# TOWN of KENNEBUNKPORT

# CLIMATE ADAPTATION PLAN

**for the**

# KENNEBUNKPORT WASTEWATER TREATMENT FACILITY AND SEWER COLLECTION SYSTEM

**Kennebunkport, Maine**

Source: http://www.visitthekennebunks.com/

**July 2019**

WRIGHT-PIERCE
Engineering a Better Environment

**TOWN OF KENNEBUNKPORT, MAINE**

**KENNEBUNKPORT WASTEWATER**
**TREATMENT FACILITY AND SEWER COLLECTION SYSTEM**

**JULY 2019**


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# TOWN OF KENNEBUNKPORT– CLIMATE ADAPTATION PLAN

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# EXECUTIVE SUMMARY

The Town of Kennebunkport (Town) received funding from the Maine Department of Environmental Protection (Maine DEP) to create a Climate Adaptation Plan (CAP). The goals of the CAP were to review the possible effects of climate change, assess the likely impacts to the Town's critical assets and system reliability, identify and evaluate possible adaptation measures and provide a cost-effective implementation plan to protect the Town's critical assets and maintain system reliability. The Town retained Wright-Pierce to assist with the evaluation of possible climate change impacts on the Town's critical systems, potential hazard vulnerabilities and their consequences and possible adaptation measures, and to develop a cost-effective implementation plan.

Section 2 of this report describes the existing conditions of the Town's critical assets. The Town owns a wastewater treatment facility (WWTF), 16 major pump stations (Figure 1 in Appendix A) and over 25 miles of gravity sewer mains and low-pressure force main pipes that make up the sewer collection system. In addition, numerous privately-owned low-pressure grinder pump stations at individual residences located throughout the Town of Kennebunkport are connected to the sewer collection system. The collection system pipes range in diameter from 6 inches to 18 inches and construction material, including vitrified clay, asbestos-cement and polyvinyl chloride. The WWTF has undergone 4 major upgrades since it commenced operations in 1974. The pump stations range in age from the early 1970s to the late 1990s.

Potential climate change impacts and the associated hazards were identified and reviewed for applicability to the Town's assets and personnel in Section 3 of the report. The likelihood of possible hazard consequences was assessed to aid in prioritizing adaptation measures. Critical systems were determined based on their importance to achieving the Town's goals of reliably serving its customers, meeting regulatory obligations and providing a safe working environment for Town staff.

Possible adaptation measures were evaluated in Section 4 of the report and grouped into two major categories: system-wide and individualized measures. System-wide adaptation measures are tasks or procedural changes that Town staff could undertake at minimal cost to the Town to prevent or mitigate potential hazard consequences that are applicable to the entire wastewater treatment and collection system. Individualized measures are adaptation measures requiring non-routine or one-time tasks, in-depth studies or evaluations, design modifications, and/or capital expenditures, applicable to a specific asset that is uniquely at-risk.

The identified system-wide adaptation measures are low-cost best management practices and have therefore been recommended for immediate implementation. Adaptation measure effectiveness, criticality to system performance and reliability, and estimated cost were considerations in determining the priority of the individualized adaptation measures. Section 5 of the report discusses the recommended CAP. Table 5-1 summarizes the priority, cost, and suggested timeline for implementation of the recommended individualized adaptation measures.

# SECTION 1
# INTRODUCTION

## 1.1 GOALS & APPROACH

In June of 2016, the Town of Kennebunkport was awarded a $20,000 loan (with 100% principal forgiveness) from the Maine Department of Environmental Protection to create a Climate Adaptation Plan.

The goals of the CAP were to review the possible effects of climate change, assess the likely impacts to the Town's critical assets and system reliability, identify and evaluate possible adaptation measures, and provide a cost-effective implementation plan to protect the Town's critical assets and maintain system reliability. The Town retained Wright-Pierce to assist with the development of the CAP.

The approach to developing the Town's CAP included:

i. A review of historic information on environmental hazards based on past observations by Town personnel, Town infrastructure data, GIS information and record drawings, readily available Federal Emergency Management Agency (FEMA) 100-year Base Flood Elevation (BFE) floodplain mapping, including the addition of 2 to 3 feet of elevation above the FEMA 100—year BFE based on NEIWPCC's *TR-16: Guides for the Design of Wastewater Treatment Works* guidance on flood protection.

ii. Supplemental field reconnaissance by Wright-Pierce personnel.

iii. An evaluation of the effects of floodplain inundation including sea level rise and Category 1 hurricane scenarios on critical assets and system reliability as well as the ability to access critical infrastructure during periods of floodplain inundation.

iv. An evaluation of the impacts from changes to precipitation patterns, storm intensity, duration and frequency on critical assets.

v. An evaluation of weaknesses in community or utility support systems that may be impacted by climate change and the consequences on the Town's system reliability.

vi. An evaluation of the impact that wind-related hazards (e.g., falling trees/utility poles/wires) may have on critical infrastructure.

