and 2.3 feet, respectively.

Glaciomarine Soils: Underlying the fill, borings B-101 and B-102 encountered glaciomarine silty clay with silt and sand seams extending to depths of about 13 and 24 feet, respectively. The silty clay encountered at B-101 was brown and stiff in consistency. The silty clay encountered at B-102 was brown and hard to medium in consistency to about 11.5 feet, transitioning to gray with brown layers and medium consistency below.

Glacial Till: Underlying the glaciomarine soils, borings B-101 and B-102 encountered loose to medium dense glacial till consisting of gray gravelly sand with varying portions of silt extending to depths of about 15.1 and 26.6 feet, respectively.

Bedrock: Bedrock was explored by roller cone and rock coring at B-101 and B-102 to depths of 31.2 and 33.0 feet, respectively. Photographs of the bedrock core obtained at the borings are attached as Appendix A.

3.3 Groundwater Conditions

The soils were generally wet at a depth of about 5 feet. Saturated soils were encountered at depths below 10 feet. Long term groundwater information is not available; however is likely influenced by the water level of Mill Creek which is tidally influenced. It should be anticipated that seasonal groundwater levels will fluctuate, especially during periods of snowmelt and precipitation. Water likely perches atop the clayey and silty site soils.

3.4 Seismic and Frost Considerations

The 25-year Air Freezing Index for the Falmouth, Maine area is about 1,290-Fahrenheit degree-days, which corresponds to a frost penetration depth on the order of 4.5 feet. Based on the findings at the explorations, we interpret the site soils to correspond to Seismic Soil Site Class E (ASCE 7) for the structures bearing on soil near the surface and Seismic Soil Site Class C (ASCE 7) for structures bearing on bedrock.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations are as follows:

- Bedrock was encountered at approximately elevation -3.1 feet at boring B-101 and at approximately -10.6 feet at boring B-102. Based on a proposed wet well invert of about -12 feet, rock removal will be required to achieve plan elevation. Rock removal by blasting should be anticipated.
- Braced sheetpiling will be required to complete the excavation for the proposed wet well. Considering bedrock was encountered above the proposed invert elevations, we anticipate the sheetpiles will need to be pinned into bedrock with the pins extending below the planned excavation depth.
- The existing fill soils are unsuitable for support of the proposed structures. Existing fill should be completely removed from beneath the proposed structures and backfilled with compacted Structural Fill.
- If the proposed generator house is not continuously heated, we recommend that at least 4.5 feet of compacted Structural Fill be provided below the building.
- Imported Crushed Stone and Structural Fill will be required for construction. The existing site soils are not suitable for reuse for the proposed structures.

4.2 Site and Subgrade Preparation

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

All existing pavement, structures, utilities, disturbed soils and existing fills must be completely removed beneath the proposed structures until undisturbed native hard to stiff brown silty clay soils are encountered. Overexcavation of unsuitable material should extend 1-foot laterally outward from edge of perimeter footings for every 1-foot of vertical excavation depth (1H:1V bearing splay). Overexcavations should be backfilled to footing and slab subgrade elevation with compacted Structural Fill.

Following stripping, grubbing and overexcavation of unsuitable material, blasting will be required to achieve proposed grade for the proposed wet well. Care must be taken to not significantly overblast in depth. We recommend at least 12-inches of Crushed Stone or Lean Concrete be provided below the wet well foundation. If used, the Crushed Stone should be thoroughly worked into the bedrock surface to choke any voids or fractures in the bedrock.

We recommend excavation to subgrade elevation for the generator building be completed with a smooth edged bucket to lessen disturbance of the bearing soils. We recommend footings bearing on soil be founded on at least 12-inches of compacted Structural Fill overlying properly prepared native soil subgrades. We anticipate the proposed generator house may not be continuously heated during cold weather. As such, we recommend that at least 4.5 feet (measured from finish floor elevation) of compacted Structural Fill be provided below the building.

4.3 Excavation and Dewatering

Excavation work will generally encounter existing fill soils, glaciomarine sands, silts and clays, glacial till and bedrock. Care must be exercised during construction to minimize disturbance of the bearing soils. Final cuts to subgrade elevation in soil should be performed with a smooth-edged bucket to help minimize soil disturbance.

The bedrock encountered at the site is hard and sound and planning should consider

blasting for excavation. Blasting can adversely affect adjacent structures, water-wells, septic systems, up-gradient wetlands, and buried utilities. We recommend that blasting be performed by a licensed and qualified contractor and that a blasting plan be prepared sufficiently in advance of blasting activities to coordinate efforts with abutting properties and to serve notice to the general public. Pre-blast surveys of structures, wells, septic systems, pipelines, and protected natural resources within 500 feet of the blast area should be completed prior to blasting.

For shallow excavations, sumping and pumping dewatering techniques should be adequate to control groundwater. Sheetpiling for groundwater cut-off will be needed for the deeper wet well excavation. Controlling the water levels to at least one foot below planned excavation depths will help stabilize subgrades during construction.

Excavations must be properly shored and/or sloped in accordance with OSHA regulations to prevent sloughing and caving of the sidewalls during construction. Care must be taken to preclude undermining adjacent structures, roadways and utilities. The contractor is ultimately responsible for planning and performance of all excavations and excavation support.

4.3.1 Braced Excavation

In our opinion, conventional open excavation is not feasible for the deeper wet well and braced shoring will be needed for excavation stability and groundwater control. Specifically, we recommend interlocking sheetpiling. Bedrock was encountered above proposed invert elevation for the wet well and as such, sheet piling will need to be pinned to the bedrock. Pinning must extend below the planned excavation depth.

We recommend the braced sheetpile shoring be designed by a Professional Engineer licensed in the State of Maine and that engineered shop drawings of the shoring be reviewed by SWCE prior to excavation at the site. We also recommend that the contractor provide a detail and plan of their proposed dewatering techniques. Soil strength and unit weight parameters are displayed on the boring logs for consideration in shoring design. Additionally, a groundwater elevation of approximately 9 feet should be used for shoring design.

4.4 Foundations

We recommend the proposed generator building be supported on spread footings founded on at least 12-inches of compacted Structural Fill bearing on hard to very stiff, undisturbed native brown silty clay. We recommend the proposed wet well structure be supported on a mat foundation bearing on at least 12-inches of compacted Crushed Stone or Lean Concrete overlying sound, intact bedrock.

Design of the deeper wet well structure should consider buoyant conditions at least to an elevation at which a positive gravity perimeter drain may be provided.

For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

- Design Frost Depth = 4.5 feet
- Allowable Soil Bearing Pressure = 2.0 ksf or less (compacted Structural Fill)
- Generator Building Seismic Soil Site Class = E (ASCE 7)
- Base Friction Factor = 0.35
- Allowable Bedrock Bearing Pressure = 8.0 ksf or less (sound, intact bedrock)
- Wet Well Seismic Soil Site Class = C (ASCE 7)
- Base Friction Factor = 0.40
- Total Unit Weight of Backfill = 130 pcf (compacted Structural Fill)
- Passive Lateral Earth Pressure Coefficient = 3.0 (compacted Structural Fill)
- At-Rest Lateral Earth Pressure Coefficient = 0.5 (compacted Structural Fill)
- Internal Friction Angle of Backfill = 30° (compacted Structural Fill)

For structures bearing on properly prepared soil subgrades, we anticipate 1-inch or less of total post-construction settlement with differential settlement approaching ½-inch or less. For structures bearing on properly prepared bedrock subgrades, we anticipate ½-inch or less of total and differential post-construction settlement.

4.5 Foundation Drainage

We recommend an underdrain system be installed around the proposed generator house perimeter spread footings. The underdrain pipe should consist of 4-inch diameter, slotted foundation drain pipe bedded in at least 12 inches of MDOT Type B Underdrain Sand. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging

and backflow. Exterior foundation backfill should be sealed with a surficial layer of clayey or loamy soil in areas that are not paved or occupied by entrance slabs. This is to reduce direct surface water infiltration into the backfill. Surface grades should be sloped away from the building for positive surface water drainage.

4.6 Slab-On-Grade

On-grade floor slabs for the unheated generator building may be designed using a subgrade reaction modulus of 120 pci (pounds per cubic inch) provided the slab is underlain by at least 4.5 feet of compacted Structural Fill placed over properly prepared native subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material shall be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

4.7 Entrance Slabs and Sidewalks

Entrance slabs and sidewalks adjacent to buildings must be designed to reduce the effects of differential frost action between adjacent pavement, doorways and entrances. We recommend that clean, non-frost susceptible Structural Fill be provided to a depth of at least 4.5 feet below the top of entrance slabs. This thickness of Structural Fill should extend the full width of the entrance slabs and outward at least 4.5 feet, thereafter transitioning up to the bottom of the adjacent sidewalk or pavement subbase gravel at a

3H:1V or flatter slope. General details of this frost transition zone are attached as Sheet 5.

4.8 Backfill and Compaction

The on-site soils are unsuitable for use in building and paved areas, but may be reused in landscape areas. For building and paved areas, we recommend the following fill and backfill materials:

Structural Fill: Fill to raise site grades and backfill for foundations should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below.

| Structural Fill | |
|------------------------|--------------------------------|
| Sieve Size | Percent Finer by Weight |
| 4 inch | 100 |
| 3 inch | 90 to 100 |
| ¾ inch | 25 to 90 |
| #40 | 0 to 30 |
| #200 | 0 to 5 |

Structural Fill is recommended for use as:

- Fill and backfill to raise grades in building areas
- Backfill for overexcavations of unsuitable materials
- Backfill against foundations
- Backfill within frost transition zones below entrances and sidewalks
- Minimum 4.5 feet thick layer below slab-on-grade (unheated generator building)

Crushed Stone: Crushed Stone, used beneath foundations and for drainage aggregate, should meet the gradation requirements of MDOT Standard Specifications 703.22 "Underdrain Backfill Type C".

Underdrain Sand: Clean, free-draining sand used around foundation underdrains should meet the gradation requirements of MDOT Standard Specifications 703.22 "Underdrain Backfill Type B".

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet weather and the site soils may require drying before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE ENGINEERING, INC. should be retained to review the final design and specifications to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A soils and concrete testing program should also be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE ENGINEERING, INC. is available to provide subgrade observations for foundations as well as testing services for soils, concrete, asphalt, steel and spray-applied fireproofing construction materials.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

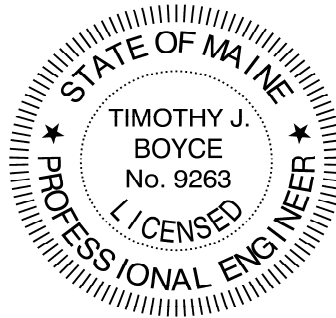
Sincerely,

S.W. COLE ENGINEERING, INC.

Evan M. Walker, P.E.
Geotechnical Engineer



Timothy J. Boyce, P.E.
Senior Geotechnical Engineer



EMW:tjb

Attachment A Limitations

This report has been prepared for the exclusive use of Wright-Pierce for specific application to the proposed Mill Creek Pump Station on Foreside Road (Route 88) in Falmouth, Maine. S.W.COLE ENGINEERING, INC. has endeavored to conduct the work in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

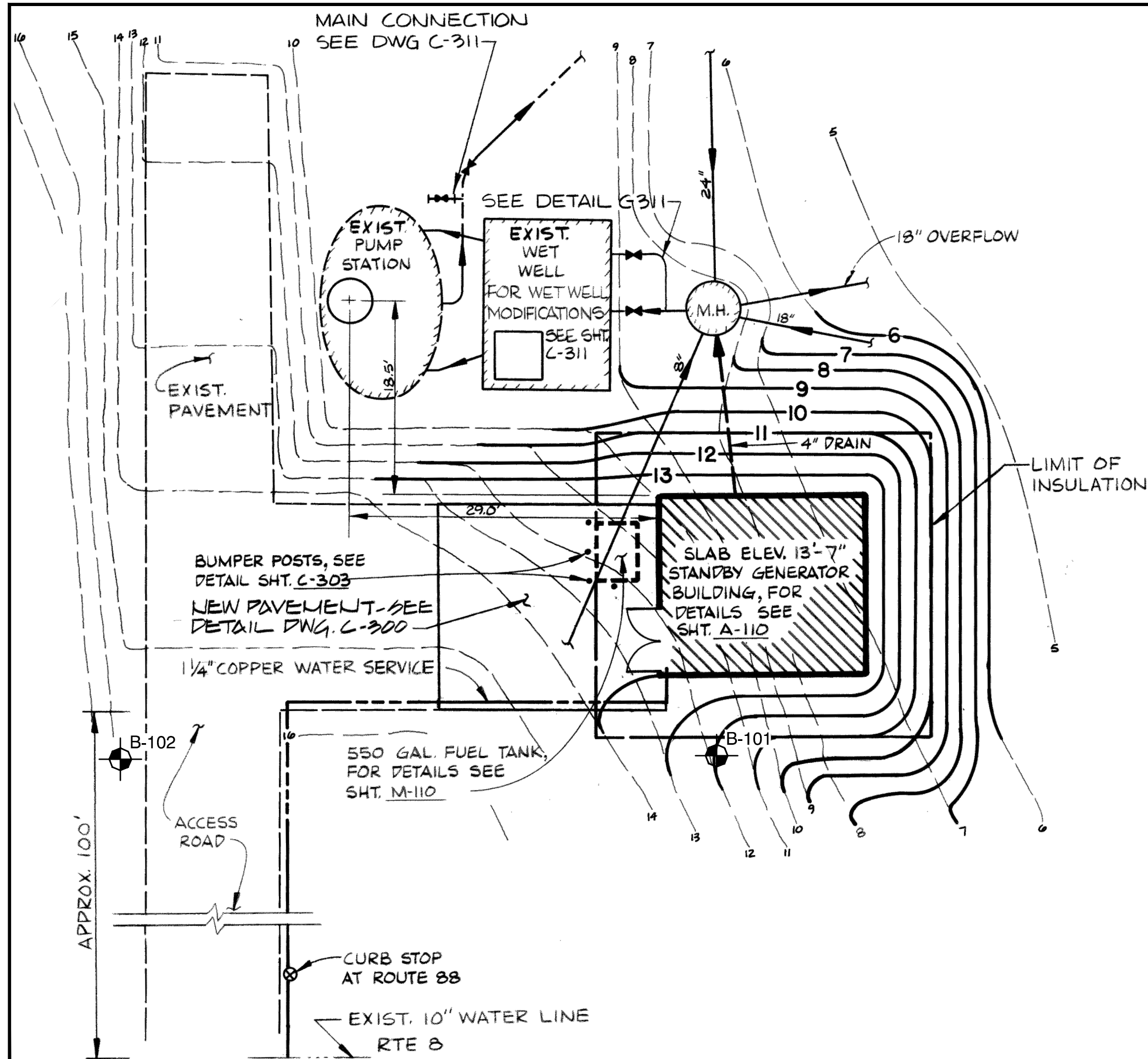
The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE ENGINEERING, INC.'s scope of work has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE ENGINEERING, INC. should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE ENGINEERING, INC.

R:\2013\13-0539\CAD\Drawings\13-0539 Sheet 1 ELP.dwg, 7/3/2013 8:54:34 AM, 1:1, TJH, S.W. Cole Engineering, Inc.



LEGEND:



APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=10' SCALE PLAN OF THE SITE ENTITLED "PUMP STATION SITE PLANS", PREPARED BY E. C. JORDAN CO., DATED 6/25/85.
2. THE BORINGS WERE LOCATED IN THE FIELD BY TAPED MEASUREMENTS FROM EXISTING SITE FEATURES.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S.W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.



S.W. COLE
ENGINEERING, INC.

WRIGHT-PIERCE

EXPLORATION LOCATION PLAN

PROPOSED MILL CREEK PUMP STATION
FORESIDE ROAD (ROUTE 88)
FALMOUTH, MAINE

Job No.: 13-0539
Date : 07/03/2013

Scale: 1" = 10'
Sheet: 1



BORING LOG

PROJECT: PROPOSED MILL CREEK PUMP STATION
CLIENT: WRIGHT-PIERCE
LOCATION: FORESIDE ROAD (ROUTE 88), FALMOUTH, ME
DRILLING FIRM: NORTHERN TEST BORING, INC. DRILLER: MIKE NADEAU
CASING: HW 4" 140 LBS. 30"
SAMPLER: SS 1 3/8" 140 LBS. 30"
CORE BARREL: NQ 2"

BORING NO.: B-101
SHEET: 1 OF 1
PROJECT NO.: 13-0539
DATE START: 6/21/2013
DATE FINISH: 6/21/2013
ELEVATION: 12' +/-
SWC REP.: E. WALKER

WATER LEVEL INFORMATION

SOILS WET BELOW 5' +/-
SOILS SATURATED BELOW 10' +/-

| CASING BLOWS PER FOOT | SAMPLE | | | | SAMPLER BLOWS PER 6" | | | | DEPTH | STRATA & TEST DATA |
|--------------------------------|--------|------|------|----------------|----------------------|------|-------|-------|-------|---|
| | NO. | PEN. | REC. | DEPTH @ BOT | 0-6 | 6-12 | 12-18 | 18-24 | | |
| | | | | | | | | | 0.8' | GRASS / DARK BROWN SILTY SAND WITH ORGANICS (TOPSOIL/FILL) |
| | 1D | 24" | 12" | 2.0' | 2 | 3 | 4 | 3 | | $\gamma_T = 130 \text{ PCF}$, $\gamma_B = 70 \text{ PCF}$, $\phi = 28^\circ$ GRAY GRAVELLY SILT AND SAND WITH TRACE ORGANICS (FILL) |
| | 2D | 24" | 12" | 4.0' | 3 | 3 | 3 | 3 | 4.0' | ~ LOOSE ~ |
| | 3D | 24" | 22" | 6.0' | 2 | 2 | 3 | 5 | | GRAY CLAYEY SILT TRACE SAND WITH ROOTLETS (PROBABLE FILL) |
| | | | | | | | | | 8.0' | ~ LOOSE ~ |
| | 4D | 24" | 24" | 11.0' | 4 | 3 | 4 | 4 | | GRAY-BROWN SILTY CLAY WITH FREQUENT SAND SEAMS AND LAYERS |
| | | | | | | | | | 13.0' | ~ STIFF ~ $q_p = 3.5 \text{ KSF}$ $\gamma_T = 115 \text{ PCF}$, $\gamma_B = 55 \text{ PCF}$, $c = 2.0 \text{ KSF}$ |
| | | | | | | | | | | $\gamma_T = 125 \text{ PCF}$, $\gamma_B = 65 \text{ PCF}$, $\phi = 28^\circ$ GRAY GRAVELLY SILTY SAND (GLACIAL TILL) |
| | 5D | 4" | 4" | 15.3' | 50/4" | | | | 15.1' | ~ MEDIUM DENSE ~ |
| | | | | | | | | | 16.0' | WEATHERED BEDROCK - ADVANCE BY ROLLER CONE |
| | | | | | | | | | | GRAY PEGMATITE GRANITE AND GNEISS; HARD; MEDIUM TO COARSE GRAINED; SLIGHTLY TO MODERATELY WEATHERED, IRON OXIDE STAINING ON FRACTURES AND CRACKS. MODERATELY SPACED FRACTURES AT 5-35 |
| | R1 | 4.9' | 4.6' | 20.9' | | | | | | RQD = 51% FAIR DEGREES. |
| | | | | | | | | | | SAME ROCK TYPE AND DESCRIPTION. SHALLOW TO STEEP FRACTURE ANGLES AT 10-70 DEGREES. |
| | R2 | 5.0' | 5.0' | 25.9' | | | | | | RQD = 65% FAIR |
| | | | | | | | | | | SAME ROCK TYPE AND DESCRIPTION. NEAR HORIZONTAL TO NEAR VERTICAL FRACTURE ANGLES. |
| | R3 | 5.3' | 5.1' | 31.2' | | | | | 31.2' | RQD = 58% FAIR |
| | | | | | | | | | | BOTTOM OF EXPLORATION @ 31.2' |

SAMPLES: SOIL CLASSIFIED BY:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE
DRILLER - VISUALLY
SOIL TECH. - VISUALLY
LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE
APPROXIMATE BOUNDARY BETWEEN SOIL TYPES
AND THE TRANSITION MAY BE GRADUAL.