## 1.2 PARTICIPATING PERSONNEL

Key stakeholders in the development of the Town's CAP included the Kennebunkport Town Manager, Wastewater Treatment Facility Chief Operator, Wastewater operations staff and Wright-Pierce staff. The CAP has been funded by Maine DEP and is subject to Maine DEP review and approval.

Review of this CAP report by the Town of Kennebunkport's local Emergency Management Agency and local planning board was not included in the current project scope. However, it is recommended that the final CAP report and its finding be discussed with the Town's local planning board and Emergency Management Agency for future planning and emergency/ natural disaster coordination purposes.

# SECTION 2 EXISTING CONDITIONS

## 2.1 WASTEWATER TREATMENT FACILITY

The Kennebunkport Waste Water Treatment Facility (WWTF) commenced operations in 1974 at its current location on Recreation Way in the Town of Kennebunkport (Figure 1 in Appendix A). The WWTF can provide secondary level treatment and nutrient removal by way of the Modified Ludzack-Ettinger (MLE) process. The facility is permitted to provide secondary level treatment including year-round chlorine disinfection to flows up to an average daily flow of 0.70 million gallons per day (MGD). The WWTF has undergone 4 major upgrades in 1979, 1997, 2005 and 2010. The facility receives wastewater from the sanitary sewer collection system that serves approximately 3,500 customers in the Town of Kennebunkport. The WWTF is equipped with two parallel preliminary grit screens, three parallel rectangular aeration basins capable of providing nitrification and denitrification, two 40-foot diameter secondary clarifiers, two parallel chlorine contact chambers, two 0.5-meter sludge belt filter presses, an outdoor 370-kW stand-by power generator, administration building operations building, screenings building, sludge dewatering building, and two biosolids composting structures.

**FIGURE 1 - KENNEBUNKPORT WWTF**

## 2.2 PUMP STATIONS

The Town owns and operates 16 major wastewater lift stations that transfer sanitary wastewater from low points in the gravity sewer collection system to elevations that allow the wastewater to then flow by gravity to the Town's WWTF for treatment and discharge to the Kennebunk River. The Town also owns three portable emergency power generators (17kW, 20.5kW and 65kW) that are capable of supplying back-up power to the Town's 16 pump stations. Eight of the pump stations also have a dedicated stand-by power generator. Figure 2 in Appendix A shows the sewer service areas of the major pump stations. A brief description of the existing conditions at each pump station follows along with a summary of the pump station attributes and flood elevation information in Table 2-1 and Table 2-2, respectively, at the end of this section as well.

Figures PS-02 through PS-17 in Appendix A include individual maps of the major pump station locations, along with the 100-year FEMA BFE and color -coded contour lines for 2 and 4 feet above the 100-year BFEs at the pump station locations.

### 2.2.1 Mill Lane Pump Station (PS-02)

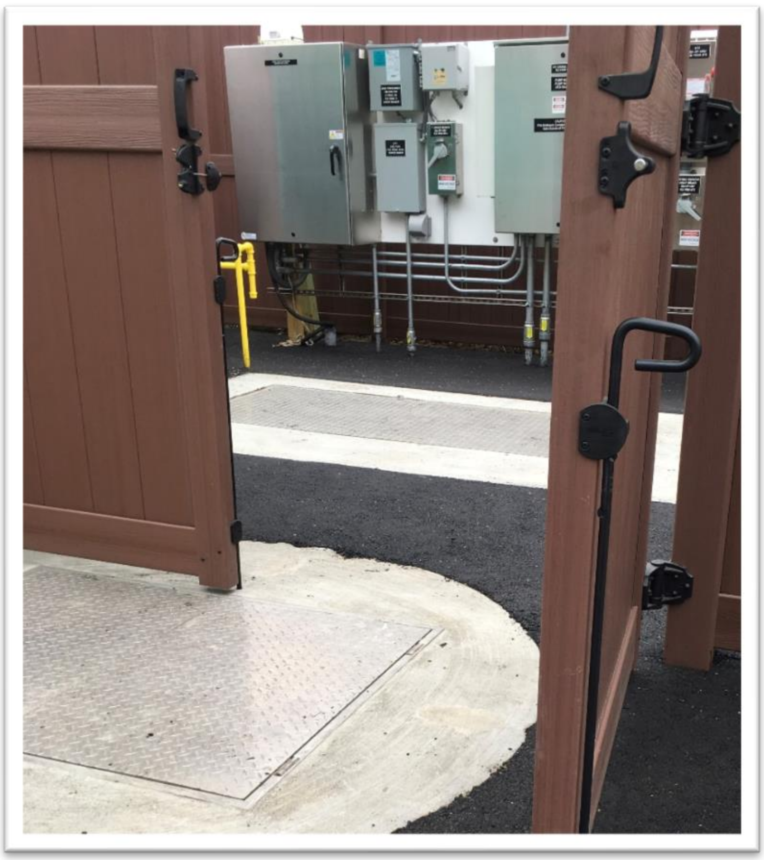
The Mills Lane pump station is a flooded-suction type pump station located at 5 Mill Lane (Figure 2). The station was constructed in 1979 and has not undergone any major upgrades. The station is equipped with two 7.5-HP flooded suction centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel. A dedicated 25-kW Kohler brand propane-fueled standby power generator powers the station during utility power failure. The station is equipped with both local alarm and radio telemetry systems.

**FIGURE 2 – MILL LANE PUMP STATION**

### 2.2.2 Greene Street Pump Station (PS-03)

The Greene Street pump station is a submersible type pump station located at the intersection of Greene Street and Ocean Avenue (53 Ocean Avenue). The station was originally constructed in 1972 and was upgraded in 2018. The station is equipped with two 10-HP submersible pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel by underground conduit. A dedicated 45-kW Cummins brand propane-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

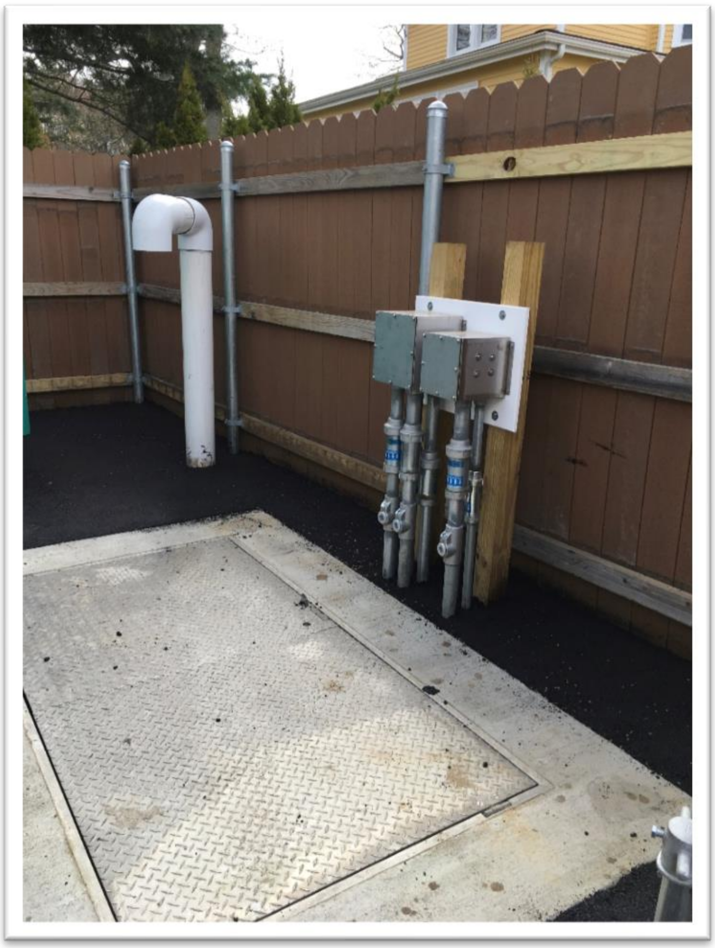
**FIGURE 3 – GREENE STREET PUMP STATION**



### 2.2.3 Chicks Creek Pump Station (PS-04)

The Chicks Creek pump station is a submersible type pump station located at 80 Ocean Avenue (Figure 4). The station was originally constructed in 1972 and was upgraded in 2018. The station is equipped with two 5-HP submersible pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel by underground conduit. A dedicated 45-kW Cummins brand propane-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

**FIGURE 4 – CHICKS CREEK PUMP STATION**



### 2.2.4 South Main Street Pump Station (PS-05)

The South Main Street pump station is a submersible type pump station located at 76 South Main Street (Figure 5). The station was constructed in 1970 and has not undergone any major upgrades. The station is equipped with two 3-HP submersible pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel by overhead conduit. The station is equipped with a stand-by power portable generator connection port. The station has both local alarm and radio telemetry systems.