BORING LOG

BORING NO.: **B-102**
 SHEET: 1 OF 1
 PROJECT NO.: 13-0539
 DATE START: 6/21/2013
 DATE FINISH: 6/21/2013
 ELEVATION: 16' +/-
 SWC REP.: E. WALKER

PROJECT: PROPOSED MILL CREEK PUMP STATION
 CLIENT : WRIGHT-PIERCE
 LOCATION: ROUTE 88, FALMOUTH, ME
 DRILLING FIRM: NORTHERN TEST BORING, INC. DRILLER: MIKE NADEAU
 TYPE SIZE I.D. HAMMER WT. HAMMER FALL
 CASING: HW 4" 140 LBS. 30"
 SAMPLER: SS 1 3/8" 140 LBS. 30"
 CORE BARREL: NQ 2"

WATER LEVEL INFORMATION

SOILS WET BELOW 5' +/-
 SOILS SATURATED BELOW 10' +/-

| CASING BLOWS PER FOOT | SAMPLE | | | | SAMPLER BLOWS PER 6" | | | | DEPTH | STRATA & TEST DATA |
|-----------------------|--------|------|------|-------------|----------------------|------|-------|-------|-------|---|
| | NO. | PEN. | REC. | DEPTH @ BOT | 0-6 | 6-12 | 12-18 | 18-24 | | |
| | | | | | | | | | | BROWN SAND SOME SILT AND GRAVEL WITH ASPHALT AND ORGANICS (FILL) |
| | 1D | 24" | 6" | 2.0' | 9 | 5 | 3 | 1 | 2.3' | ~ LOOSE ~ $\gamma_T = 130 \text{ PCF}, \phi = 28^\circ$ |
| | 2D | 24" | 12" | 4.0' | 3 | 3 | 5 | 5 | | ~ UPPER 0.5' REWORKED/DISTURBED ~ ~ HARD ~ $w = 31.9\%, \gamma_T = 115 \text{ PCF}, \gamma_B = 55 \text{ PCF}, c = 2.0 \text{ KSF}$ ~ VERY STIFF ~ |
| | 3D | 24" | 20" | 7.0' | 4 | 5 | 5 | 6 | | $q_p = 9 \text{ KSF}$ $q_p = 4.5 \text{ KSF}$ |
| | | | | | | | | | | BROWN SILTY CLAY |
| | 4D | 24" | 20" | 12.0' | 3 | 2 | 2 | 2 | 11.5' | $q_p = 1.5 \text{ KSF}$ ~ MEDIUM ~ |
| | | | | | | | | | | GRAY SILTY CLAY WITH FREQUENT SAND SEAMS (SAND SEAMS UP TO 2" THICK) |
| | 5D | 24" | 24" | 17.0' | WOH / 12" | | 1 | 2 | | $w = 31.9\%, \gamma_T = 115 \text{ PCF}, \gamma_B = 55 \text{ PCF}, c = 0.5 \text{ KSF}$ ~ MEDIUM ~ |
| | 1V | 0" | | 20.0' | | | | | 20.0' | VANE SHEAR ATTEMPTED @ 20' - NO PENETRATION |
| | 6D | 24" | | 22.0' | 4 | 1 | 3 | 2 | | LAYERED GRAY AND BROWN SILTY CLAY, CLAYEY SILT, AND SILTY FINE SAND (SAND LAYERS UP TO 6" THICK) |
| | | | | | | | | | 24.0' | ~ MEDIUM ~ |
| | | | | | | | | | | GRAY GRAVELLY SILT AND SAND (GLACIAL TILL) |
| | 7D | 20" | 16" | 26.6' | 2 | 1 | 7 | 50/2" | 26.6' | $w = 13.4\%, \gamma_T = 125 \text{ PCF}, \gamma_B = 65 \text{ PCF}, \phi = 28^\circ$ ~ LOOSE ~ |
| | | | | | | | | | 27.0' | WEATHERED BEDROCK - ADVANCE BY ROLLER CONE |
| | | | | | | | | | | GRAY PEGMATITE GRANITE AND GNEISS; MODERATELY HARD; MEDIUM TO COARSE GRAINED; SLIGHTLY TO MODERATELY WEATHERED, IRON OXIDE STAINED. HIGHLY FRACTURED. |
| | R1 | 5.0' | 3.6' | 32.0' | | | | | 32.0' | RQD = 10% VERY POOR |
| | R2 | 1.0' | 0.5' | 33.0' | | | | | 33.0' | RQD = 0% VERY POOR SAME DESCRIPTION. HIGHLY FRACTURED. |
| | | | | | | | | | | BOTTOM OF EXPLORATION @ 33.0' |

SAMPLES: SOIL CLASSIFIED BY:
 D = SPLIT SPOON
 C = 3" SHELBY TUBE
 U = 3.5" SHELBY TUBE
 DRILLER - VISUALLY
 SOIL TECH. - VISUALLY
 LABORATORY TEST

REMARKS:
 STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

KEY TO THE NOTES & SYMBOLS

Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

| | | |
|----------------|---|--|
| w | - | water content, percent (dry weight basis) |
| q _u | - | unconfined compressive strength, kips/sq. ft. - based on laboratory unconfined compressive test |
| S _v | - | field vane shear strength, kips/sq. ft. |
| L _v | - | lab vane shear strength, kips/sq. ft. |
| q _p | - | unconfined compressive strength, kips/sq. ft. based on pocket penetrometer test |
| O | - | organic content, percent (dry weight basis) |
| W _L | - | liquid limit - Atterberg test |
| W _P | - | plastic limit - Atterberg test |
| WOH | - | advance by weight of hammer |
| WOM | - | advance by weight of man |
| WOR | - | advance by weight of rods |
| HYD | - | advance by force of hydraulic piston on drill |
| RQD | - | Rock Quality Designator - an index of the quality of a rock mass. RQD is computed from recovered core samples. |
| γ _T | - | total soil weight |
| γ _B | - | buoyant soil weight |
| f | - | finer content (percent by weight passing U.S. No. 200 Sieve) |

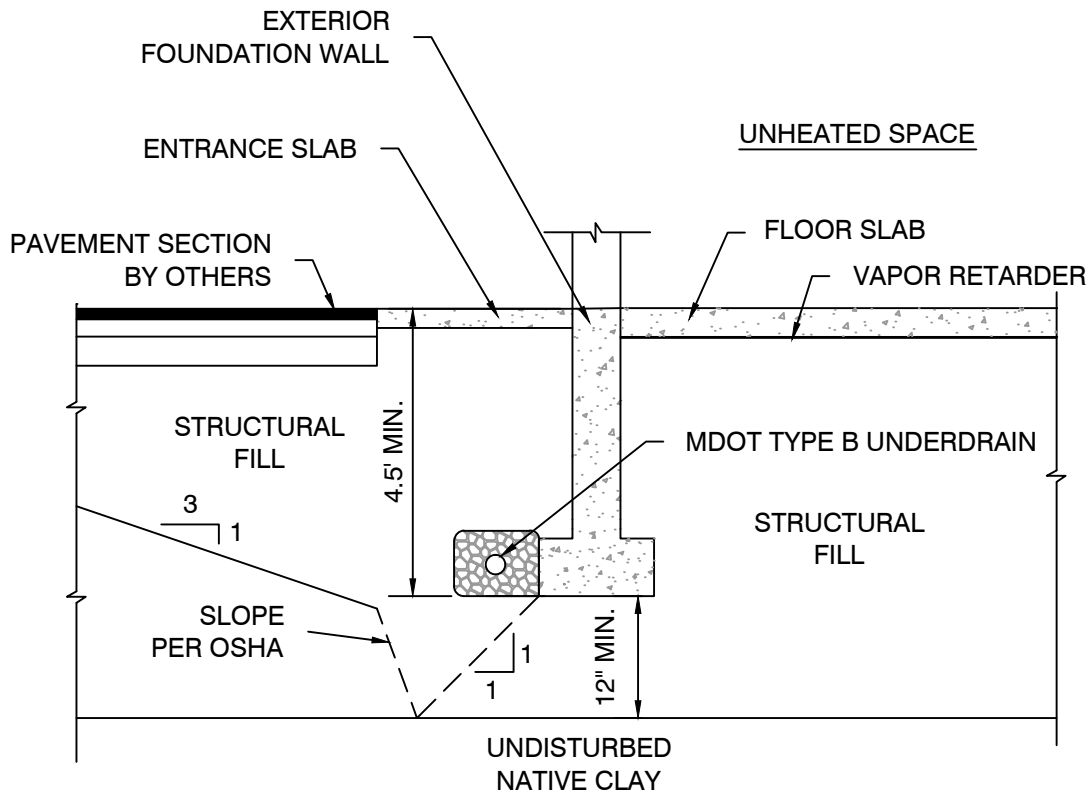
Description of Proportions:

0 to 5% TRACE
5 to 12% SOME
12 to 35% "Y"
35+% AND

REFUSAL: Test Boring Explorations - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: Test Pit Explorations - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.



NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.
2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.



S.W. COLE
ENGINEERING, INC.

WRIGHT-PIERCE

UNDERDRAIN AND OVEREXCAVATION DETAIL

PROPOSED MILL CREEK PUMP STATION
FORESIDE ROAD (ROUTE 88)
FALMOUTH, MAINE

Job No.: 13-0539
Date : 07/03/2013

Scale: Not to Scale
Sheet: 5

APPENDIX A

ROCK CORE PHOTOGRAPHS



APPENDIX C
PRELIMINARY DESIGN EXISTING AND FUTURE FLOWS

| | | | |
|----------|--|--------------|--------------------|
| TO: | Pete Clark | DATE: | September 16, 2013 |
| FROM: | Chris Dwinal, Kattie Collins | PROJECT NO.: | 12776A |
| SUBJECT: | Town of Falmouth, Maine Mill Creek Pump Station Upgrade – Preliminary Design Existing and Future Flows | | |

The following memorandum describes the approach used to establish the existing and future sanitary flow conditions to the Mill Creek Pump Station and the recommended design capacity for the upgraded Mill Creek Pump Station. The following identifies the basis for determining this flow:

- Establish current average and peak flows from Falmouth and Cumberland
- Identify the reasonable peak flow to be handled under present day conditions
- Estimate sewered growth within the area of Falmouth draining to the Mill Creek Pump Station considering both residential and commercial development (including redevelopment of the Route 1 Business Corridor)
- Assume sewered growth within the area of Cumberland draining to the Mill Creek Pump Station (per Cumberland, future growth is equivalent to the contracted capacity at the water pollution control facility (WPCF) less current day average flow)
- Apply a reasonable peaking factor to the new sewered growth for each community reflective of today's construction standards and water conservation measures
- Add the current peak flows to the projected peak flows to establish pump station design capacity

Current Flows:

The analysis of current flows is based on historical flow data from January 2011 to July 2013. Data was provided by the Town of Falmouth for the flume at the WWTF which measures flow from Mill Creek Pump Station and for the flume at the Cumberland/Falmouth town line which measures flow from Cumberland¹. The flow for Falmouth has been estimated by subtracting the Cumberland flow rate from the Mill Creek Pump Station flow rate. Table 1 summarizes the current flows.

¹ There is also a small portion of Cumberland that drains by gravity to the Johnson Road Pump Station and is not measured by the Cumberland flume.

**TABLE 1
CURRENT FLOWS
(JANUARY 2011 TO JULY 2013)**

| Flow Parameter | Mill Creek PS | | Town of Falmouth | | Town of Cumberland | |
|--|----------------------|-----|----------------------|------|--------------------|------|
| | Flow (MGD) | PF | Flow (MGD) | PF | Flow (MGD) | PF |
| Average Day | 0.526 | -- | 0.314 | -- | 0.212 | -- |
| Peak Day | 2.419 | 4.6 | 1.506 | 4.8 | 1.313 | 6.2 |
| Peak Instantaneous ⁽¹⁾ | | | | | | |
| 15-Min. Interval | 2.458 ⁽²⁾ | 4.7 | 1.959 ⁽³⁾ | 6.2+ | 2.206 | 10.4 |
| 15-Min. Interval (99.9 th Percentile) | 2.416 | 4.6 | 1.556 ⁽³⁾ | 5.0+ | 1.067 | 5.0 |

Notes:

1. The peak instantaneous flow rates listed for the Town of Falmouth and the Town of Cumberland do not add up to the peak instantaneous flow rates listed for the Mill Creek Pump Station. This is due to the fact that the peak flows from each community reached the pump station at different times and/or that there was some volume that overflowed to Mill Creek.
 2. The peak instantaneous flow rate recorded at the Mill Creek Pump Station during this time period was 2.483 MGD (1,724 GPM). However this instance, along with several other peak flow instances of similar magnitude, appeared to be arbitrary as there was minimal or no rain. The data may be invalid or it may reflect a time when pumps were brought online for routine maintenance purposes. The peak instantaneous flow rate recorded in Table 1 corresponds to the largest wet weather event during the time period (June 2012).
 3. During the June 2012 storm event, the Town reported a sanitary sewer overflow (SSO) of unknown volume. The flows listed for Falmouth in this table are calculated by subtracting the Town of Cumberland flow from the Mill Creek Pump Station flow. The amount of flow overflowed is not known and thus is not accounted for in recorded values.
- During the June 2012 wet weather event, the pump station operated at or very near its peak pumping capacity for over two days (pumped flows ranged between 1,500 GPM to 1,707 GPM). The Town also reported a sanitary sewer overflow (SSO) at the manholes upstream of the Mill Creek Pump Station wet well on the Mill Creek Interceptor; however, the duration and the volume of the SSO are unknown. As such, the peak instantaneous flow rate for the Town of Falmouth was actually the value recorded in Table 1 plus the unknown SSO flow rate. The June 2012 storm was determined to be greater than a 10-year design storm.
 - The Comprehensive Pump Station Assessment² reported an estimated peak pumping capacity for Mill Creek Pump Station of approximately 2.38 MGD (1,650 GPM) based on drawdown testing. With surcharged interceptors and higher wet well levels during the storm event, it is not unreasonable to assume that the pump station could achieve the slightly higher peak instantaneous flow rate recorded in Table 1.
 - Foreside Road Pump Station collects most of the sanitary flow from the Town of Cumberland, and the pump station force main discharges just upstream from the Cumberland flume. The Comprehensive Pump Station Assessment reported that the pumping capacity of the Foreside Road Pump Station is 1.26 MGD (875 GPM) with one pump operating and 1.73

² Comprehensive Pump Station Assessment for the Town of Falmouth, Maine; dated July 2009; by Wright-Pierce.

MGD (1,201 GPM) with both pumps operating. At the time, it was reported that only one pump operated at a time except when one pump was clogged and operating at reduced capacity. However, based on the flow data available from the pump station flow meter and from the Cumberland flume, it appears that the pumps either have more capacity than reported or that there are periods of time when both pumps run concurrently during wet weather events.

Future Growth

As part of this preliminary design effort, an estimate of future growth was generated to establish the proposed design capacity of the future Mill Creek Pump Station. The future growth estimates were calculated differently for each community as follows:

Town of Falmouth

- Residential Development:
 - Based on a review of the Town's online GIS mapping, there are currently nine relatively large, undeveloped parcels in the Mill Creek Pump Station drainage area that are zoned for residential use (one parcel is partially zoned for residential use). The total undeveloped residential property is approximately 66 acres (Zoning District RA).
 - In addition to the undeveloped properties, the Town has indicated that there are seven parcels near Route 1, to the south of the Mill Creek Pump Station, that are being targeted for redevelopment. Two of these parcels are at least partially located in residential zones (approximately 8 acres, Zoning Districts RA and RB).
 - Assuming 20% of the available acreage will be used for roads and open space and based on the minimum lot sizes required in Zoning Districts RA and RB, the total number of potential residential units is estimated to be 111 units.
 - Using the previously developed analysis of sewer population during the 2002 Facilities Plan Update³ of 2.61 capita per home in Falmouth and an estimate of 60 gallons per day per capita, this would translate to an estimated average residential flow rate of 17,900 GPD.
- Commercial Development:
 - Based on a review of the Town's online GIS mapping, there are currently ten relatively large, undeveloped parcels in the Mill Creek Pump Station drainage area that are zoned for commercial use (one parcel is partially zoned for commercial use). The total undeveloped commercial property is approximately 148 acres located in Zoning District BP (Business Professional) and approximately 8 acres located in Zoning District SB1 (Suburban Business 1).

³ Wastewater Facilities Study Update of the Richard B. Goodenow Water Pollution Control Facility, Town of Falmouth, Maine; dated December 2002; by Wright-Pierce.

- In addition to the undeveloped properties, the Town has indicated that there are seven parcels near Route 1, to the south of the Mill Creek Pump Station, that are being targeted for redevelopment. Six of these parcels are at least partially located in Zoning District SB1 (approximately 21 acres).
- Typical design standards recommend an average daily flow of 800 to 1,500 gallons per day per acre for commercial properties. Using a value of 1,150 GPD/acre, this would translate to an estimated average commercial flow rate of 203,800 GPD.
- Infiltration: Typical design standards recommend an infiltration rate of 150 GPD/acre. This would translate to an estimated infiltration rate of 36,600 for the undeveloped properties.

As such, the proposed future average daily flow rate to the Mill Creek Pump Station from the Town of Falmouth is 0.314 MGD plus 0.018 MGD of future residential flow plus 0.204 MGD of future commercial flow and 0.037 MGD of future infiltration for a total of 0.573 MGD. A more detailed summary of the estimates for residential, commercial and infiltration flows has also been included in Appendix A.

Town of Cumberland

Regarding the potential for future growth in the Town of Cumberland, Portland Water District (PWD) indicated that the estimate should be based on the average daily flow capacity that the Town of Cumberland currently owns at the Falmouth WPCF (0.468 MGD⁴). As such, the proposed future average daily flow rate to the Mill Creek Pump Station from the Town of Cumberland is 0.468 MGD which will provide approximately 0.256 MGD of additional average daily flow capacity for the Town of Cumberland (0.468 MGD less the current average daily flow of 0.212 MGD).

Peaking Factors

As can be seen in Table 1 above, there is a significant difference between the 15-minute interval peak flow (100th percentile) and the 99.9th percentile 15-minute interval peak flow. This is especially obvious in the Cumberland flow data, which indicates a 15-minute interval peak flow of 2.206 MGD (peaking factor of 10.4) and the 99.9th percentile of the 15-minute interval peak flow of 1.067 MGD (peaking factor of 5.0). Although the historical peak instantaneous flow rate to the pump station is unknown due to the unknown quantity of SSO flow, it is known that the peak instantaneous flow rate is greater than 2.416 MGD only 0.1% of the time. As such, it is not recommended that the peaking factors for the 100th percentile 15-minute interval peak flow condition be used. This condition reflects an extreme situation that occurs very infrequently and

⁴ For a discussion of capacities owned by the Town of Cumberland in the Town of Falmouth's wastewater collection and treatment system, refer to the Wastewater Treatment Plant Capacity Assessment and Impacts on Future Development/Growth in Falmouth and Cumberland Technical Memorandum; dated May 22, 2013; by Wright-Pierce. TR-16: Guides for the Design of Wastewater Treatment Works

could result in oversizing the pump station. Instead, we would suggest that the 99.9th percentile peaking factor of 5.0 is more reasonable for current flows.

For projected future flows, it is important to recognize that new development will have new, tighter infrastructure (i.e. fewer occurrences of inflow and infiltration) and will utilize more efficient water fixtures (i.e. faucets, shower heads, etc.), a reduced peaking factor is recommended for the future Falmouth and Cumberland flows. Although slightly lower than certain design standards such as *TR-16: Guides for the Design of Wastewater Treatment Works*⁵, which recommends a peaking factor of 3.8, we would suggest a peaking factor of 3 as there is already a level of conservatism built into the flow estimating (e.g. an average daily flow of 60 GPD/capita is based on older standards when water fixtures were not as efficient, etc.).

Proposed Pump Station Design Capacity

The proposed pump station design capacity is summarized in Table 2.

TABLE 2
MILL CREEK PUMP STATION: PROPOSED CAPACITY

| | Current (2013) | | | Sewered Growth | | | Design (2033) |
|-------------------|----------------|-----|-----------|----------------|-----|-----------|---------------|
| | Average Flow | PF | Peak Flow | Average Flow | PF | Peak Flow | Peak Flow |
| | (MGD) | | (MGD) | (MGD) | | (MGD) | (MGD) |
| Falmouth | 0.314 | 5.0 | 1.571 | 0.259 | 3.0 | 0.703 | 2.274 |
| Cumberland | 0.212 | 5.0 | 1.059 | 0.256 | 3.0 | 0.768 | 1.827 |

Mill Creek Pump Station Design Capacity: 4.102

The design average daily flow was calculated as noted in the previous section. Based on the peaking factors proposed in the previous section, the future peak instantaneous flow rate was calculated as follows:

$$\begin{aligned}\text{Current Peak Flow} &= \text{Avg. Flow} \times \text{PF}^6 \\ &= 0.526 \text{ MGD} \times 5.0 = 2.631 \text{ MGD}\end{aligned}$$

$$\begin{aligned}\text{Future Development Peak Flow} &= (\text{Avg. Flow} \times \text{PF}) + \text{Est. Infiltration} \\ &= (0.478 \text{ MGD} \times 3.0) + 0.017 \text{ MGD} = 1.471 \text{ MGD}\end{aligned}$$

⁵ *TR-16: Guides for the Design of Wastewater Treatment Works*, 2011 edition; New England Interstate Water Pollution Control Commission.

⁶ As there is no data available on the future growth in Cumberland (e.g. parcel acreage to be developed), a separate estimate for future infiltration could not be calculated. As such, it is assumed that the average daily flow includes infiltration.

$$\begin{aligned}\text{Total Future Peak Flow} &= 2.361 \text{ MGD} + 1.471 \text{ MGD} \\ &= 4.102 \text{ MGD (2,850 GPM)}\end{aligned}$$

It is essential to note that both Falmouth and Cumberland will need to continue to reduce inflow and infiltration in the Mill Creek Pump Station drainage area. The proposed pump station will have an additional 1.643 MGD of peak pumping capacity over the current pumping capacity which should reduce the occurrence of SSO events in the short-term. However, if I/I has not been reduced when the future growth occurs, SSO events will continue and potentially become worse.

Miscellaneous Design Considerations

The following list summarizes several key issues to be taken into consideration during design:

- In order for the Town of Falmouth to continue to meet their permitted effluent limits, it is essential to ensure that the WPCF has the ability to treat additional flow from the Mill Creek Pump Station. Historically, the WPCF has treated peak day flows of up to 4.91 MGD, and hydraulically, it is estimated that the plant can pass approximately 5.2 MGD of influent flow. Based on the proposed Mill Creek Pump Station design capacity of 4.102 MGD and the combined peak capacity of the Clearwater Drive and Lunt Road Pump Stations of 1.940 MGD, the plant has a potential to see peak instantaneous flow rates of up to 6.042 MGD if all stations operate at the same time. These flows suggest that an upgrade will be required at the WPCF in the future (especially as there is also growth expected in the Clearwater Drive and Lunt Road Pump Station drainage areas). In the meantime, provisions will be included to limit the pumping rate from the Mill Creek Pump Station to approximately 3.26 MGD to ensure that the WPCF is not overwhelmed. As I/I removal occurs and/or when the WPCF is upgraded, the maximum flow limit can be adjusted.
- It appears that the current minimum instantaneous flow rate to the Mill Creek Pump Station ranges from approximately 0.05 MGD to 0.10 MGD. Pump alternatives will be considered to provide the greatest amount of turndown possible; however, pump cycling will likely occur during periods of low flow.
- Force Main
 - Velocity: Based on the future peak flow condition of 4.102 MGD, the velocity in the existing 14-inch diameter force main will be approximately 5.9 FPS. For new construction, the targeted range of velocities in a force main is typically 3.5 to 5 feet per second. Although slightly higher than the targeted range, 5.9 FPS is not an unreasonable velocity for short durations in a force main that is in good condition.

- Operating Pressure. The preliminary pumping system model indicates that the total dynamic head at the pumps will be approximately 50 feet (22 PSI) under the current average flow condition and 205 feet (89 PSI) under the future maximum flow condition. The total dynamic head design condition for the existing large pumps is about 71.5 feet (31 PSI). As such, under the future maximum flow condition, the force main pressure near the pump station will be approximately 134 feet of head (58 PSI) higher than the current peak pressure condition. (Note that this is based on an assumed friction factor (C) of 100. Testing will be completed to establish a more accurate estimate for the C factor of the force main.)
- Based on visual observation, it appears that the Mill Creek Pump Station force main is ductile iron (DI) pipe at the pump station and at the WPCF and asbestos cement (AC) pipe in between. Pressure class information is not available for the force main. Common classes for ductile iron pipe include Class 50, Class 51, Class 52, etc.; based on wall thickness, all classes noted here are nominally rated for greater than 350 PSI. Common classes for asbestos cement pipe include Class 100, Class 150 and Class 200 and the class reflects the pressure rating (i.e. Class 100 is nominally rated for 100 PSI).
- Assuming that the force main pipe is in good condition, both the asbestos cement and the ductile iron portions of the force main should be able to withstand the estimated peak flow velocities and line pressures for short durations (assuming at least Class 50 DI and Class 100 AC pipe). However, the condition of the existing force main is unknown, and the Town may want to consider additional investigations to confirm the condition of the pipe. One alternative would be to cut a coupon(s) from the pipe to determine pipe thickness, presence of a lining, etc. Another alternative would be to drain or partially drain the force main and TV inspect the line; however, the feasibility (can the force main be drained back to the pump station) and cost implications (night-time inspection) of this alternative would need to be closely considered.
- Based on the future flow estimates, 2.274 MGD of the peak capacity will serve the Town of Falmouth and 1.828 MGD of the peak capacity will serve the Town of Cumberland.

APPENDIX A
Future Flow Estimate

Town of Falmouth, Maine
Mill Creek Pump Station - Preliminary Design

Future Flow Estimate

| Source | Zoning | Total Acreage | Sanitary Flow Contribution (GPD) | I/I Contribution (GPD) | Total Average Daily Flow (GPD) | Notes |
|----------------------------------|---------------|---------------|----------------------------------|------------------------|--------------------------------|------------|
| Residential Flow Estimate | | | | | | |
| Parcel U61-001 | RA | 8.8 | 2,400 | 1,300 | 3,700 | 3, 4 |
| Parcel U60-14-R | RA | 4.2 | 1,200 | 600 | 1,800 | 3, 4 |
| Parcel U19-052 | RA | 6.0 | 1,600 | 900 | 2,500 | 3, 4 |
| Parcel U60-014-W | RA | 2.9 | 800 | 400 | 1,200 | 3, 4 |
| Parcel U14-014 | RA | 7.7 | 2,100 | 1,200 | 3,300 | 3, 4 |
| Parcel U14-014-A | RA | 3.4 | 900 | 500 | 1,400 | 3, 4 |
| Parcel U59-011 | BP/RA/SP | 24.9 | 6,800 | 3,700 | 10,500 | 1, 3, 4, 6 |
| Parcel R02-011 | RB/VOD | 4.0 | 1,100 | 600 | 1,700 | 3, 5, 7 |
| Parcel U52-005 | SB1/VOD/RA | 3.7 | 1,000 | 600 | 1,600 | 2, 3, 4, 7 |
| <i>Residential Subtotals</i> | | 65.6 | 17,900 | 9,800 | 27,700 | -- |
| Commercial Flow Estimate | | | | | | |
| Parcel U62-001 | BP | 50.4 | 58,000 | 7,600 | 65,600 | 1 |
| Parcel U62-005-001 | BP | 5.8 | 6,600 | 900 | 7,500 | 1 |
| Parcel U60-014 | BP/SP | 32.0 | 36,800 | 4,800 | 41,600 | 1, 6 |
| Parcel U59-011 | BP/RA/SP | 25.3 | 29,100 | 3,800 | 32,900 | 1, 3, 4, 6 |
| Parcel U53-004 | BP | 4.2 | 4,800 | 600 | 5,400 | 1 |
| Parcel U53-004-A | BP | 2.1 | 2,400 | 300 | 2,700 | 1 |
| Parcel U13-002-B | BP/VOD/LR/CW | 21.0 | 24,200 | 3,200 | 27,400 | 1, 6 |
| Parcel U12-007-A | SB1/VOD/LR/CV | 4.3 | 4,900 | 600 | 5,500 | 2, 6 |
| Parcel U12-006-A | SB1/VOD/LR | 3.5 | 4,000 | 500 | 4,500 | 2, 6 |
| Parcel U58-010 | BP/VOD | 7.2 | 8,300 | 1,100 | 9,400 | 1 |
| Parcel U52-001 | SB1/VOD | 3.8 | 4,400 | 600 | 5,000 | 2, 7 |
| Parcel U52-006 | SB1/VOD | 3.1 | 3,600 | 500 | 4,100 | 2, 7 |
| Parcel U52-005 | SB1/VOD/RA | 11.3 | 12,900 | 1,700 | 14,600 | 2, 3, 4, 7 |
| Parcel U52-008 | SB1/VOD | <1.0 | 1,200 | 200 | 1,400 | 2, 7 |
| Parcel U24-006 | SB1/VOD | <1.0 | 1,200 | 200 | 1,400 | 2, 7 |
| Parcel U24-007 | SB1/VOD | 1.2 | 1,400 | 200 | 1,600 | 2, 7 |
| <i>Commercial Subtotals</i> | | 177.2 | 203,800 | 26,800 | 230,600 | -- |

Residential and Commercial Totals 243 221,700 36,600 258,300

Notes:

1. The future average daily flow in the BP zone is based on a flow rate of 1,150 GPD/acre.
2. The future average daily flow in the SB1 zone is based on a flow rate of 1,150 GPD/acre.
3. The future average daily flow in the RA and RB zones is based on the number of parcels and 157 GPD/parcel (assumed 2.61 people per parcel and 60 GPD/person). All development was assumed to be single family homes.
4. The parcels per lot in the RA zone is based on 80% of the total acreage divided by 20,000 SF per lot which is the
5. The parcels per lot in the RB zone is based on 80% of the total acreage divided by 40,000 SF per lot which is the
6. No reductions to total acreage were made due to the prescense of protected resources. As a worst-case scenario, all acreage was assumed to be available for development.
7. Parcel to be redeveloped per Town.

APPENDIX D
PUMP VENDOR INFORMATION

NP 3301 HT 3~ 464

Performance curve



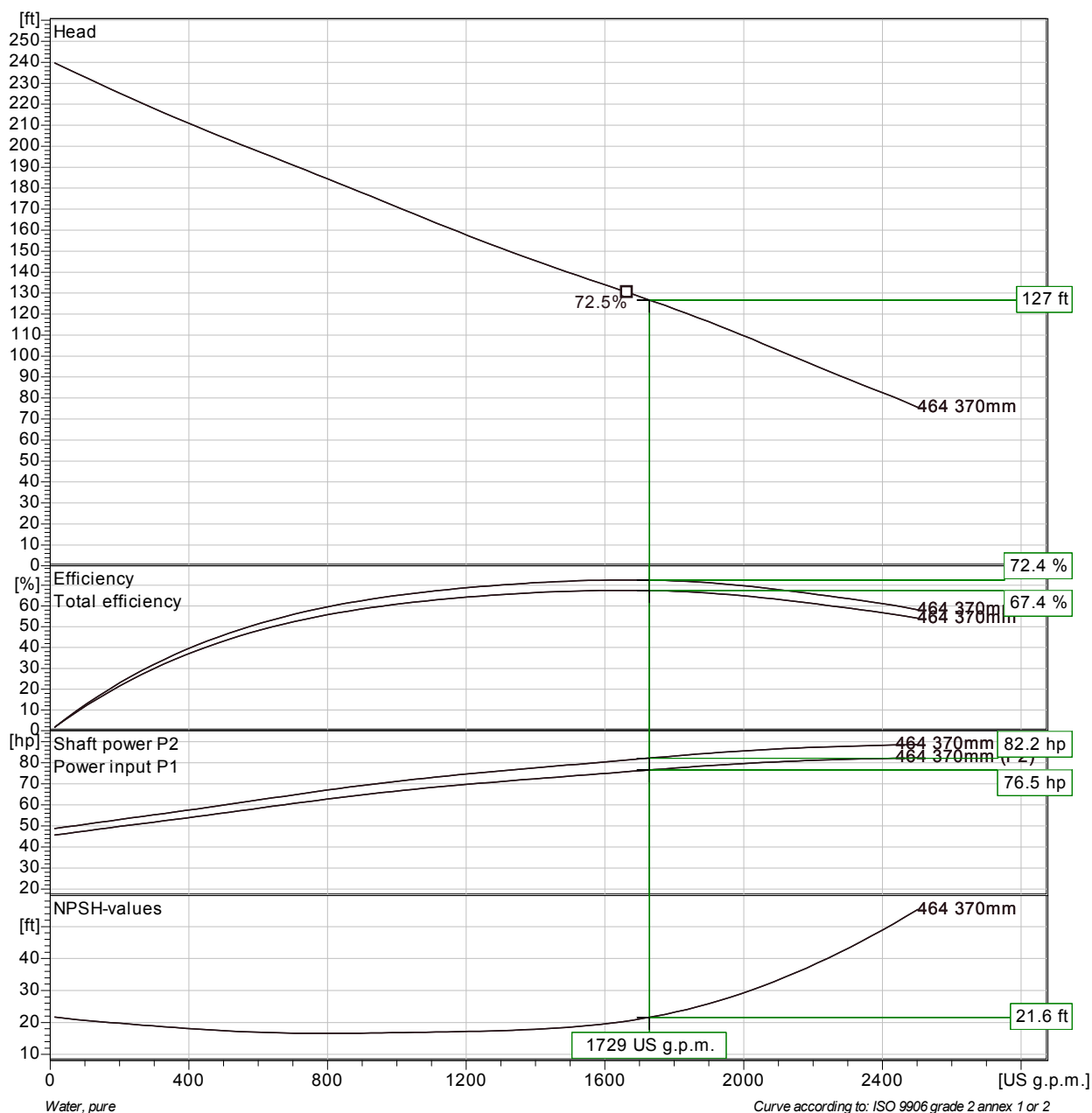
Pump

Discharge Flange Diameter 6 inch
Suction Flange Diameter 150 mm
Impeller diameter 14^{9/16}"
Number of blades 2

Motor

Motor # N3301.185 35-25-4AA-W 85hp
Stator variant 1
Frequency 60 Hz
Rated voltage 460 V
Number of poles 4
Phases 3~
Rated power 85 hp
Rated current 101 A
Starting current 490 A
Rated speed 1775 rpm

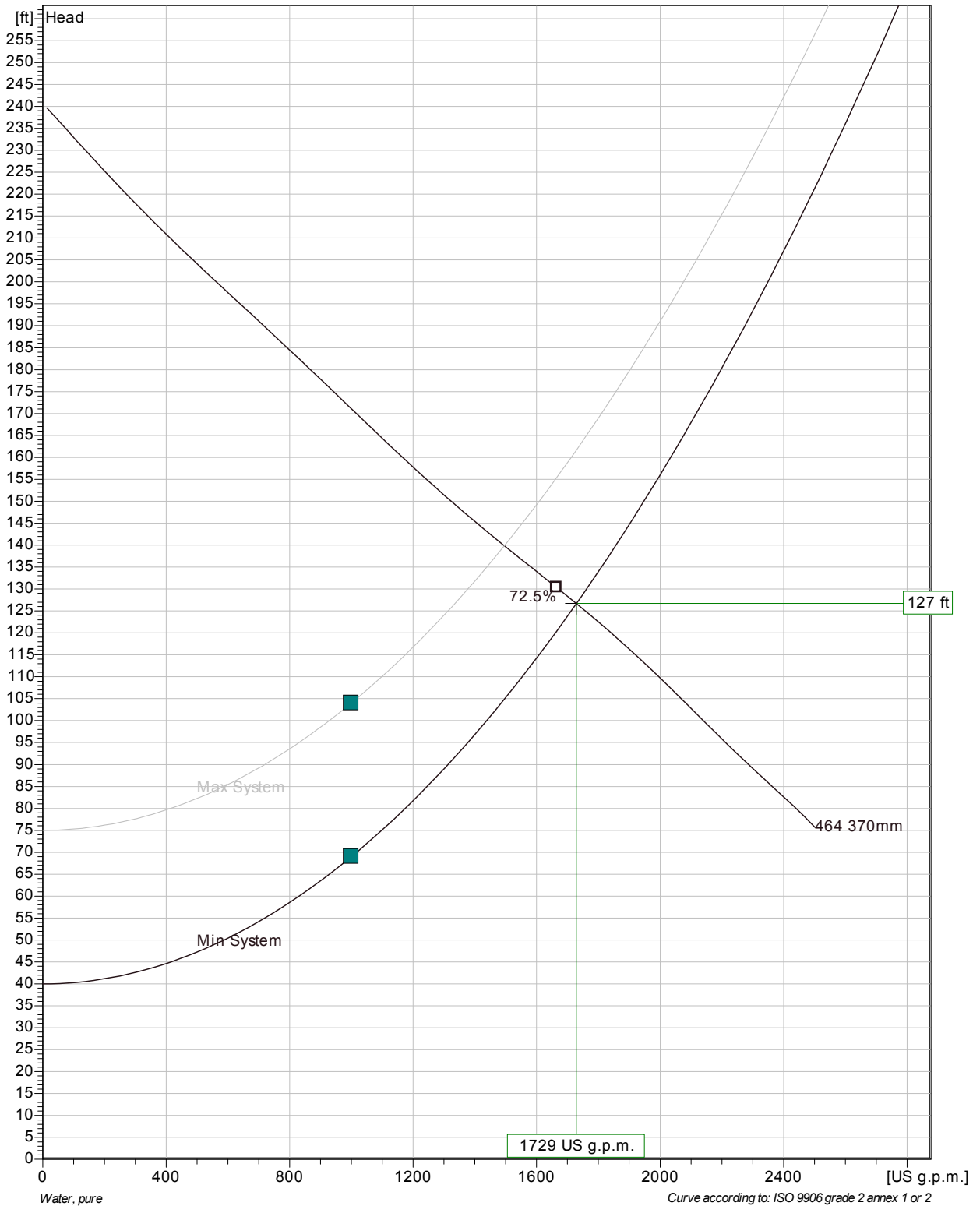
Power factor
1/1 Load 0.85
3/4 Load 0.82
1/2 Load 0.74
Efficiency
1/1 Load 92.5 %
3/4 Load 93.5 %
1/2 Load 93.5 %



| | | | | |
|---------|------------|------------|--------------------------|-------------|
| Project | Project ID | Created by | Created on 2014-12-17 | Last update |
|---------|------------|------------|--------------------------|-------------|

NP 3301 HT 3~ 464

Duty Analysis

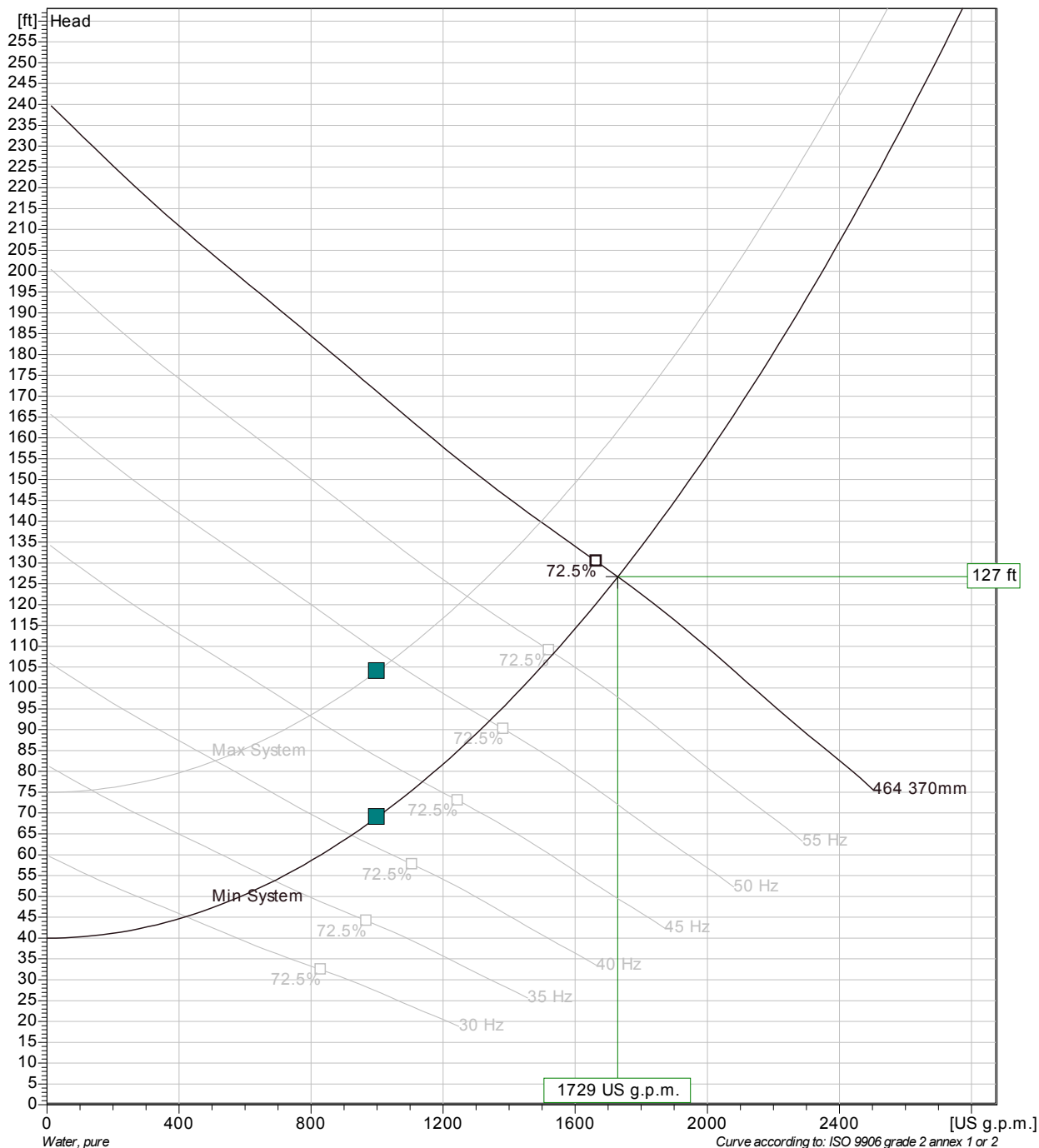


| Individual pump | | | | Total | | | | | |
|-----------------------|----------------|--------|-------------|----------------|--------|-------------|-----------|-----------------|---------|
| Pumps running /System | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| Max System | 1500 US g.p.m. | 140 ft | 73.6 hp | 1500 US g.p.m. | 140 ft | 73.6 hp | 71.9 % | 656 kWh/US MG | 18.5 ft |
| Min System | 1730 US g.p.m. | 127 ft | 76.5 hp | 1730 US g.p.m. | 127 ft | 76.5 hp | 72.4 % | 591 kWh/US MG | 21.6 ft |

| | | | | |
|---------|------------|------------|------------|-------------|
| Project | Project ID | Created by | Created on | Last update |
| | | | 2014-12-17 | |

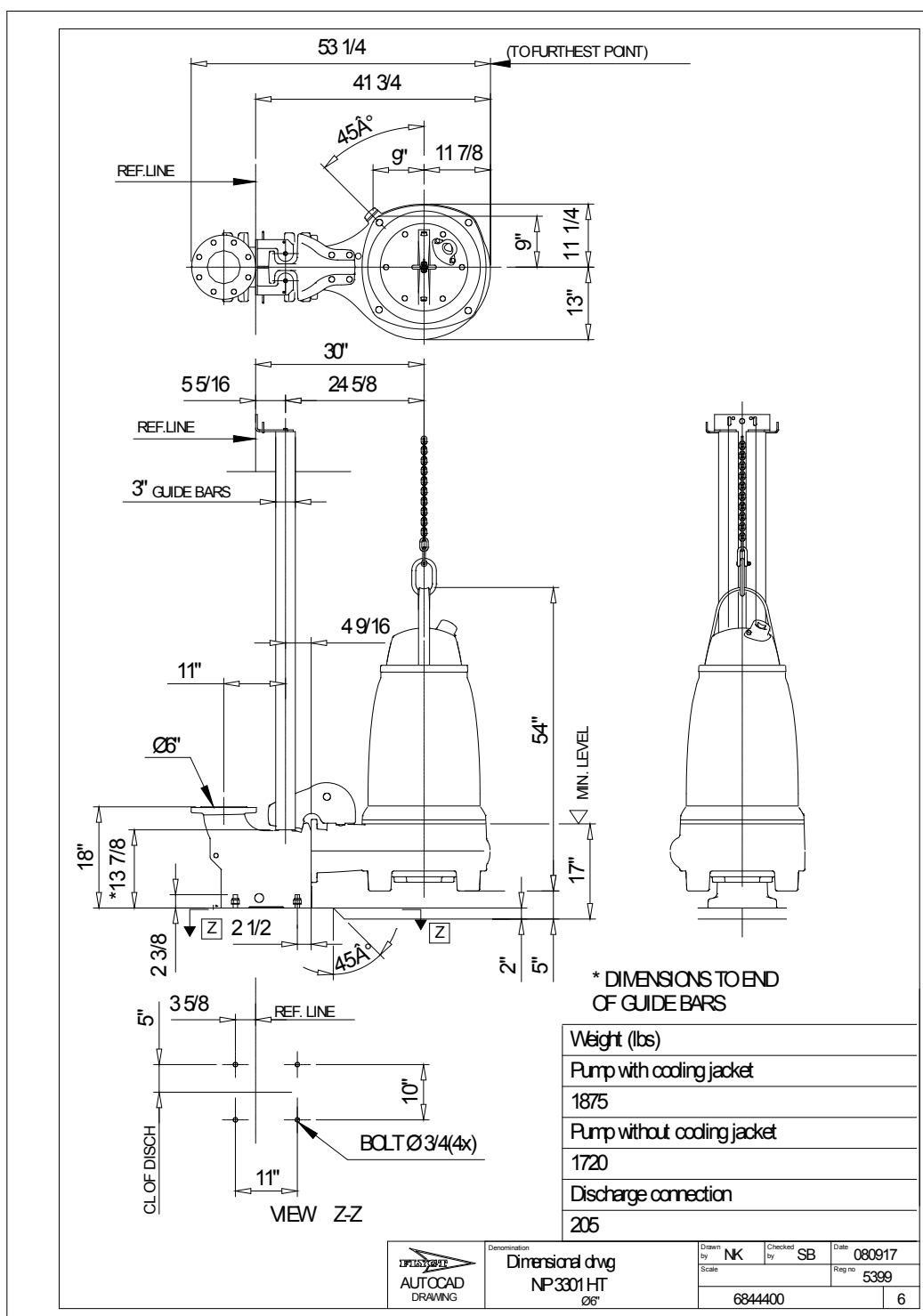
NP 3301 HT 3~ 464

VFD Analysis



| Pumps running /System | Individual pump | | | Total | | | | | | |
|-----------------------------|-----------------|----------------|---------|-------------|----------------|---------|-------------|----------|--------------------|---------|
| | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
| Max System | 60 Hz | 1500 US g.p.m. | 140 ft | 73.6 hp | 1500 US g.p.m. | 140 ft | 73.6 hp | 71.9 % | 656 kWh/US MG | 18.5 ft |
| Max System | 55 Hz | 1270 US g.p.m. | 122 ft | 55.3 hp | 1270 US g.p.m. | 122 ft | 55.3 hp | 71.1 % | 576 kWh/US MG | 15.5 ft |
| Max System | 50 Hz | 1040 US g.p.m. | 107 ft | 40.5 hp | 1040 US g.p.m. | 107 ft | 40.5 hp | 69.5 % | 515 kWh/US MG | 12.9 ft |
| Max System | 45 Hz | 796 US g.p.m. | 93.4 ft | 28.3 hp | 796 US g.p.m. | 93.4 ft | 28.3 hp | 66.4 % | 476 kWh/US MG | 10.6 ft |
| Max System | 40 Hz | 511 US g.p.m. | 82.6 ft | 18.2 hp | 511 US g.p.m. | 82.6 ft | 18.2 hp | 58.4 % | 492 kWh/US MG | 8.65 ft |
| Max System | 35 Hz | 134 US g.p.m. | 75.5 ft | 9.92 hp | 134 US g.p.m. | 75.5 ft | 9.92 hp | 25.9 % | 1080 kWh/US MG | 8.2 ft |
| Min System | 60 Hz | 1730 US g.p.m. | 127 ft | 76.5 hp | 1730 US g.p.m. | 127 ft | 76.5 hp | 72.4 % | 591 kWh/US MG | 21.6 ft |
| Min System | 55 Hz | 1540 US g.p.m. | 108 ft | 58.1 hp | 1540 US g.p.m. | 108 ft | 58.1 hp | 72.5 % | 502 kWh/US MG | 17.9 ft |
| Min System | 50 Hz | 1340 US g.p.m. | 92.1 ft | 43.1 hp | 1340 US g.p.m. | 92.1 ft | 43.1 hp | 72.4 % | 427 kWh/US MG | 14.7 ft |
| Min System | 45 Hz | 1140 US g.p.m. | 77.5 ft | 31 hp | 1140 US g.p.m. | 77.5 ft | 31 hp | 72.1 % | 363 kWh/US MG | 11.8 ft |
| Min System | 40 Hz | 922 US g.p.m. | 64.7 ft | 21.2 hp | 922 US g.p.m. | 64.7 ft | 21.2 hp | 71 % | 313 kWh/US MG | 9.27 ft |
| Min System | 35 Hz | 689 US g.p.m. | 53.8 ft | 13.7 hp | 689 US g.p.m. | 53.8 ft | 13.7 hp | 68.5 % | 281 kWh/US MG | 7.21 ft |

| | | | | |
|---------|------------|------------|------------|-------------|
| Project | Project ID | Created by | Created on | Last update |
| | | | 2014-12-17 | |



| Project | Project ID | Created by | Created on | Last update |
|---------|------------|------------|------------|-------------|
| | | | 2014-12-17 | |

NP 3301 HT 3~ 464

Performance curve



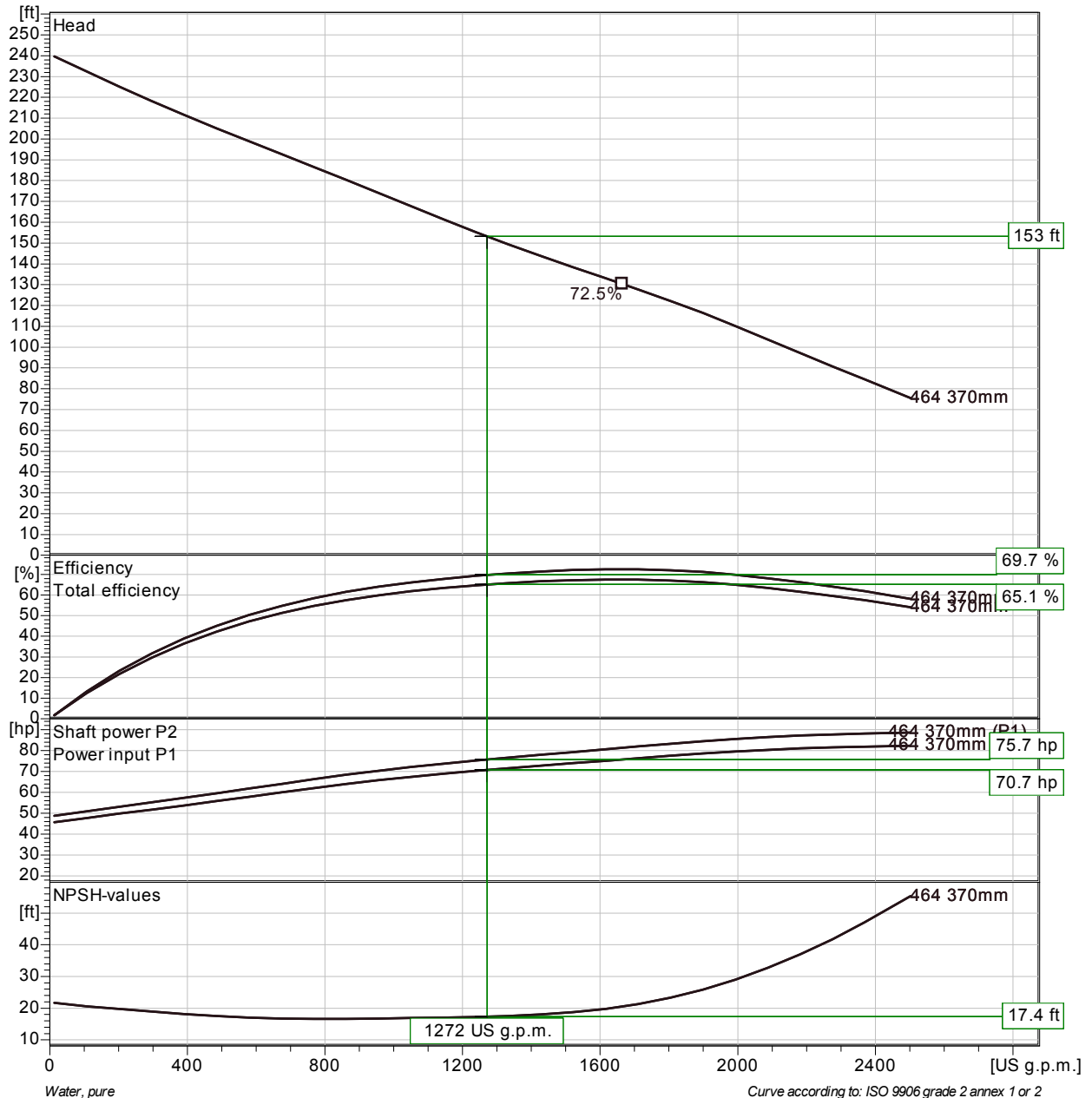
Pump

Discharge Flange Diameter 6 inch
Suction Flange Diameter 150 mm
Impeller diameter 14^{9/16}"
Number of blades 2

Motor

Motor # N3301.185 35-25-4AA-W 85hp
Stator variant 1
Frequency 60 Hz
Rated voltage 460 V
Number of poles 4
Phases 3~
Rated power 85 hp
Rated current 101 A
Starting current 490 A
Rated speed 1775 rpm

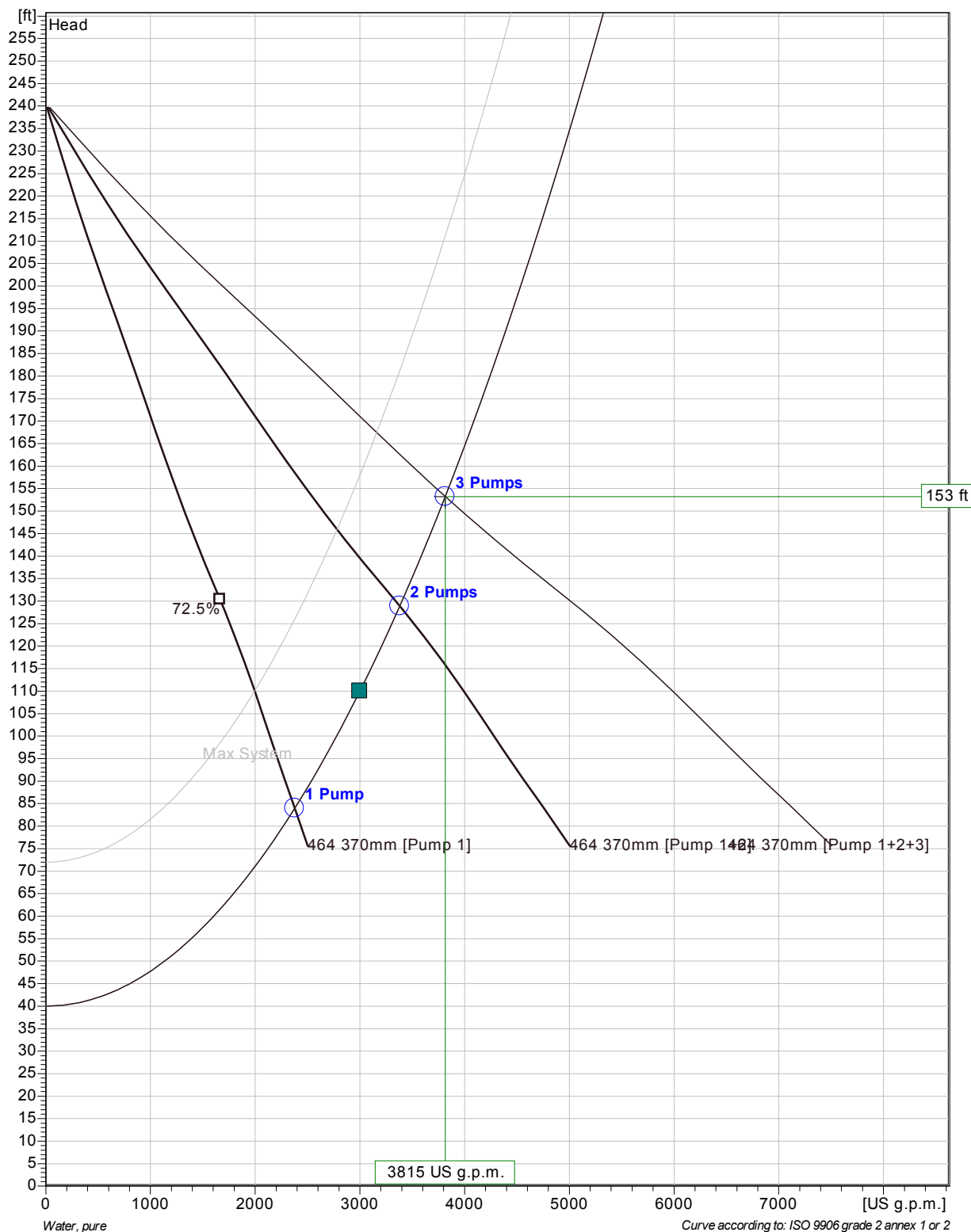
Power factor
1/1 Load 0.85
3/4 Load 0.82
1/2 Load 0.74
Efficiency
1/1 Load 92.5 %
3/4 Load 93.5 %
1/2 Load 93.5 %



| | | | | |
|---------|------------|------------|--------------------------|-------------|
| Project | Project ID | Created by | Created on 2014-12-17 | Last update |
|---------|------------|------------|--------------------------|-------------|

NP 3301 HT 3~ 464

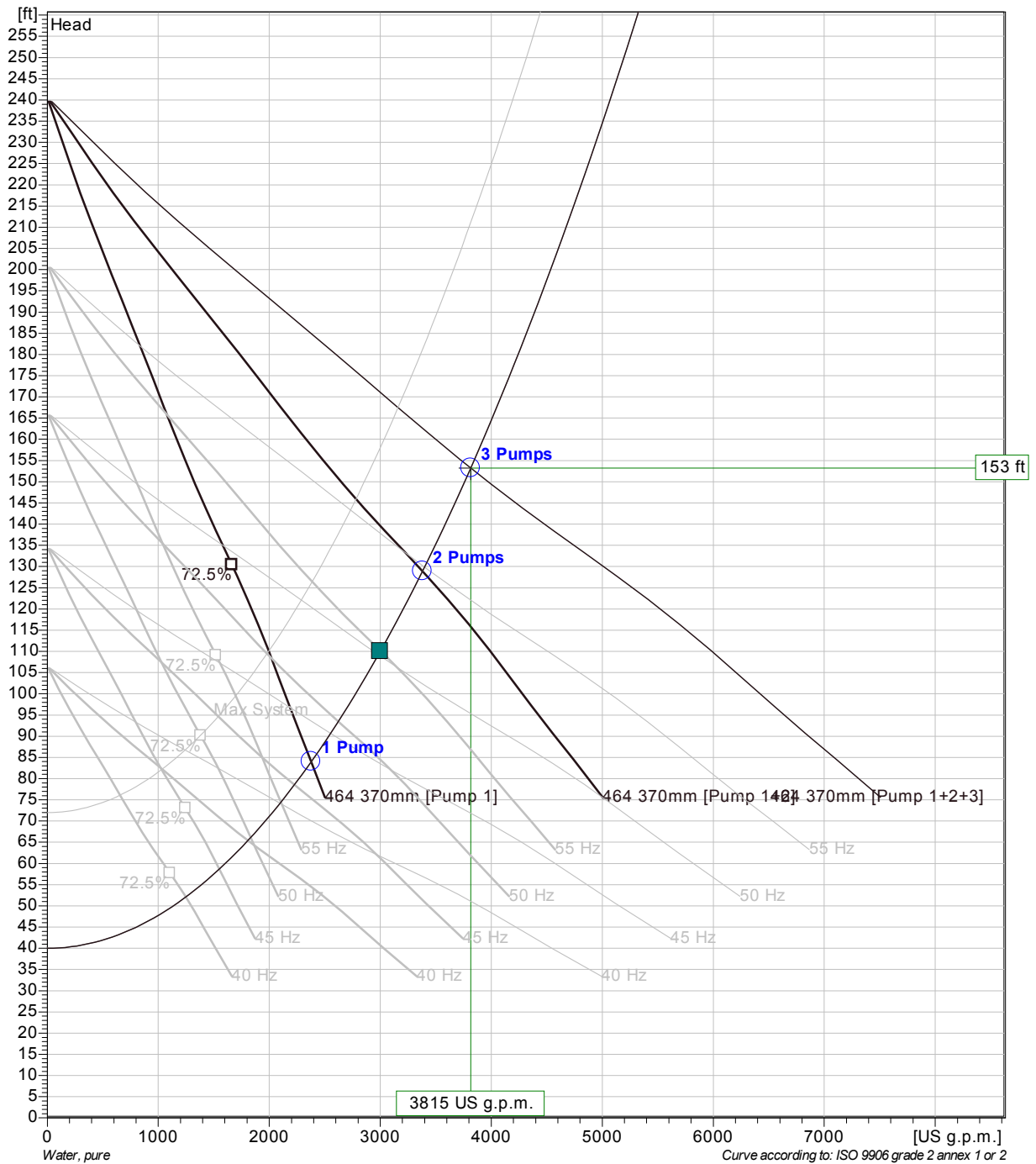
Duty Analysis



| Individual pump | | | | Total | | | | | |
|-----------------------|----------------|------------|-------------|----------------|------------|-------------|------------|-----------------|-------------|
| Pumps running /System | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 1050 US g.p.m. | 167 ft | 67.4 hp | 3160 US g.p.m. | 167 ft | 202 hp | 66.2 % | 851 kWh/US MG | 16.9 ft |
| 3 | 1270 US g.p.m. | 153 ft | 70.7 hp | 3820 US g.p.m. | 153 ft | 212 hp | 69.7 % | 740 kWh/US MG | 17.4 ft |
| 2 | 1690 US g.p.m. | 129 ft | 76.1 hp | 3380 US g.p.m. | 129 ft | 152 hp | 72.5 % | 598 kWh/US MG | 20.9 ft |
| 1 | 2380 US g.p.m. | 84 ft | 81.9 hp | 2380 US g.p.m. | 84 ft | 81.9 hp | 61.7 % | 457 kWh/US MG | 47.6 ft |
| Project | | Project ID | | | Created by | | Created on | | Last update |
| | | | | | | | 2014-12-17 | | |

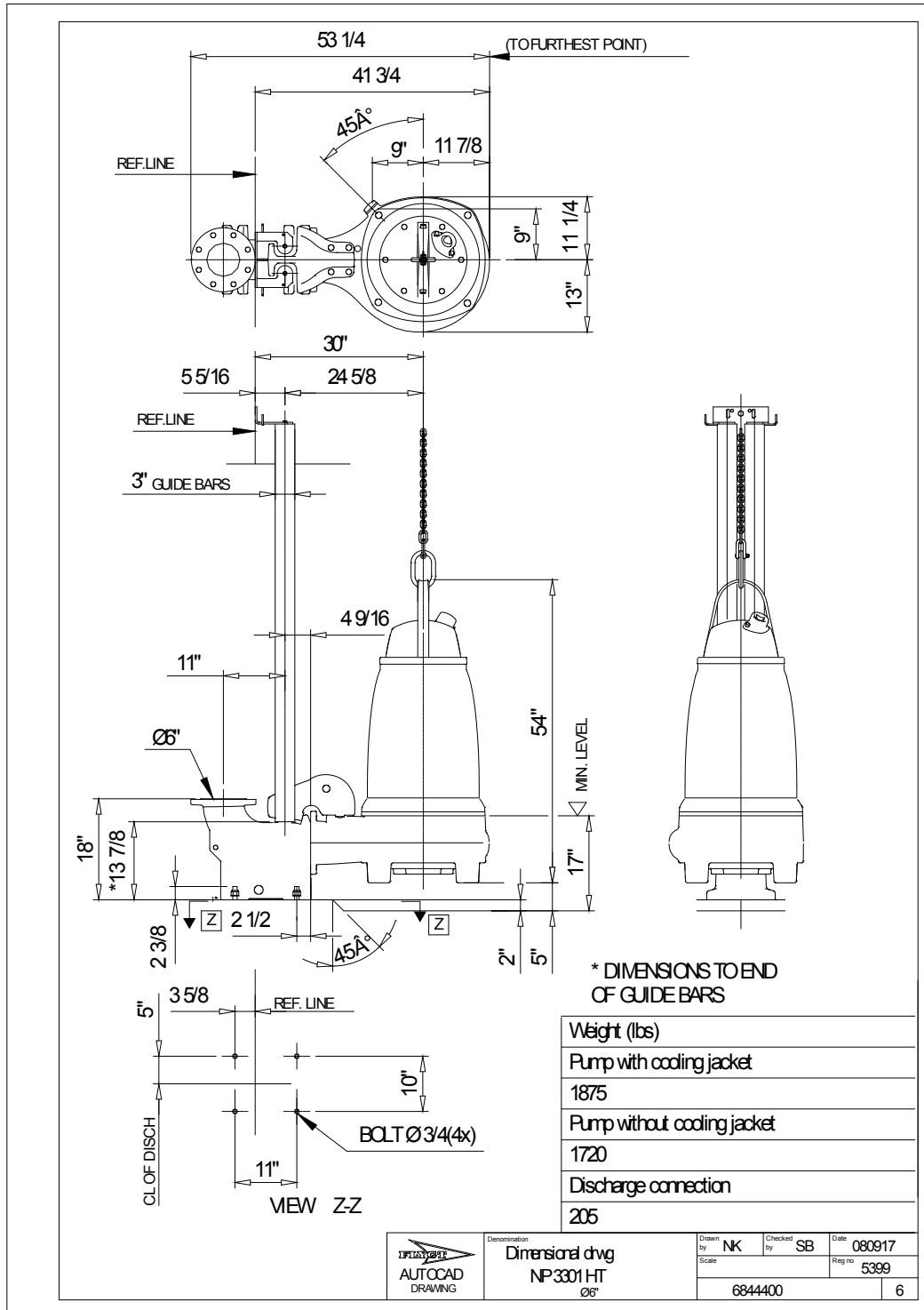
NP 3301 HT 3~ 464

VFD Analysis

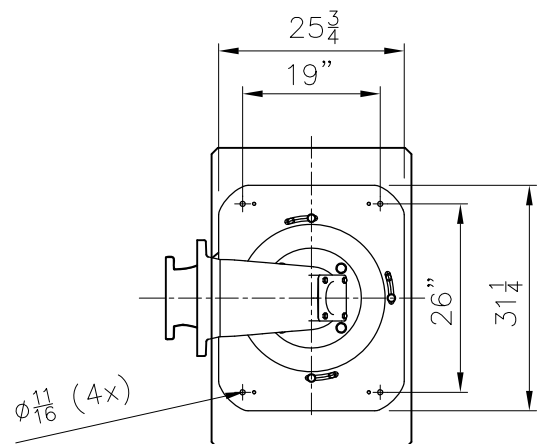
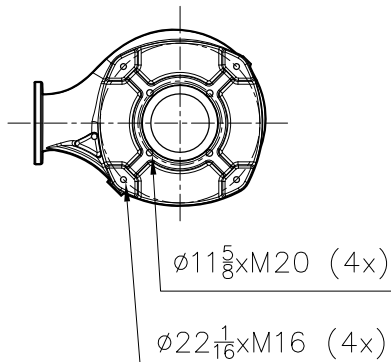
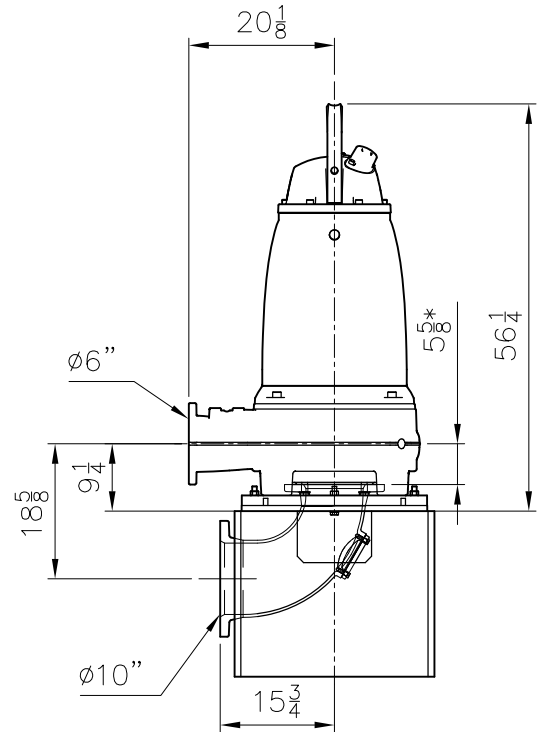
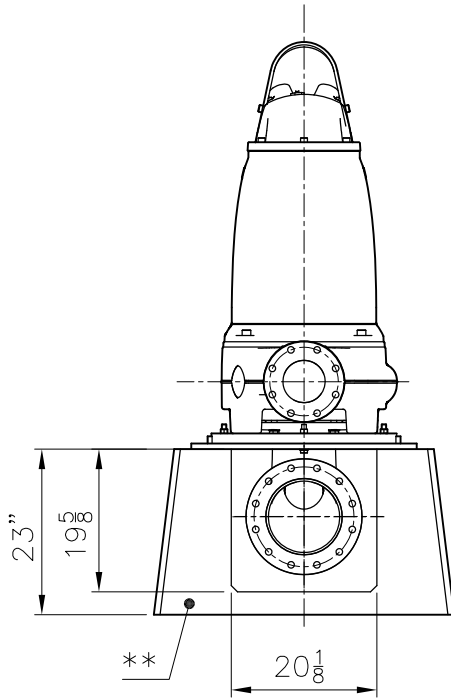
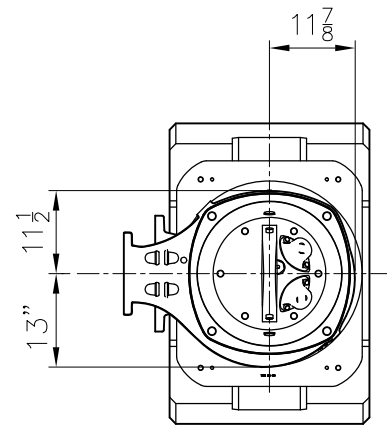
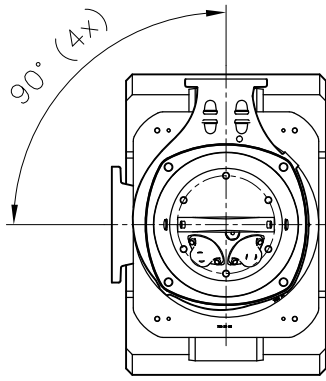


| Pumps running /System | Individual pump | | | Total | | | | | | |
|-----------------------|-----------------|----------------|------------|-------------|----------------|------------|-------------|------------|-----------------|-------------|
| | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
| 1 | 60 Hz | 1050 US g.p.m. | 167 ft | 67.4 hp | 3160 US g.p.m. | 167 ft | 202 hp | 66.2 % | 851 kWh/US MG | 16.9 ft |
| 1 | 55 Hz | 911 US g.p.m. | 143 ft | 50.8 hp | 2730 US g.p.m. | 143 ft | 152 hp | 65 % | 740 kWh/US MG | 14.6 ft |
| 1 | 50 Hz | 763 US g.p.m. | 122 ft | 37.4 hp | 2290 US g.p.m. | 122 ft | 112 hp | 63.1 % | 651 kWh/US MG | 12.4 ft |
| 1 | 45 Hz | 602 US g.p.m. | 103 ft | 26.3 hp | 1810 US g.p.m. | 103 ft | 78.9 hp | 59.7 % | 587 kWh/US MG | 10.4 ft |
| 1 | 40 Hz | 414 US g.p.m. | 86.7 ft | 17.3 hp | 1240 US g.p.m. | 86.7 ft | 51.9 hp | 52.5 % | 578 kWh/US MG | 8.78 ft |
| 3 | 60 Hz | 1270 US g.p.m. | 153 ft | 70.7 hp | 3820 US g.p.m. | 153 ft | 212 hp | 69.7 % | 740 kWh/US MG | 17.4 ft |
| 3 | 55 Hz | 1130 US g.p.m. | 130 ft | 53.7 hp | 3400 US g.p.m. | 130 ft | 161 hp | 69.3 % | 628 kWh/US MG | 15.1 ft |
| 3 | 50 Hz | 994 US g.p.m. | 109 ft | 40 hp | 2980 US g.p.m. | 109 ft | 120 hp | 68.7 % | 534 kWh/US MG | 13.1 ft |
| 3 | 45 Hz | 851 US g.p.m. | 90.7 ft | 28.8 hp | 2550 US g.p.m. | 90.7 ft | 86.4 hp | 67.7 % | 453 kWh/US MG | 10.7 ft |
| 3 | 40 Hz | 699 US g.p.m. | 74.2 ft | 19.8 hp | 2100 US g.p.m. | 74.2 ft | 59.5 hp | 66.1 % | 388 kWh/US MG | 8.8 ft |
| 2 | 60 Hz | 1690 US g.p.m. | 129 ft | 76.1 hp | 3380 US g.p.m. | 129 ft | 152 hp | 72.5 % | 598 kWh/US MG | 20.9 ft |
| 2 | 55 Hz | 1500 US g.p.m. | 110 ft | 57.7 hp | 3000 US g.p.m. | 110 ft | 115 hp | 72.5 % | 510 kWh/US MG | 17.4 ft |
| 2 | 50 Hz | 1310 US g.p.m. | 93.5 ft | 42.9 hp | 2620 US g.p.m. | 93.5 ft | 85.8 hp | 72.3 % | 434 kWh/US MG | 14.4 ft |
| 2 | 45 Hz | 1110 US g.p.m. | 78.5 ft | 30.8 hp | 2230 US g.p.m. | 78.5 ft | 61.6 hp | 71.9 % | 370 kWh/US MG | 11.6 ft |
| 2 | 40 Hz | 904 US g.p.m. | 65.4 ft | 21.1 hp | 1810 US g.p.m. | 65.4 ft | 42.3 hp | 70.7 % | 321 kWh/US MG | 9.2 ft |
| Project | | | Project ID | | | Created by | | Created on | | Last update |
| | | | | | | | | 2014-12-17 | | |
| 1 | 40 Hz | 1250 US g.p.m. | 52.1 ft | 23 hp | 1250 US g.p.m. | 52.1 ft | 23 hp | 71.4 % | 255 kWh/US MG | 13.1 ft |

NP 3301 HT 3~ 464
Dimensional drawing



| | | | | |
|---------|------------|------------|--------------------------|-------------|
| Project | Project ID | Created by | Created on 2014-12-17 | Last update |
|---------|------------|------------|--------------------------|-------------|



* Dimension to inlet elbow flange.

** For concrete foundation dimensions, see drawing 768 50 00.

NT 3301.090, 095, 180, 185 HT

| WEIGHT (lbs) | | |
|--------------|------------|-------------|
| Pump | Stand unit | Inlet elbow |
| 1815 | 170 | 155 |

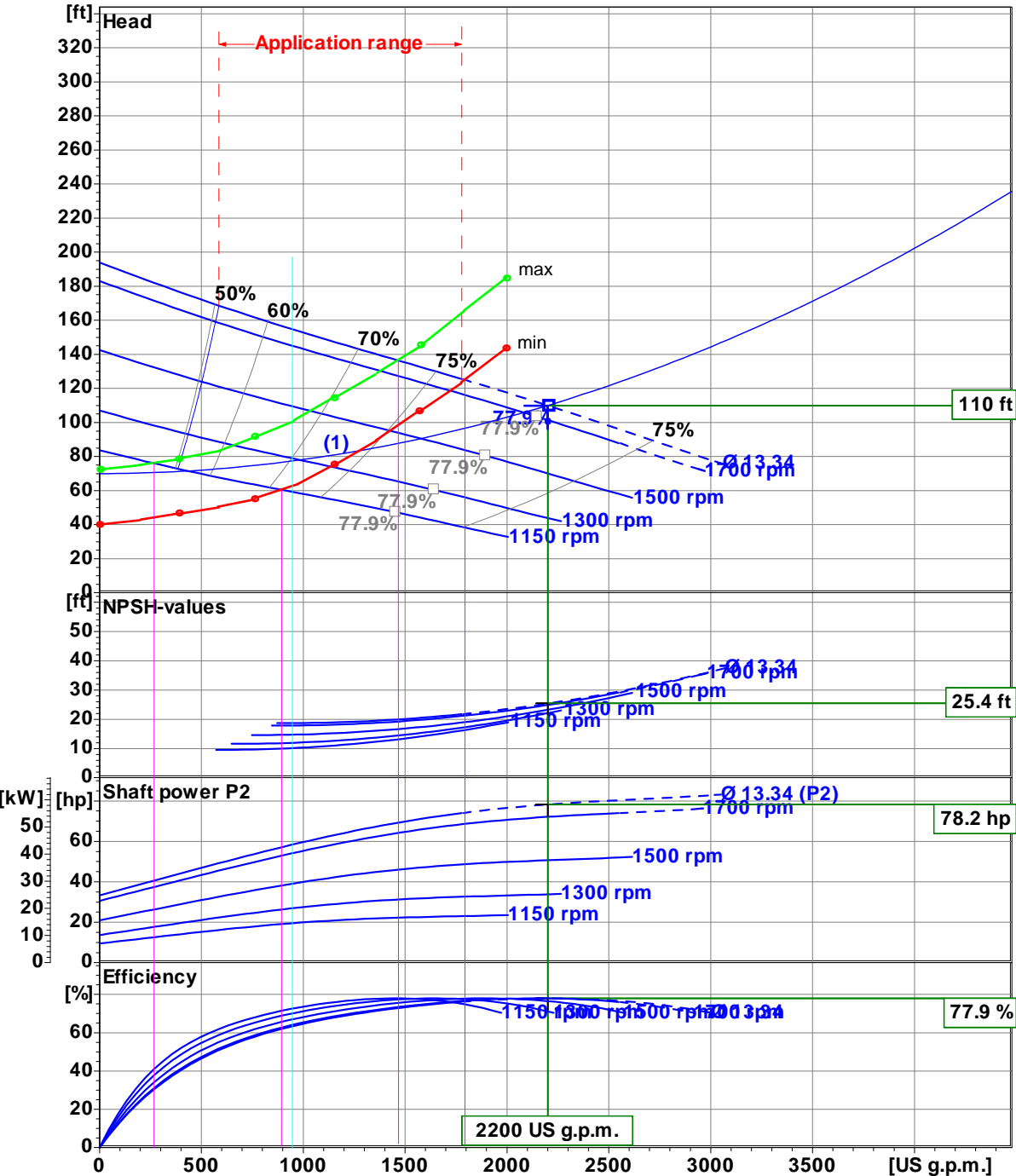


Denomination
Dimensional drwg
NT 3301.090,095,180,185 HT
ø10"/ø6"

| | | |
|-------------|------------|-------------|
| Drawn by JS | Checked by | Date 130703 |
| Scale | | Reg no 5399 |
| 7788600 | | 3 |

Performance curve

Pump typeKRT K 150-401/654XNG-D



| | | | | | |
|---------------|------------------------|-----------|----------------|-----------|------------|
| Impeller type | Multi channel impeller | | Curve number | K42589/3 | |
| Free passage | 3" | Density | 62.322 lb/ft³ | Frequency | 60 Hz |
| Impeller size | 13 3/8" (339) | Viscosity | 1.082E-5 ft²/s | Speed | 1750 1/min |

KSB Inc., Richmond, VA. / KSB Pumps Inc., Mississauga, Ontario / KSB AG, Halle (Germany)

| | |
|-----------------|---------------------------|
| Project | Mill Creek |
| Customer pos.no | |
| Project ID | Dry pit submersible pumps |
| Pos.no | |
| Created by | D. Weaver |



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2014-12-29

Data sheet

Pump type KRT K 150-401/654XNG1-D

Operating data

| | | | | | |
|--------------------|------|-----------|-------------|-----------|--------|
| Flow | 983 | US g.p.m. | Fluid | | |
| Head | 150 | ft | Density | 62.3 | lb/ft³ |
| Operating speed | 1750 | rpm | Viscosity | 1.08E-5 | ft²/s |
| Shaft power | 57.9 | hp | Temperature | 68 | °F |
| Efficiency | 64.3 | % | | | |
| Required pump NPSH | 18.7 | ft | | | |
| Head H(Q=0) | 190 | ft | | | |
| Application range | Head | | Flow | | |
| From | 165 | ft | 580 | US g.p.m. | |
| To | 117 | ft | 1930 | US g.p.m. | |

Design

| | | | |
|-----------------------------|--|----------------------|---|
| Make | KSB | Impeller type | Multi channel impeller |
| Design | Submersible pump | | Closed |
| Series | KRT K -D | Impeller size | (337) 13 ¹ / ₄ inch |
| Frame size | 150-401 | | Max. (404) 15 ⁷ / ₈ inch |
| Stages | 1 | | Min. (310) 12 ³ / ₁₆ inch |
| Curve number | K42589/3 | Free passage | 3 inch |
| | | Weight | 2120.8 lb |
| Type of bearings | Antifriction | | |
| Nos. of bearings | 2 / 1 | | |
| Lubrication | Grease lubrication, regreasing without dismantling of pump | | |
| Suction port | Pressure rating | CLASS 125 | |
| | Nominal pipe size DN0 | 10 inch | |
| | Nominal pipe size DN1 | 6 inch | |
| | Norm | ASME/ANSI B16.1 | |
| Discharge port | Pressure rating | CLASS 125 | |
| | Nominal pipe size DN2 | 6 inch | |
| | Nominal pipe size DN3 | --- | |
| | Norm | ASME/ANSI B16.1 | |
| Suction port: suction elbow | | discharge port: pump | |

Materials

| | |
|-------------------------|--|
| Pump casing | Grey cast iron EN-JL1040 (A 48 Class 35) |
| Discharge cover | Grey cast iron EN-JL1040 (A 48 Class 35) |
| Impeller | Duplex stainless steel EN-1.4517 (A 890 CD4MCu) |
| Shaft | Tempered steel EN-1.0503+N (A 576 Grade 1045) |
| Bearing bracket | Grey cast iron EN-JL1040 (A 48 Class 35) |
| Motor casing | Grey cast iron EN-JL1040 (A 48 Class 35) |
| Bolts, nuts | Stainless steel A4 (EN-1.4571) (A 276 Type 316) |
| Shaft protection sleeve | Stainless steel EN-1.4021+QT800 (A 276 Type 420) |
| Casing wear ring | Semi austenitic CrNi stainless steel VG 434 (A 890 Grade 5A) |
| Impeller wear ring | --- |
| O-Rings | Nitrile rubber (NBR) |

KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961

KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

Project
Customer pos.no
Project ID
Pos.no
Created by

Mill Creek
Dry pit submersible pumps
D. Weaver



Page 2 / 5
2014-12-29

Data sheet

Pump type

KRT K 150-401/654XNG1-D

Shaft seal

Type of seal
Arrangement:
Seal on medium side
Mechanical seal, pump-side
Mechanical seal, bearing-side

Double mechanical seal
Tandem
with elastomer bellows
Silicon carbide / Silicon carbide
Carbon / Silicon carbide

Monitoring

Thermal winding protection
Explosion proof protection
Motor housing monitoring
Mechanical seal leakage detection
Bearing temperature monitoring

By temperature sensitive switches or PTC

By conductive moisture sensor electrode
By float switch
By PT 100 thermistor

Coating

Preparatory treatment
Blasting method
Primer
Dry film thickness primer
Top coat
Solids content
Dry film thickness top coat
Colour

Sa 2 1/2 to ISO 8501-1 / ISO 12 944-4 DIN 55928, Part 4
Steel grit blasting
Zinc phosphate or Zinc dust
> 35 microns
2-component epoxy resin
> 82 %
> 150 microns
Ultramarine Blue (RAL 5002 to DIN 6174)

Installation

INSTALLATION

Type of installation:

Vertical dry pit installation of
submersible motor pump
DN 6

Discharge size:

Flange dimensions to:

ASME/ANSI B16.1, CLASS 125

Installation accessories:

Foundation rails for pump,
fasteners

SUCTION ELBOW – EXTENDED

Flanges: (DN0/DN1):

10 inch / 6 inch

Flange dimension to:

ASME/ANSI B16.1, CLASS 125

Minimum diameter of clean-out port:

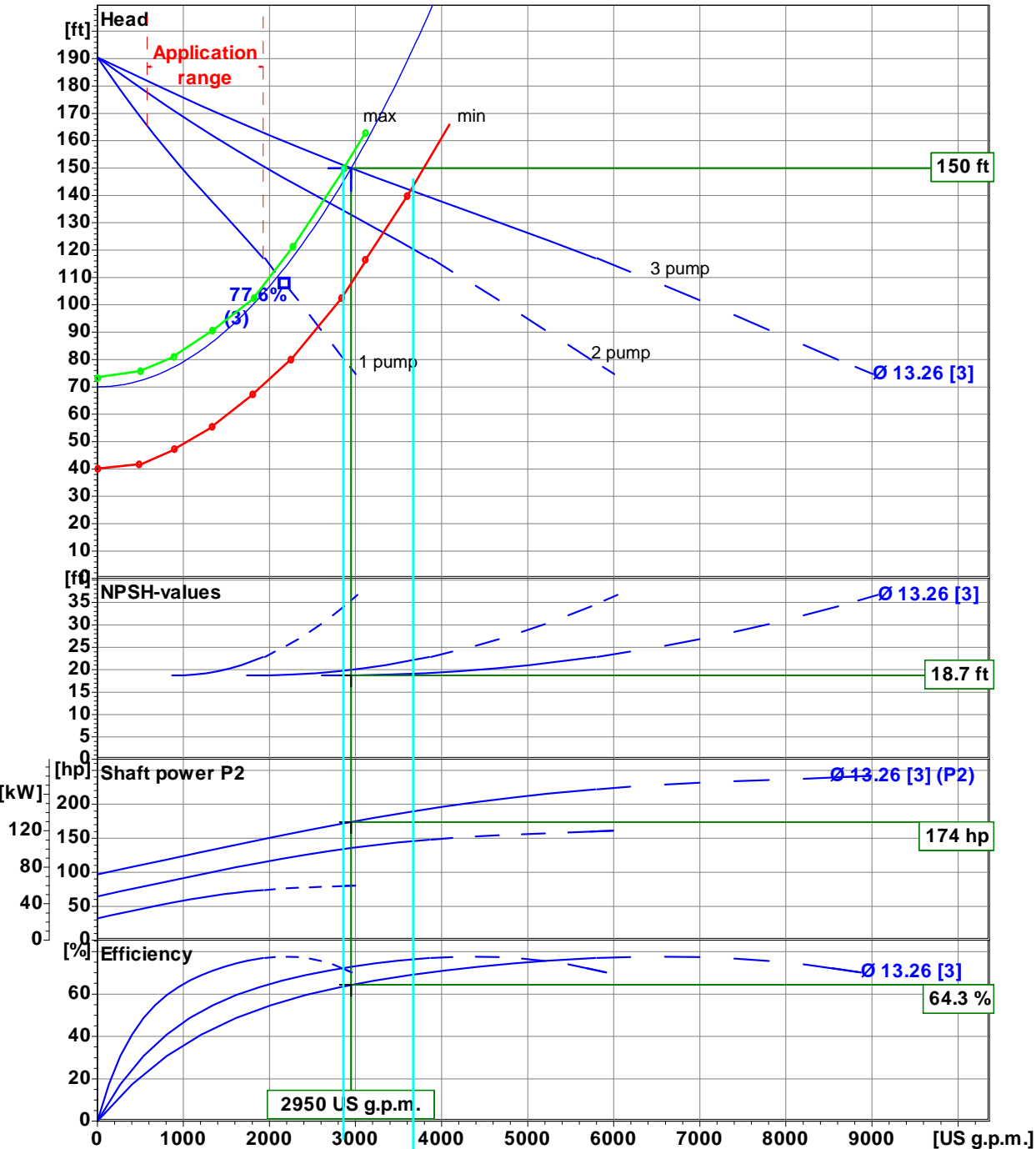
7 7/8 inch

Material:

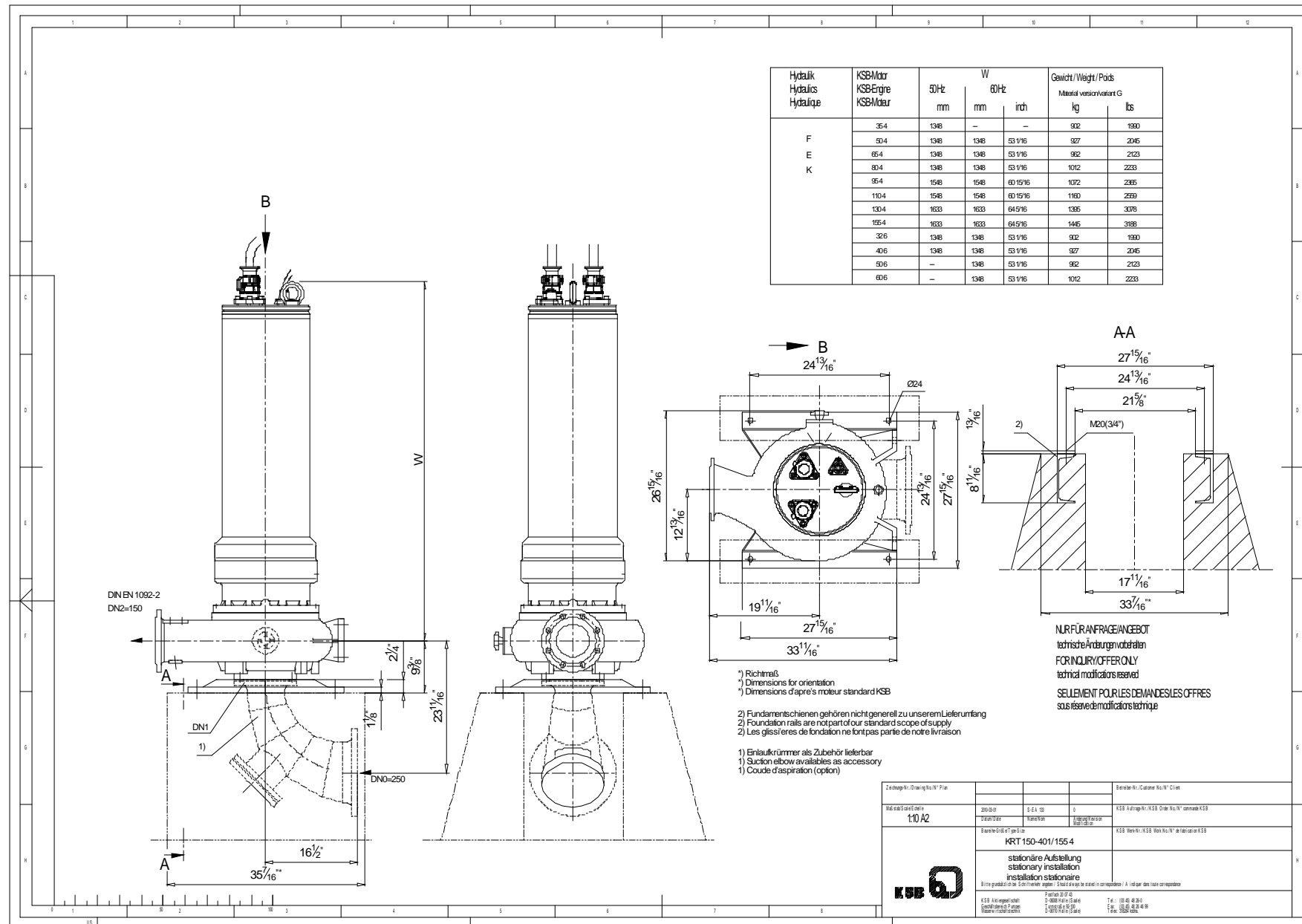
Grey cast iron EN-JL1040 (A 48 Class 35)

Performance curve

Pump typeKRT K 150-401/654XNG1-D



| | | | | | |
|---------------|------------------------|-----------|----------------|--------------|------------|
| Impeller type | Multi channel impeller | Density | 62.322 lb/ft³ | Curve number | K42589/3 |
| Free passage | 3" | Viscosity | 1.082E-5 ft²/s | Frequency | 60 Hz |
| Impeller size | 13 1/4" (337) | | | Speed | 1750 1/min |





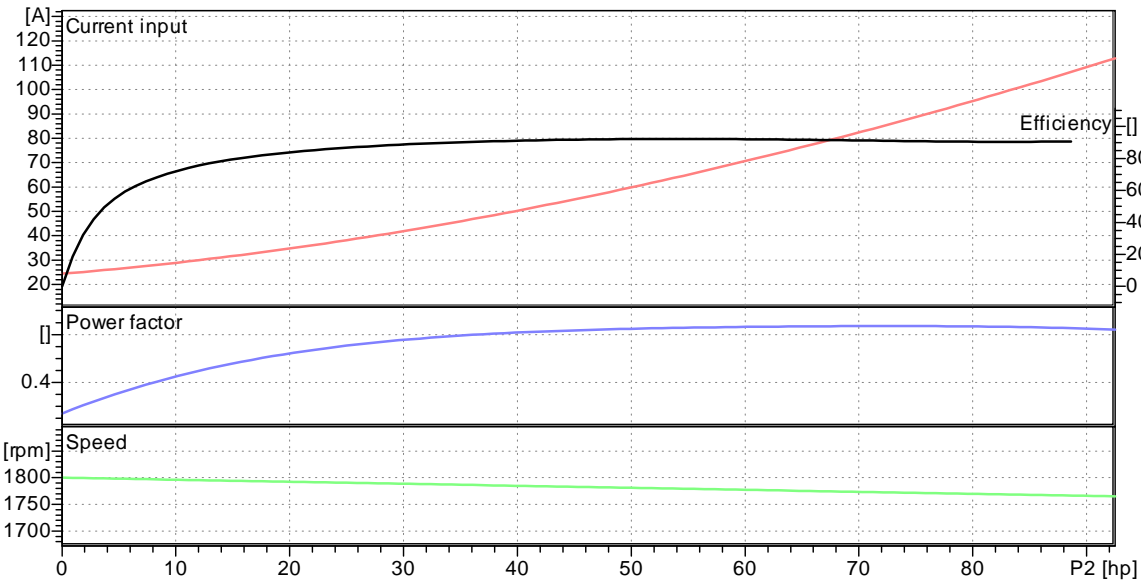
Data sheet: Motor data

Motor type654XNG K / D

| | | | | |
|----------------------|--|---------------------------|------|-----|
| Motor manufacturer | KSB Aktiengesellschaft | Rated voltage | 460 | V |
| Design acc. standard | - | Rated frequency | 60 | Hz |
| Service factor | 1.15 | Rated power P2 | 74 | hp |
| Degree of protection | IP68 | Rated current | 86.8 | A |
| Insulation class | H | Nominal speed | 1772 | rpm |
| Starting mode | Direct | NEMA code letter | G | |
| No. starts / h | 10 | Starting to rated current | 6.7 | |
| Coolant temperature | < / = 40 °C (104 °F) | Starting current | 582 | A |
| Motor casing | Grey cast iron EN-JL1040 (A 48 Class 35) | | | |
| Explosion protection | Class I, Div. 1, Groups C,D, T3 | | | |
| Pump type | KRT K 150-401/654XNG1-D | | | |

| Load | P1 kW | P2 hp | eta % | cos phi | I A |
|------|----------|----------|----------|---------|--------|
| 4/4 | 60.17 | 74.0 | 91.7 | 0.87 | 86.8 |
| 3/4 | 45.29 | 55.5 | 91.4 | 0.86 | 66.1 |
| 2/4 | 30.62 | 37.0 | 90.1 | 0.8 | 48.0 |
| 1/4 | 16.41 | 18.5 | 84.1 | 0.62 | 33.2 |

| | | | |
|---------------------|--------------------------------------|----------|-----------------|
| Main cable | 2 x AWG 7-4 | Diameter | 0.72..0.77 inch |
| Control cable | 1 x AWG 15-10 | Diameter | 0.63..0.67 inch |
| Cable, outer sheath | Waterproof synthetic rubber compound | | |
| Cable length | 10 m | | |



APPENDIX E
FORCE MAIN MEMORANDUM &
FORCE MAIN REPLACEMENT ALTERNATIVES
MEMORANDUM

| | | | |
|----------|--|--------------|------------------|
| TO: | Pete Clark | DATE: | October 29, 2013 |
| FROM: | Chris Dwinal, Kattie Collins | PROJECT NO.: | 12776A |
| SUBJECT: | Town of Falmouth, Maine Mill Creek Pump Station Upgrade – Preliminary Design Force Main Assessment | | |

Over the past few years, the Town has expressed concern about the age and failure potential of the existing 42-year old, 14-inch diameter force main that conveys flows from the Mill Creek Pump Station directly to the water pollution control facility (WPCF). Therefore, as part of the Mill Creek Pump Station Upgrade preliminary design, Wright-Pierce was tasked with evaluating the impacts that increased operating pressures and velocities from an upgraded pump station would have on the existing force main. The following memorandum presents a brief background of the existing force main, an assessment of its condition based upon readily available information (not including any field investigations), possible force main replacement alternatives and costs, and recommendations.

I. BACKGROUND

The Mill Creek Pump Station pumps into a 14-inch diameter force main that conveys flow directly to the WPCF. The force main is approximately 1.3 miles long. From the pump station, the force main travels cross-country along Mill Creek and Webes Creek, then behind Shaw's Plaza where it intersects Depot Road, then continues cross-country behind Skillin's Greenhouse where it crosses Route 1 and continues down Clearwater Drive to the WPCF. Figure 1 shows the route of the force main. Based upon as-built drawings and information from Town staff, the force main is ductile iron (DI) on the pump station property and then transitions to asbestos cement (AC) before traveling to the WPCF.

II. CONDITION ASSESSMENT

The force main is an essential asset as Mill Creek Pump Station is the largest pump station in the Town. It collects over 50% of the average daily flows treated at the WPCF and 100% of the flows from Cumberland. Additionally, failure of the force main may result in significant environmental damage due to the proximity to Mill Creek and Webes Creek. As such, the dependability of the force main is vital to the Town.

From the 1940s to the 1970s, AC pipe was commonly used in potable water, sanitary sewer and storm drain applications as it was light and relatively easy to handle, had lower friction losses due to the smooth interior surface, and was purported to be extremely corrosion resistant. The useful life of AC pipe is reported to range from 40 years to 80 years with statistics showing a rapid increase in failure rate after about 50 years. One source indicated failure rates may be as

high as one per year per mile of pipe after 50 years.¹ Additionally, studies show that aggressive soils or the presence of hydrogen sulfide from wastewater do cause chemical leaching of the cement used in AC pipe, which significantly reduces the structural integrity.

Based on a review of available information and discussions with the Town and a representative from the engineering firm that designed the original pump station and force main, the following is known:

- Age: Approximately 42 years old.
- Pressure: Based on information provided by Ralph Oulton, who worked for E. C. Jordan at the time the pump station was constructed, the AC portion of the force main is Class 150 pipe which has a design operating pressure rating of 150 pounds per square inch (psi).
 - Operating Pressure: Flow testing completed on September 25, 2013 indicates that the existing pumping system can generate a peak operating pressure of approximately 36 psi with one large and one small pump operating (maximum capacity of the station). The future peak operating pressure is estimated to be approximately 74 PSI. As operating pressures dissipate over the length of the force main, the pipe closest to the pump station will see the greatest operating pressures. Both existing and future peak operating pressure conditions are well within the original pressure rating of the force main.
 - Surge Pressure: Peak surge pressure (i.e. water hammer) is estimated to be approximately 200 psi under existing conditions and up to 350 psi under future conditions. Information is not available on the transient pressure rating for Class 150 AC pipe; however, pipes are typically designed for surge pressures equal to the rated pressure multiplied by factors of 1.5 to 2.0. As such, it is not unreasonable to assume that a Class 150 AC pipe in good condition would be capable of handling the existing surge pressure. However, the future surge pressure will likely exceed the rating of a Class 150 AC pipe.
- Velocity: At current average and peak flow rates, velocities in the pipe range from approximately 0.8 feet per second (fps) to 3.5 fps. At recommended future average and peak flow rates (710 gpm and 2,850 gpm, respectively); velocities in the pipe will range from approximately 1.5 fps to 5.9 fps. The ideal and recommended range of velocities in a force main is 3.5 to 5 fps, with a minimum of 2 fps recommended at average daily flow in order to prevent solids deposition. At current average flows, velocities are significantly lower than desired to minimize solids deposition in the force main, and at current peak flows, velocities are on the low end of the recommended range. At the future average flow rate, the velocity will still be below the recommended minimum of 2 fps; and at the future peak flow rate, the velocity will be slightly above the recommended range but still well within the capabilities of pipe in good condition. As such, current and future projected velocities are not expected to structurally impact the existing force main assuming the pipe is in good condition.
- Friction Loss: Flow testing completed on September 25, 2013 indicates that the friction factor (C factor) for the force main is in the range of 100 to 110. Typical textbook C factors

¹ Williams, G. Eric and Von Aspern, Kent; *Asbestos Cement Pipe: What If It Needs to be Replaced?*

for new cement-lined DI pipe range from 110 to 140 and for new AC pipe range from 140 to 160. The discrepancy between the estimated C factor of the existing pipe vs. typical design C factors may be a result of a number of factors such as:

- The interior of the pipe may be damaged from age, corrosion, poor construction, etc.
- Based on flows to the pump station from January 1, 2011 to July 23, 2013, it is very likely that there has been some level of sediment build-up over the life of the force main. An analysis of flow distribution indicates that the velocity in the force main is less than 2 fps almost 99% of the time. Peak flows during wet weather events may provide some level of solids flushing; however, these events occur infrequently.
- Operating Environment: There is no data available at this time on the aggressiveness of the soils along the force main route. Aggressive soils can have varying characteristics, but common features of soils that can attack pipes include acidic soils, soils with high chloride levels, soils with high sulfate levels and poorly aerated soils. Given that a portion of the force main is installed alongside a brackish/saltwater creek, one or more of the above conditions could be present. The wastewater conveyed by the force main is typical of residential and commercial sanitary waste. Although the drawings indicate that the force main was installed at a positive slope from the pump station to the WPCF, the formation of air pockets (i.e. presence of hydrogen sulfide and increased potential for corrosion) is a possibility.
- Historic Failures: There have been no failures recorded to date.

III. ALTERNATIVES

Determining the length, diameter and friction factor of any force main is a necessary and critical part of pump selection and the Mill Creek Pump Station and force main is no exception. Given the above preliminary condition assessment of the force main, a decision will need to be made to either re-use the existing force main (after additional investigations detailed later in this memorandum) or to completely or partially replace the force main. The following is a brief discussion of the pros and cons of each alternative.

Although it appears to be possible to re-line or burst the existing force main, these alternatives are not presented herein. Based on preliminary discussions with pipe re-lining and bursting companies, the cost for these alternatives will likely be extremely high due to bypass pumping requirements, permitting and accessibility issues. Additionally, the Town would continue to have a force main that they could not easily access for monitoring, maintenance and repairs; and the force main would still be located adjacent to environmentally sensitive resources. For the same reasons, replacement of the force main in place is not presented herein.

Alternative 1: Re-Use of the Existing Force Main

This alternative would involve re-using the existing force main with modifications to the yard piping at the pump station only as needed to connect to the new station. The pros and cons of this alternative are as follows:

| Pros | Cons |
|---|--|
| <ul style="list-style-type: none"> It is the least expensive alternative now, but the force main will still likely need to be replaced in the future due to age. To date, the force main has been able to handle operating and surge pressures. However, as sewer growth continues in Falmouth and Cumberland, pressures will increase and subject the force main to conditions which may lead to failure. The timeline for replacement would depend upon how many failures occur under increased operating and surge pressures. | <ul style="list-style-type: none"> Due to the age and the possibility for deterioration of the force main, the potential for failure is high. This could lead to expensive repairs on an inaccessible force main, permit violations, and environmental damage. This potential will only be greater under future operating pressures. The existing force main may not be capable of handling the surge pressures under future conditions. Wright-Pierce has recently assisted a community in NH that has had several failures of a DI force main due to surge pressure. There is minimal access to over half the length of the force main, and the section that is expected to fail the soonest due to pressures and soils is the least accessible. There are increased friction losses due to the low friction factor which will require larger pumps to deliver the recommended design flow for the pump station. |

If the Town chooses to continue using the existing force main, additional investigations are strongly recommended to further assess the condition of the pipe. Unfortunately, there is no single method that will definitively determine the condition of the force main. Some potential alternatives are as follows:

- Soil and Groundwater Analysis: Soil and groundwater samples would be taken from a number of locations along the force main to determine the presence of aggressive soil and/or groundwater conditions.
- Coupon Sampling: A 4½-inch long length of the force main (full diameter preferable, but could use partial diameter) would be removed for laboratory analysis to establish wall

thickness, strength, extent of corrosion (if applicable), etc. The downside of this option is that it would only provide the condition at one point along the force main.

- CCTV Inspection: The force main could be drained, cleaned and CCTV inspected. The volume of the force main is approximately 55,000 gallons; so provisions would need to be made to deliver this volume to the plant after draining the line and to provide for bypass pumping during the draining, cleaning and TV inspection. The cleaning and inspection would only show the most obvious types of defects such as presence of significant solids deposition, damaged joints, eroded pipe surface, etc. As the pipe would be completely wet from use and cleaning, cracks may be difficult to see. Inspection of the entire force main would be cost prohibitive due to requirements for bypass pumping and accessibility issues; however, the first 600 linear feet of the force main near the pump station could be inspected for approximately \$10,000 to \$20,000.
- Internal Acoustic Inspection: Technology is available which allows an internal acoustic analysis of a pipe to identify and locate leaks and gas pockets. A probe would be inserted into a check valve at the pump station and would flow along the length of the force main to the WPCF where it would be collected from the influent channel. Sensors would be placed at the beginning and end of the force main and near the midpoint to locate the probe as it moves along the force main. Based on the number and location of leaks and/or gas pockets, the area at each defect could be excavated and further analysis performed on the force main (e.g. visual inspection of pipe interior, soils and groundwater analysis, wall thickness testing). The cost of the acoustic analysis alone would be approximately \$60,000; any excavation and analysis of defects would be an additional cost.

Alternative 2: Complete Replacement of the Force Main

This alternative would involve constructing a completely new force main. Figure 1 shows two potential routes. The force main would travel southwest on Foreside Road (Rt. 88), then northwest on Depot Road. From Depot Road, the force main could either follow the existing route to the southwest along Webes Creek to Rt. 1 and Clearwater Drive or it could continue up Depot Road and travel south on Rt. 1 to Clearwater Drive (these options are highlighted orange and green on the figure, respectively). The new force main would be 1.34 to 1.50 miles long depending on the selected routing. The pros and cons of this alternative are as follows:

| Pros | Cons |
|---|--|
| <ul style="list-style-type: none"> • The revised route would provide greater accessibility for monitoring, maintenance and repair. • The new force main would be designed to handle future operating and surge pressures and velocities. • The potentially longer force main would increase total dynamic head; however it may be balanced out by a smoother interior surface. • The portion of the force main in Route 1 could be constructed as part of the Route 1 revitalization project. | <ul style="list-style-type: none"> • It is the most expensive alternative (approximately \$1,200,000 to \$1,400,000 for engineering and construction depending on the route²). |

Alternative 3: Partial Replacement of the Force Main

This alternative would involve replacing only a portion of the existing force main. It has been assumed that the new portion of the force main will travel southwest down Foreside Road (Rt. 88) and northwest on Depot Road where it would connect to the existing force main at Webes Creek. Approximately 0.7 miles of new force main would be constructed. The pros and cons of this alternative are as follows:

| Pros | Cons |
|---|--|
| <ul style="list-style-type: none"> • The revised route would provide greater accessibility for monitoring, maintenance and repair. • The portion of the force main closest to the pump station is at the highest risk for failure due to the higher operating pressures and the potential for corrosion due to brackish groundwater adjacent to the tidal creek. Replacement of this section would provide increased reliability. | <ul style="list-style-type: none"> • It would cost approximately \$650,000 for engineering and construction². • The remaining AC pipe may not be capable of handling the surge pressures under future conditions. |

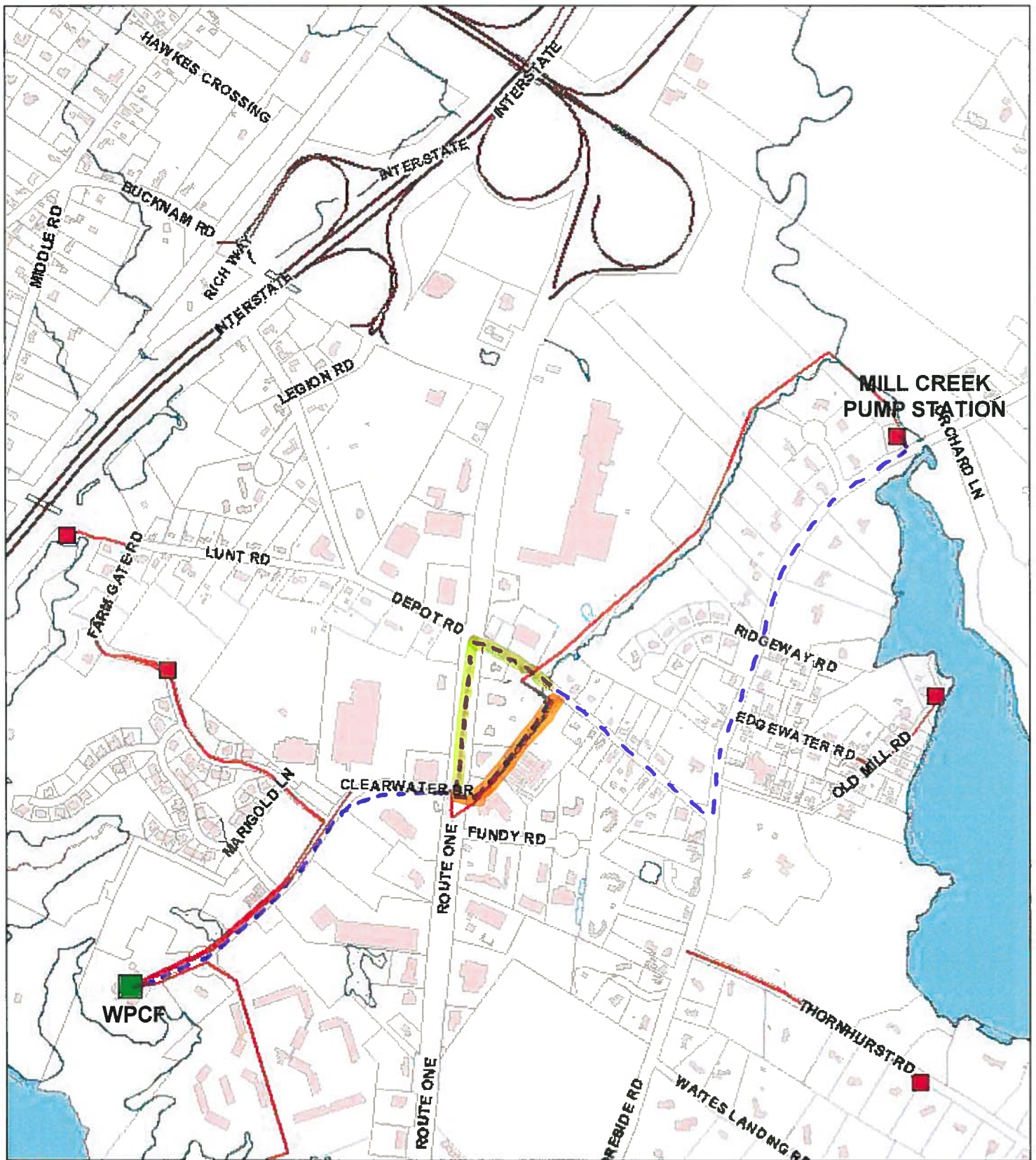
² This cost is based on a single force main; however the Town may wish to consider installing parallel force mains to increase the operating velocity in the pipe and minimize the potential for solids deposition.

- The smoother interior surface of the new pipe will reduce the total dynamic head which will require smaller pumps to deliver the recommended design flow for the pump station.

IV. RECOMMENDATIONS

The Mill Creek Pump Station force main is a vital asset to the Towns of Falmouth and Cumberland. When the Mill Creek Pump Station is upgraded to a higher capacity, it will increase the risk of failure and will make the existing force main a “weak link in the chain.” Due to the unknown condition of the existing force main and the uncertainty of the capability of Class 150 AC pipe to handle the future surge pressure, it is recommended that the Town replace the force main as part of the Mill Creek Pump Station Upgrade. As the cost of replacing the entire force main is high, it is possible to replace the force main in two phases. During the first phase of replacement (from the pump station to the crossing at Depot Road), samples of the removed pipe could be analyzed to evaluate the condition of the remaining pipe and to determine whether or not it would be capable of handling future surge pressure. The analysis could include structural testing to determine strength, wall thickness, etc. and chemical testing to determine the extent of cement leaching. If it is determined that the pipe is in poor condition or could not handle the future surge pressure, the second phase of the force main replacement could be accelerated and the pump station could be flow-limited in the meantime to reduce surge pressure.

Once the Town has had an opportunity to review this memorandum, we would like to schedule a meeting to discuss the content and to develop a strategy to move forward with the preliminary design of the pump station upgrade. A decision on the force main is critical to selecting the appropriate pumps, electrical service, and generator and to establishing the proposed footprint of the pump station to allow site layout to progress.



Town of Falmouth, Maine

Figure 1: Force Main Route

- EXISTING FORCE MAIN ROUTE
- PROPOSED FORCE MAIN ROUTE

CDM

consulting engineering construction operation

| | | | |
|----------|---|--------------|--------------|
| TO: | Pete Clark, Town of Falmouth | DATE: | May 16, 2014 |
| FROM: | Chris Dwinal, Kattie Collins | PROJECT NO.: | 12776C |
| SUBJECT: | Town of Falmouth, Maine Mill Creek Pump Station Upgrade Force Main Replacement Alternatives | | |

Over the past few years, the Town has expressed concern about the age and failure potential of the existing 42-year old, 14-inch diameter force main that conveys flows from the Mill Creek Pump Station directly to the Water Pollution Control Facility (WPCF). As part of the preliminary design of the Mill Creek Pump Station upgrade, Wright-Pierce evaluated the impacts that increased operating pressures and velocities from an upgraded station would have on the existing force main. Due to the age of the force main, the materials of construction, the unknown condition, the proximity to protected environmental resources, and the cost associated with assessing the condition of the pipe, it was determined that some level of force main replacement should be included in the upgrade of the Mill Creek Pump Station.¹

As such, Wright-Pierce has been tasked by the Town with identifying and assessing the available force main routing alternatives. The following memorandum summarizes the alternative routes considered, including a discussion of pros and cons and cost for each alternative, and provides recommendations for supplemental investigation of the preferred routes. The routes considered were reviewed with key Town staff in advance of evaluation and the Town provided available archived information for each alternative routing to assist in this evaluation.

I. ALTERNATIVE ROUTES

Seven new and unique force main route alternatives were developed for consideration, which are depicted in Figures 1 through 7 in Appendix A. In order to improve accessibility over the existing force main route, the new route alternatives were kept within existing road rights-of-way with the exception of three short, cross-country runs for some alternatives.

Initially, the existing force main route was not going to be considered for the new force main due to accessibility issues and potential environmental impacts. However, the cost estimates for the alternative routes was higher than expected and the existing route was added as an alternative to determine how the costs would compare to the alternative routes. Figure 8, in Appendix A shows the existing force main route.

¹ For additional information on the existing force main and the findings of the conditions assessment, refer to the memorandum by Wright-Pierce, entitled “Town of Falmouth, Maine, Mill Creek Pump Station Upgrade – Preliminary Design, Force Main Assessment” and dated October 29, 2013.

A few key considerations regarding the routes are as follows:

- All of the new alternative routings require installation of a portion of the force main in Foreside Road (Rt. 88). Because there significant underground utilities within the right-of-way, survey is required to positively establish the location of other utilities and the potential for installation of the force main outside of the paved way. As such, it has been assumed that installation would occur under the existing paved surface as a worst-case scenario for cost estimating until survey can be completed. Rt. 88 was originally a 10 inch thick by 20 foot wide concrete road and the concrete still remains beneath the existing asphalt surface. If Rt. 88 was a Maine Department of Transportation maintained highway, the Town would be required to replace the concrete in kind along the length of any pipe trench in addition to the typical 4 to 5 inches of pavement. Because the Town owns and maintains the portion of the road affected by the force main, the Town may wish to consider replacing the 10-inch concrete base within the trench with four inches of gravel and six inches of asphalt to reduce cost while minimizing the potential for differential settlement. This approach has been assumed in order to prepare the attached cost estimates.
- Alternatives 1, 2 and 3 require installation of a portion of the force main in Mussel Cove Lane. Mussel Cove Lane is currently a private road belonging to a homeowner's association. Further, the easement between the end of Mussel Cove Lane and Depot Road (19 Depot Road) containing the gravity sewer which serves the Mussel Cove Lane development also belongs to the homeowner's association. Although the road was constructed to Town standards, the homeowner's association has not requested acceptance by the Town to date. If one of alternatives that travel along this road is selected, the Town will either need to accept the road and the 19 Depot Road easement, or the Town will need to acquire an easement for both Mussel Cove Lane and 19 Depot Road. Further, since Mussel Cove Lane has recently been repaved, the cost estimates for Alternatives 1 through 3 assumed complete overlay paving for the wearing course.
- Two options were considered for the existing route – complete replacement of the force main (Alternative 8A) or relining the force main with a sleeve (Alternative 8B).²
 - Complete replacement of the force main would include installation of a parallel force main pipe adjacent to the existing pipe to allow the existing force main to be used during construction. The existing force main would be abandoned in place once the new one was operational.
 - Relining the force main could be completed in about 12 sections. Access pits would be dug at the ends of each section (13 total) which would allow cleaning and initial TV inspection to identify any potential problems, installation of the new sleeve, and

² The option to burst the existing force main and pull a new pipe through in its place was also considered and a proposal to do the work was requested from a local pipe bursting company. However, the company indicated that they did not feel that bursting was the most practical approach due the issues with the accessibility and environmental.

final TV inspection to confirm installation. During the relining, bypass pumping would be required from the pump station to the wastewater treatment facility with temporary pumps and force main piping.

In addition to the figures depicting the potential force main routes, key information for each alternative is summarized in Table 1, in Appendix B, as follows:

- Approximate total length
- Elevation of highest point along the route (the force main will exit the proposed pump station at approximately El 9.0 and enter the influent channel at the WPCF at approximately El 36.0)
- Differential operating horsepower due to differences in total dynamic head conditions
- Easements required
- Areas where ledge is present or areas where data on ledge is unavailable
- List of major utility crossings (20-inch diameter and greater)
- Areas where there are protected resources (i.e. streams or wetlands)
- Other miscellaneous considerations
- Estimated project cost

The pros and cons of each alternative are summarized in Table 2 in Appendix B.

Property owners were contacted to discuss potential easements for the eight properties that would be impacted by the new force main route alternatives. Table 3, in Appendix B, summarizes property owner preferences and concerns gathered from the preliminary easement discussions. Note that the three or four property owners that would be impacted by the temporary access required for Alternative 8B were not contacted as part of this evaluation.

For ease of reference, the capital cost for each alternative is summarized below as well as in Table 1.

| Alternative | Capital Cost |
|-------------|--------------|
| 1 | \$1,880,000 |
| 2 | \$1,660,000 |
| 3 | \$1,740,000 |
| 4 | \$2,170,000 |
| 5 | \$1,950,000 |
| 6 | \$2,010,000 |
| 7 | \$2,150,000 |
| 8A | \$2,010,000 |
| 8B | \$1,500,000 |

II. CONCLUSIONS AND RECOMMENDATION

Based on the information presented in this memorandum, Wright-Pierce recommends that the Town move forward with survey, geotechnical investigations and wetlands delineation for Alternative 2. The following is a brief summary of key conclusions:

- Alternative 1 is the third shortest route and the fourth lowest cost alternative. It includes almost 1,000 linear feet of new pipe in Route 1. As there are shorter, less expensive alternatives and due to the impacts construction of this pipe would have on the current Route 1 reconstruction project, this alternative is not recommended.
- Alternative 3 is the second shortest route and has the third lowest estimated cost. From a hydraulic perspective, it is preferred over Alternatives 4, 5, 6 and 7 as it has a lower high point along the force main route. However, more easements will be required for this alternative than Alternative 2 and the easements may be more complicated and/or costly due to the impact on operations and utility conflicts of the Skillins greenhouse property at 26 Depot Road and the existing drainage swale maintenance issue at 3 Fundy Road.
- Alternatives 4, 5, 6, and 7 are the longest and most costly alternatives evaluated and would all have a higher intermediate high point along the force main than the other routes. The higher costs are due to the longer routes and to the additional cost associated with restoring the 10-inch thick concrete slab beneath Route 88 as noted in Appendix A. Alternative 4 would also have the same impacts to the Route 1 reconstruction project as Alternative 1. As such, these four alternatives are not recommended.
- Alternatives 8A or 8B would provide the most favorable hydraulic conditions as the force main could be installed at a continuous slope from the pump station to the wastewater treatment facility. However, due to the significant environmental resource impacts that would be caused by reconstruction along the existing route, cost, concerns with the feasibility of accessing the entire route for construction, and continued difficulty with long term access for operation and maintenance, Alternative 8A is not recommended. Additionally, although Alternative 8B is the lowest cost alternative and would have less impact on environmental resources than Alternative 8A, there are serious concerns about the feasibility of construction access, the impacts of reducing the internal diameter of the force main by relining, and the continued difficulty with long term access for operation and maintenance. Finally, the cost estimate for Alternative 8B has been based on the best available data gathered from record drawings, visual inspection of the route and conversations with a relining company; however costs could be significantly impacted by findings of topographical survey data if slopes in targeted access areas are too steep or of geotechnical investigation if poor soils are identified. Therefore, Alternative 8B is not recommended.

Alternative 2 is the shortest route and has the second lowest estimated cost. Similarly to Alternative 3, it is preferred over Alternatives 4, 5, 6 and 7 from a hydraulic perspective, as it has

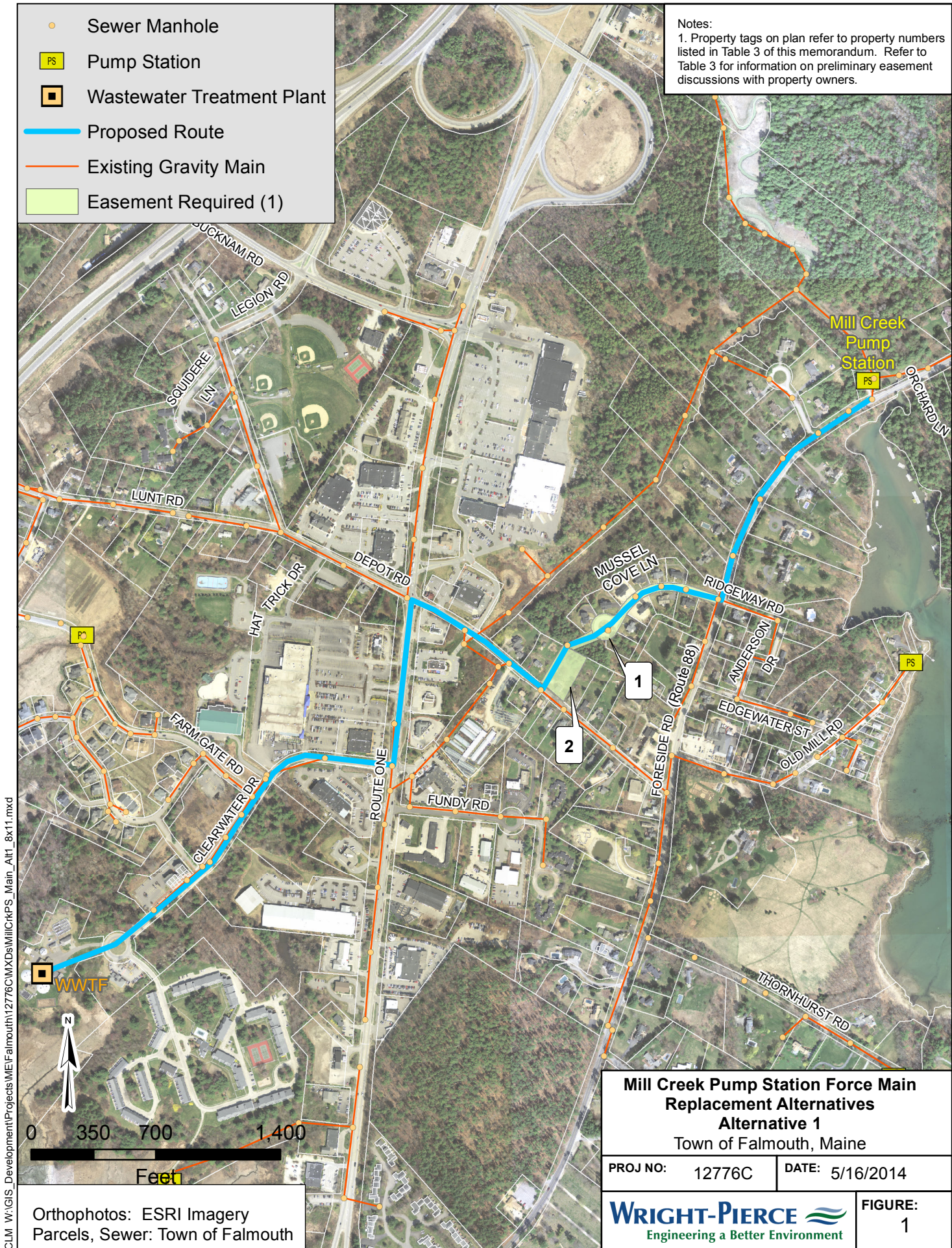
Memo: Pete Clark, Town of Falmouth – Force Main Replacement Alternatives
May 16, 2014
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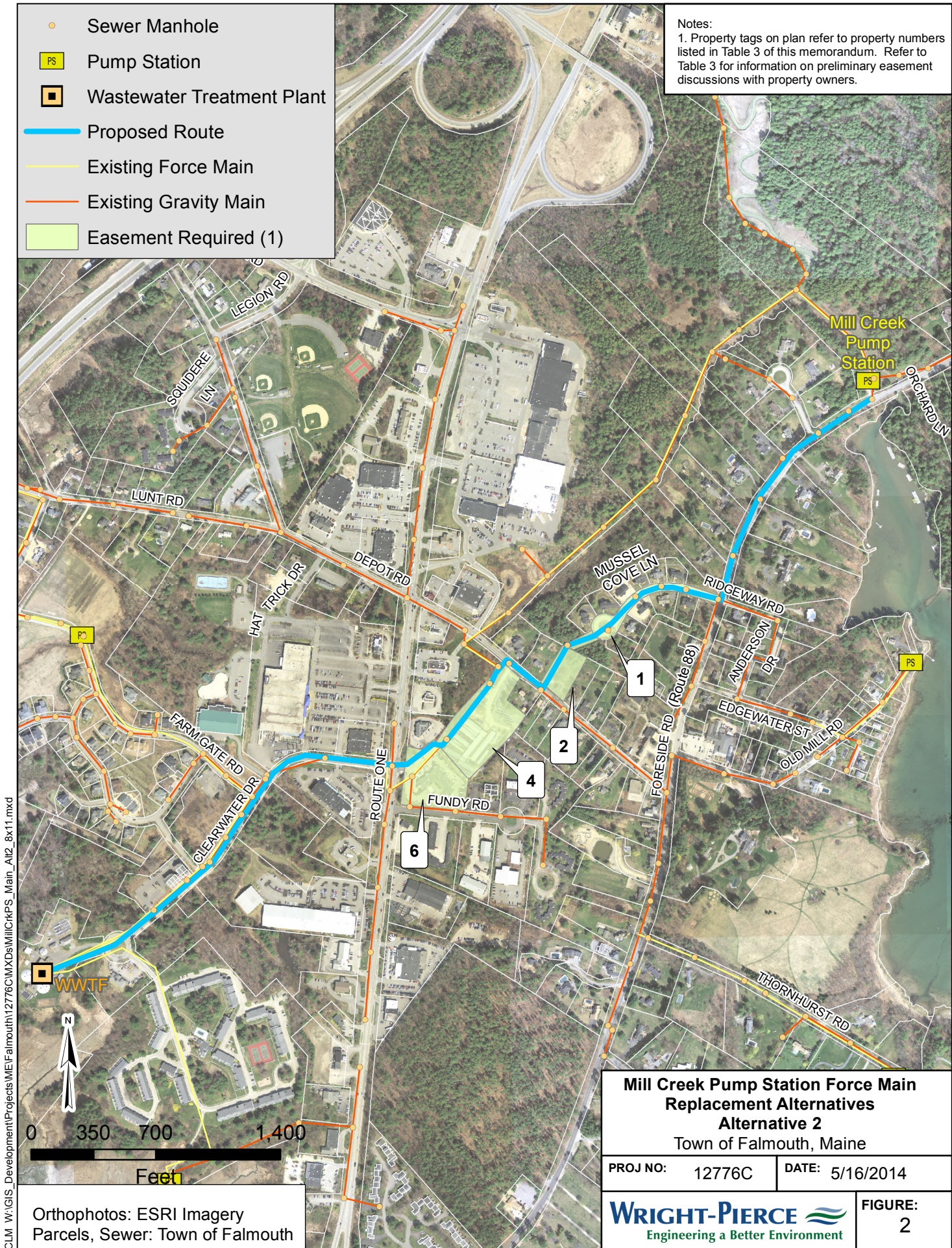
a lower high point along the force main route. Although environmental permitting will likely be required for the section of force main along Webes Creek between Depot Road and Rt. 1, it is expected that it would be a straightforward application process as it would be adjacent to the existing force main and gravity interceptor. The Town will also need to continue discussions with property owners of Mussel Cove Lane and 19 Depot Road to determine if easements will be required or if the Town will accept ownership of Mussel Cove Lane and the 19 Depot Road easement. At a minimum, Wright-Pierce recommends contacting the residents to discuss this final recommendation before conducting the additional investigations.

If the Town is in agreement with this recommendation and once the issue of easements has been addressed, the next step will be to perform topographical survey, geotechnical investigations and wetlands delineation along the proposed route. The estimated cost for these additional investigations is \$_____.

Pete – Once we get the Town's buy-in on the proposed alternative, we can contact the various subcontractors to get estimates for the additional investigations.

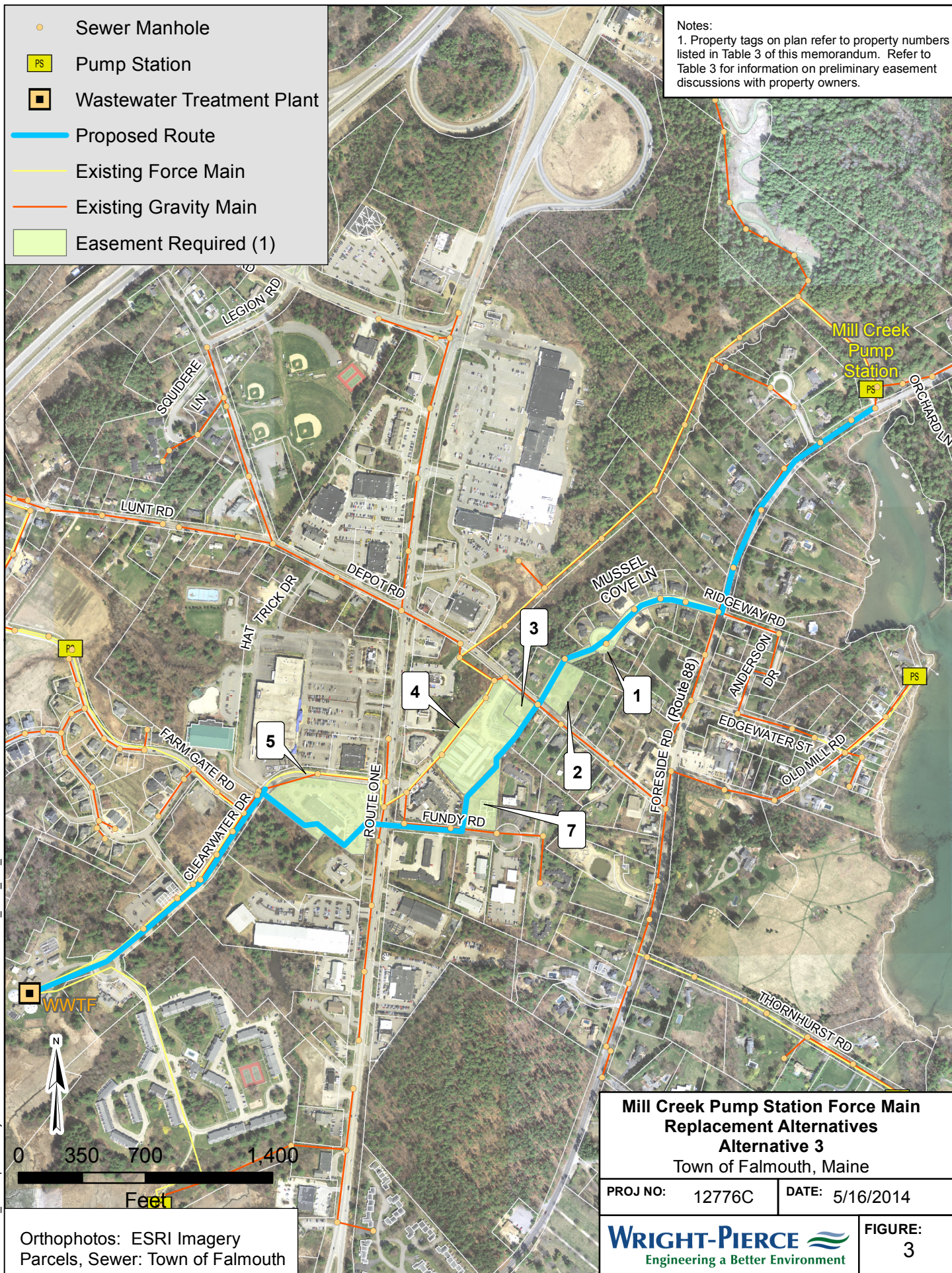
APPENDIX A
Figures 1 through 8
Proposed Force Main Alternative Routes



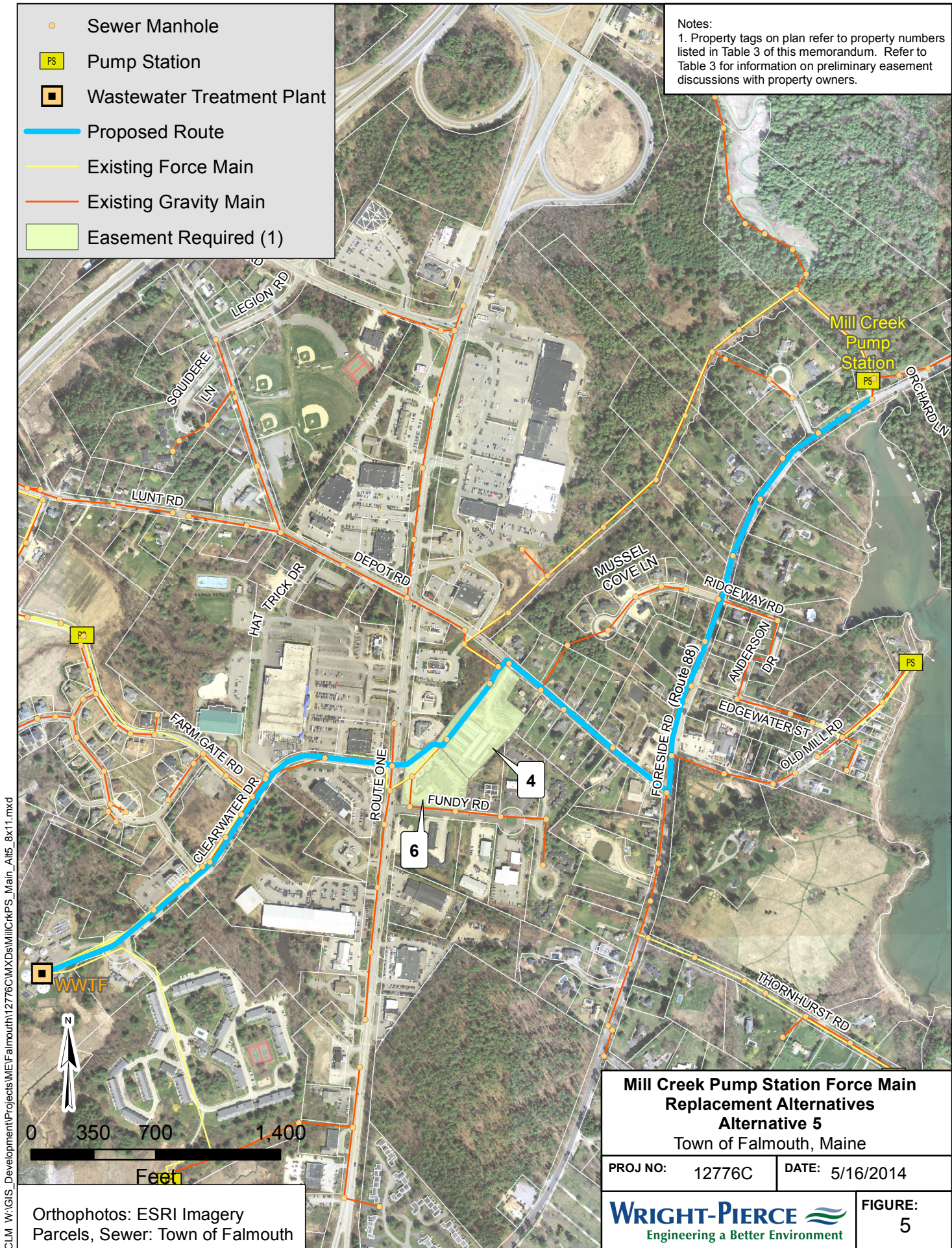


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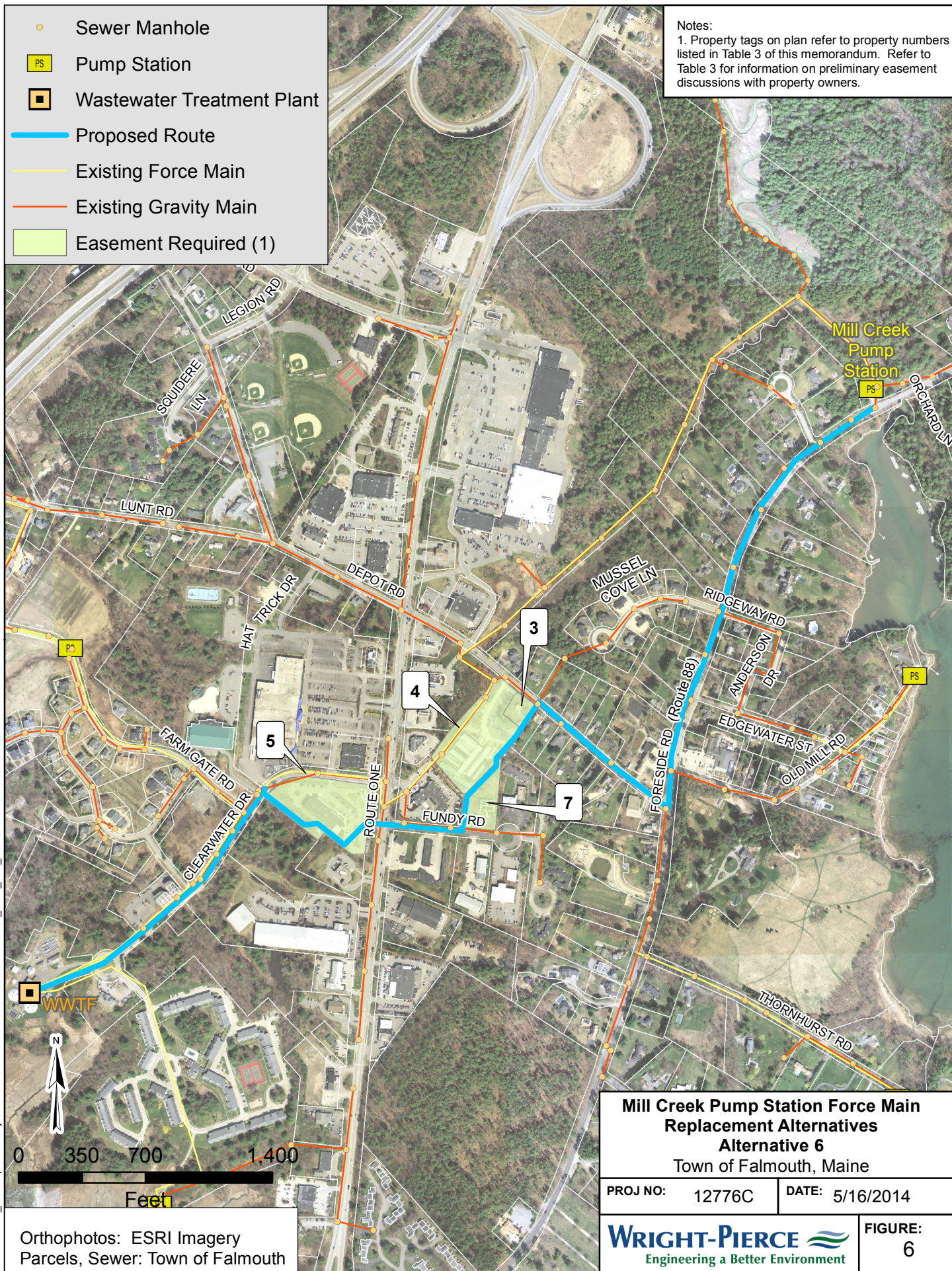






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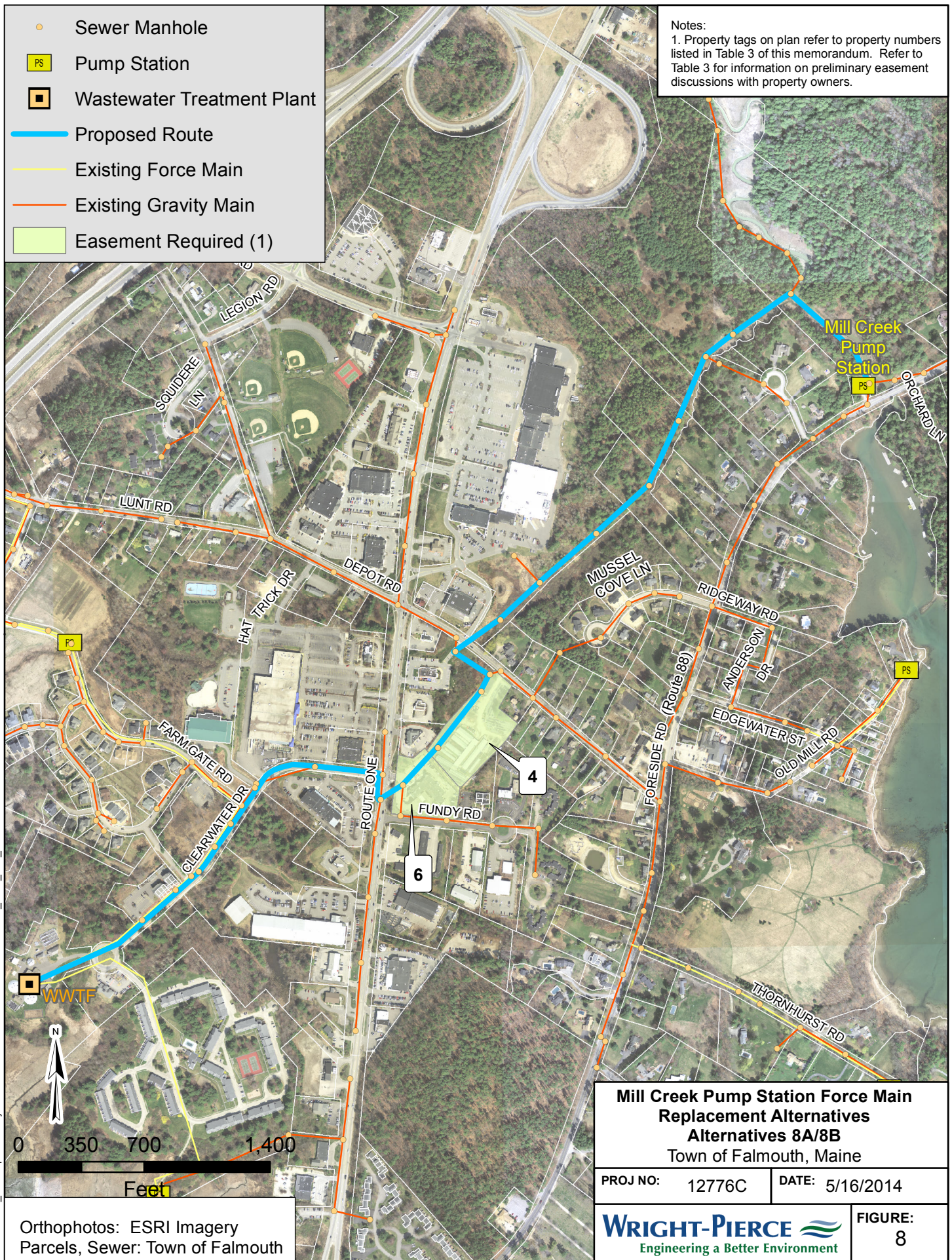
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APPENDIX B

Tables 1: Summary of Force Main Alternatives Information

Table 2: Summary of Pros and Cons

Table 3: Summary of Easement Discussions

TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION - FORCE MAIN REPLACEMENT ALTERNATIVES

TABLE 1: SUMMARY OF FORCE MAIN ALTERNATIVES INFORMATION

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|--------------------------------|---|---|---|--|
| Total Length, ft. | 7,150 | 6,450 | 6,750 | 7,950 |
| Approx. High Point Elevation | 57 | 57 | 57 | 70 |
| Differential HP ⁽¹⁾ | 20 | 15 | 18 | 38 |
| Easements Required? | Mussel Cove Ln. does not currently belong to the Town. Two new easements will be required. | Mussel Cove Ln. does not currently belong to the Town. Two new easements and modifications to two existing easements will be required. | Mussel Cove Ln. does not currently belong to the Town. Five new easements and modifications to one existing easement will be required. | None |
| Ledge Present? | Record drawings show significant ledge in Rt. 88 for about 450 linear feet. There is no record data available for the following: - Mussel Cove Ln. - Rt. 1 (from Depot Rd. to Clearwater Dr.) - Clearwater Dr. | Record drawings show significant ledge in Rt. 88 for about 450 linear feet. There is no record data available for the following: - Mussel Cove Ln. - Clearwater Dr. | Record drawings show significant ledge in Rt. 88 for about 450 linear feet. There is no record data available for the following: - Mussel Cove Ln. - Cross-Country b/w Depot Rd. and Fundy Rd. - Fundy Rd. - Clearwater Dr. | Record drawings show significant ledge in Rt. 88 for about 850 linear feet. There is no record data available for the following: - Rt. 1 (from Depot Rd. to Clearwater Dr.) - Clearwater Dr. |
| Major Utility Crossings | 4-foot box culvert at Webes Creek (or beneath Webes Creek) 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. | 4-foot box culvert at Webes Creek (or beneath Webes Creek) 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. | 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. | 4-foot box culvert at Webes Creek (or beneath Webes Creek) 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. |
| Protected Resources | Potentially minor wetland near the cul-de-sac at the end of Mussel Cove Ln. Travels beneath Webes Creek. | Potentially minor wetland near the cul-de-sac at the end of Mussel Cove Ln. Travels beneath and adjacent to Webes Creek. | Potentially minor wetland near the cul-de-sac at the end of Mussel Cove Ln. Potentially wetlands in cross-country area between Depot Rd. and Fundy Rd. | Travels beneath Webes Creek. |
| | | | Potentially wetlands and an intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. | |
| Miscellaneous | Mussel Cove Ln. is a private road and has recently been paved. | Mussel Cove Ln. is a private road and has recently been paved. | Mussel Cove Ln. is a private road and has recently been paved. | N/A |
| Project Cost | \$1,880,000 | \$1,660,000 | \$1,740,000 | \$2,170,000 |

| | Alternative 5 | Alternative 6 | Alternative 7 |
|--------------------------------|--|--|---|
| Total Length, ft. | 7,250 | 7,550 | 7,800 |
| Approx. High Point Elevation | 70 | 70 | 70 |
| Differential HP ⁽¹⁾ | 33 | 36 | 38 |
| Easements Required? | Modifications to two existing easements will be required. | Four new easements will be required. | Two new easements will be required. |
| Ledge Present? | Record drawings show significant ledge in Rt. 88 for about 850 linear feet. There is no record data available for the following: - Clearwater Dr. | Record drawings show significant ledge in Rt. 88 for about 850 linear feet. There is no record data available for the following: - Cross-Country b/w Depot Rd. and Fundy Rd. - Fundy Rd. - Clearwater Dr. | Record drawings show significant ledge in Rt. 88 for about 850 linear feet. There is no record data available for the following: - Cross-Country b/w Rt. 88 and Fundy Rd. - Fundy Rd. - Clearwater Dr. |
| Major Utility Crossings | 4-foot box culvert at Webes Creek (or beneath Webes Creek) 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. | 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. | 20-inch water main in Rt. 1 36-inch water main in Clearwater Dr. |
| Protected Resources | Travels beneath and adjacent to Webes Creek. | Potentially wetlands in cross-country area between Depot Rd. and Fundy Rd. | Potentially wetlands in cross-country area between Rt. 88 and Fundy Rd. |
| | | Potentially wetlands and an intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. | Potentially wetlands and an intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. |
| Miscellaneous | N/A | N/A | N/A |
| Project Cost | \$1,950,000 | \$2,010,000 | \$2,150,000 |

**TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION - FORCE MAIN REPLACEMENT ALTERNATIVES**

TABLE 1: SUMMARY OF FORCE MAIN ALTERNATIVES INFORMATION

| | Alternative 8A (Replacement) | Alternative 8B (Relining) |
|--------------------------------|---|--|
| Total Length, ft. | 7,180 | 7,180 |
| Approx. High Point Elevation | 36 | 36 |
| Differential HP ⁽¹⁾ | 0 | 0 |
| Easements Required? | The new pipe will be located within the existing easements. One existing easement may need to be modified. Additional easements may be required for temporary access during construction. | Three or four easements will be required depending on final topography (temporary for access to force main). |
| Ledge Present? | Record drawings show some ledge was found during construction of the cross-country portion of the force main. No information is provided for Clearwater Drive. | Not applicable |
| Major Utility Crossings | - 20-inch water main in Rt. 1 - 36-inch water main in Clearwater Dr. | - 20-inch water main in Rt. 1 - 36-inch water main in Clearwater Dr. |
| Protected Resources | Travels adjacent to Mill Creek and Webes Creek and crosses under Mill Creek. | Travels adjacent to Mill Creek and Webes Creek and crosses under Mill Creek. |
| Miscellaneous | N/A | N/A |
| Project Cost | \$2,010,000 | \$1,500,000 |

Notes:

1. The existing force main route requires the least amount of power to pump flow from the station to the WWTF as it is the route with the lowest static head loss and a relatively low frictional head loss. The differential horsepower (HP) in this table indicates the HP required for the other alternatives above and beyond the HP required for the existing force main route.

TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION - FORCE MAIN REPLACEMENT ALTERNATIVES

TABLE 2: SUMMARY OF PROS AND CONS

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|-------------|---|--|--|--|
| Pros | <ul style="list-style-type: none"> • Third shortest route • Fourth lowest HP requirement which will lead to smaller electrical gear and lower operation cost over the life of the station • Lower high point elevation above discharge elevation, which can reduce the potential for air pockets if air/vacuum release structures are not properly maintained | <ul style="list-style-type: none"> • Shortest route • Second lowest HP requirement which will lead to smaller electrical gear and lower operation cost over the life of the station • Lower high point elevation above discharge elevation, which can reduce the potential for air pockets if air/vacuum release structures are not properly maintained | <ul style="list-style-type: none"> • Second shortest route • Third lowest HP requirement which will lead to smaller electrical gear and lower operation cost over the life of the station • Lower high point elevation above discharge elevation, which can reduce the potential for air pockets if air/vacuum release structures are not properly maintained | <ul style="list-style-type: none"> • No easements will be required • Avoids issues around Mussel Cove Ln. being a private road |
| Cons | <ul style="list-style-type: none"> • Mussel Cove Ln. is not currently an accepted Town road and the easement between the Mussel Cove Ln. dead end and Depot Rd. is not held by the Town • Two new easements will be required • Mussel Cove Ln. plans show minor wetlands in the area between Mussel Cove Ln. and Depot Rd. • Depending on the force main construction schedule, this route would need to be coordinated with the Route 1 reconstruction project which has already begun. | <ul style="list-style-type: none"> • Mussel Cove Ln. is not currently an accepted Town road and the easement between the Mussel Cove Ln. dead end and Depot Rd. is not held by the Town • Two new easements and modifications to two existing easements will be required • This route travels adjacent to Webes Creek between Depot Rd. and Rt. 1 (similar to existing route) • Mussel Cove Ln. plans show minor wetlands in the area between Mussel Cove Ln. and Depot Rd. | <ul style="list-style-type: none"> • Mussel Cove Ln. is not currently an accepted Town road and the easement between the Mussel Cove Ln. dead end and Depot Rd. is not held by the Town • Five new easements and modifications to one existing easement will be required • Mussel Cove Ln. plans show minor wetlands in the area between Mussel Cove Ln. and Depot Rd. • Potential wetlands in cross-country area between Depot Rd. and Fundy Rd. • Potential wetlands and/or intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. | <ul style="list-style-type: none"> • Longest route • Higher high point elevation above discharge elevation, which can lead to air pockets if air/vacuum release structures are not properly maintained • One of two highest HP requirements which will lead to a larger electrical service and higher operational cost over the life of the station • Highest cost alternative • Depending on the force main construction schedule, this route would need to be coordinated with the Route 1 reconstruction project which has already begun |
| | Alternative 5 | Alternative 6 | Alternative 7 | |
| Pros | <ul style="list-style-type: none"> • Avoids issues around Mussel Cove Ln. being a private road | <ul style="list-style-type: none"> • Avoids issues around Mussel Cove Ln. being a private road | <ul style="list-style-type: none"> • Avoids issues around Mussel Cove Ln. being a private road | |
| Cons | <ul style="list-style-type: none"> • Fourth longest route • Higher high point elevation above discharge elevation, which can lead to air pockets if air/vacuum release structures are not properly maintained • Third highest HP requirement which will lead to a larger electrical service and higher operational cost over the life of the station • Modifications to two existing easements will be required • This route travels adjacent to Webes Creek between Depot Rd. and Rt. 1 (similar to existing route) | <ul style="list-style-type: none"> • Third longest route • Higher high point elevation above discharge elevation, which can lead to air pockets if air/vacuum release structures are not properly maintained • Second highest HP requirement which will lead to a larger electrical service and higher operational cost over the life of the station • Four new easements will be required • Potential wetlands in cross-country area between Depot Rd. and Fundy Rd. • Potential wetlands and/or intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. | <ul style="list-style-type: none"> • Second longest route • Higher high point elevation above discharge elevation, which can lead to air pockets if air/vacuum release structures are not properly maintained • One of two highest HP requirements which will lead to a larger electrical service and higher operational cost over the life of the station • Two new easements will be required • Potential wetlands in cross-country area between Rt. 88 and Fundy Rd. • Potential wetlands and/or intermittent stream in cross-country area between Rt. 1 and Clearwater Dr. • Requires the most number of air release/drain structures | |

TOWN OF FALMOUTH, MAINE
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TABLE 2: SUMMARY OF PROS AND CONS

| | Alternative 8A | Alternative 8B |
|-------------|---|---|
| Pros | <ul style="list-style-type: none"> • Fourth shortest route • Lowest HP requirements which will lead to smallest electrical gear and lowest operation cost over the life of the station • No air/vacuum release structures required • Avoids issues around Mussel Cove Ln. being a private road | <ul style="list-style-type: none"> • Fourth shortest route • Lowest HP requirements which will lead to smaller electrical gear and lower operation cost over the life of the station • No air/vacuum release structures required • Avoids issues around Mussel Cove Ln. being a private road • Lowest cost alternative |
| Cons | <ul style="list-style-type: none"> • Maintaining the existing route will provide little to no access for half the force main for maintenance and operation without construction • Travels adjacent to Mill Creek and Webes Creek (and under Mill Creek) and will require significant permitting and cost to restore any disturbance of wetlands • Travels for approximately 700 linear feet in an existing easement through Falmouth Conservation Trust property • Steep embankments along portions of the route may make access with equipment difficult and dangerous; additionally, soil conditions may make construction very difficult, if not impossible in places (especially in the tidal flat areas) • One existing easement may need to be modified; additional temporary easements may be required for access during construction | <ul style="list-style-type: none"> • Maintaining the existing route will provide little to no access for half the force main for maintenance and operation without construction • Travels adjacent to Mill Creek and Webes Creek (and under Mill Creek) and will require significant permitting and cost to restore any disturbance of wetlands • Travels for approximately 700 linear feet in an existing easement through Falmouth Conservation Trust property • Steep embankments along portions of the route may make access with equipment difficult and dangerous; additionally, soil conditions may make construction very difficult, if not impossible in places (especially in the tidal flat areas) • Three or four new easements will be required for temporary access roads • Will require temporary bypass piping from the pump station to the WWTF for about four months while existing force main is being relined • Relining the existing force main will reduce the internal diameter of the 14-inch diameter pipe which will increase operating velocities and friction (as this is a pressure pipe, the liner thickness will be greater than liners used in gravity installations). |

TOWN OF FALMOUTH, MAINE
MILL CREEK PUMP STATION - FORCE MAIN REPLACEMENT ALTERNATIVES

TABLE 3: SUMMARY OF EASEMENT DISCUSSIONS

| Property No. ⁽¹⁾ | Location | Comments | Applicable Alternatives | | | | | | | | | |
|-----------------------------|---------------------------------|---|-------------------------|---|---|---|---|---|---|----|-------------------|--|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8A | 8B ⁽²⁾ | |
| 1 | Mussel Cove Lane and Greenspace | <p>Mussel Cove Lane is privately owned and maintained, including the gravity sewer. Although the subdivision developer has recently turned common space property rights over to the homeowner's association, the developer has not fulfilled all of the property improvements required by Town Planning when the development was originally approved. Until the improvements are completed or an alternate arrangement is agreed upon, it is not clear who would make decisions related to an easement.</p> <p>If the Town accepts ownership of the road, an easement would not be required for the area within the road. An easement may be required for the green space between the cul-de-sac and 19 Depot Road.</p> <p>The proposed route was discussed with one of the eleven property owners (recommended by the developer). Aside from a concern about restoration of the newly paved road and landscaping as well as a concern about potential odors, the property owner seemed generally open to discussing options. However, he is not an appointed representative for the development and clearly stated that he could not speak for the rest of the development.</p> | X | X | X | | | | | | | |
| 2 | 19 Depot Road | <p>The Mussel Cove Lane development has a sewer easement through this property to the sewer main in Depot Road. This easement would need to be turned over to the Town if the Town accepts ownership of the Mussel Cove Lane sewer.</p> <p>The property owner indicated a preference that an alternate route be selected as they do not want their property to be disturbed again. Final landscaping after the Mussel Cove Lane development was completed only occurred within the past year or two.</p> | X | X | X | | | | | | | |
| 3 | 22 Depot Road | The property owner was amenable to negotiating an easement. | | | X | | | X | | | | |
| 4 | 26 Depot Road | <p>This is the Skillins greenhouse property. There is an existing right-of-way along the northwest border of this parcel where the existing force main and gravity interceptor are located. Two different routes are proposed in the alternatives - parallel and adjacent to the existing force main or along the southeast property line.</p> <p>Of the two routes, the route along the northwest property line would have the least impact as this area is not regularly used. However, the property owners indicated that there would be significant impacts to their business unless the work was completed between October 1 and March 1, regardless of which route is selected.</p> <p>The route along the southeast property line would have the most impact on operations as it would pass through their winter plant storage area. There is also a row of mature apple trees that would need to be protected as they provide shade for plant storage during the summer. There are three utilities that will need to be avoided in this area including a 1-inch diameter water service that runs the length of the property from Depot Road, a 200A below-grade electrical service from Fundy Road and fuel storage tanks. Access to the fuel storage tanks would need to be maintained at all times.</p> <p>The property owner's preferred route is along the northwest property line as it would have the least impact on their operations.</p> | | X | X | | X | X | | X | X | |
| 5 | 202 US Route 1 | The property owner was amenable to negotiating an easement. | | | X | | | X | X | | | |
| 6 | 215 US Route 1 | <p>The existing easement on this property may need to be modified. The proposed force main route has been adjusted to minimize the impact to the parking lot, which has recently been repaved. The property owner is amenable to the proposed changes.</p> <p>There are underground electrical lines to the lights that will need to be avoided.</p> | | X | | | X | | | X | X | |

| Property No. ⁽¹⁾ | Location | Comments | Applicable Alternatives | | | | | | | | | |
|-----------------------------|--------------|--|-------------------------|---|---|---|---|---|---|----|-------------------|--|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8A | 8B ⁽²⁾ | |
| 7 | 3 Fundy Road | <p>The property is owned by a condo association. The president of the association indicated that the property has what he believes to be a town-owned drainage easement that passes behind the building. When the properties at 5 and 7 Fundy Road were developed, it created a flooding issue at this property. When he contacted the Town, he was informed that there was no management plan in place for the drainage swale and that he was responsible for maintenance.</p> <p>He indicated they would be willing to negotiate an easement for the force main provided that the Town accepts responsibility for maintaining the drainage swale.</p> <p>He also indicated that loss of parking would be a major concern during business hours. On-street parking may be a temporary solution.</p> | | | X | | | X | | | | |
| 8 | 7 Fundy Road | <p>The property owner was amenable to negotiating an easement. There is a three to four foot deep drainage swale that was recently constructed along the eastern edge of the property closest to the cul-de-sac. The force main will need to be deep enough to pass beneath the swale.</p> | | | | | | X | | | | |

Notes:

1. Refer to Figures 1 through 8 in Appendix A for the location of these properties. The property tags on the Figures correspond to the property numbers in this table.
2. Owners of properties where access may be required for the relining option were not contacted as part of this evaluation.