**FIGURE 5 – SOUTH MAIN STREET PUMP STATION**

### 2.2.5 Ocean Avenue Pump Station (PS-06)

The Ocean Avenue pump station is a flooded-suction type pump station located at 192 Ocean Avenue (Figure 6). The station was originally constructed in 1984 and has not undergone any major upgrades. The station is equipped with two 3-HP flooded-suction centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel by underground conduit. The station is equipped with a stand-by power portable generator connection port. The station has both local alarm and radio telemetry systems.

**FIGURE 6 – OCEAN AVENUE PUMP STATION**

### 2.2.6 Turbats Creek Pump Station (PS-07)

The Turbats Creek pump station is a flooded-suction type pump station located at 71 Turbats Creek Road (Figure 7). The station was originally constructed in 1984 and has not undergone any major upgrades. The station is equipped with two 30-HP flooded-suction centrifugal pumps and an above-ground electrical control panel mounted to a building adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground conduit. A dedicated 45-kW Onan brand diesel-fueled standby power generator powers the station during utility power failure. The station is equipped with a local alarm and telemetry system.

**FIGURE 7 – TURBATS CREEK PUMP STATION**

### 2.2.7 Wildes District Road Pump Station (PS-08)

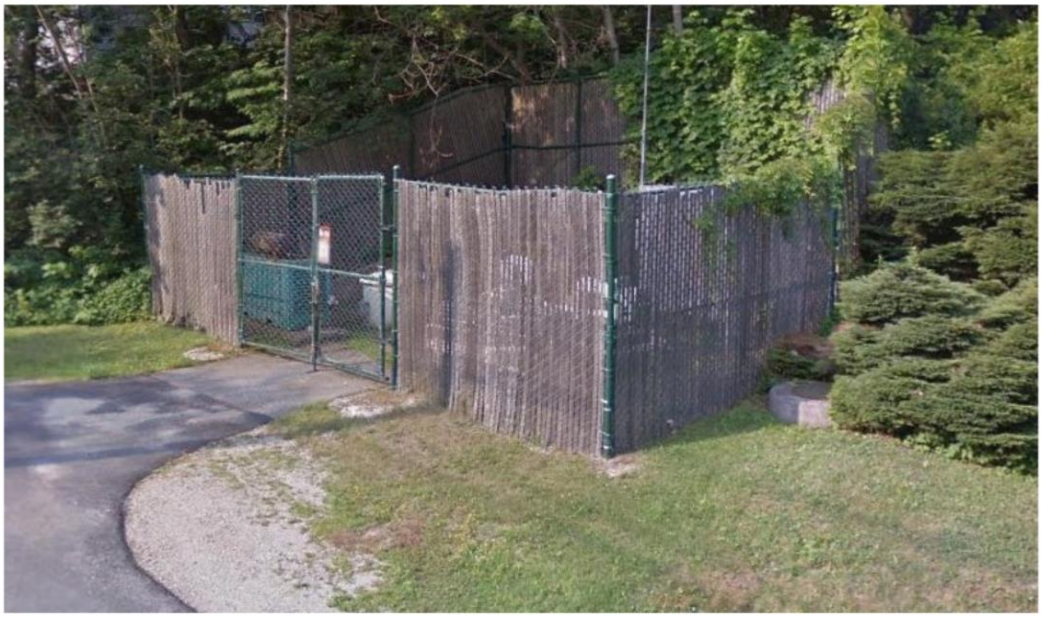
The Wildes District Road pump station is a flooded-suction type pump station located at 131 Wildes District Road (Figure 8). The station was originally constructed in 1983 and has not undergone any major upgrades. The station is equipped with two 30-HP flooded-suction centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. A dedicated 45-kW Kohler brand propane-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

**FIGURE 8 – WILDES DISTRICT ROAD PUMP STATION**

### 2.2.8 Paddy Creek Road Pump Station (PS-09)

The Paddy Creek Road pump station is a flooded-suction type pump station located at 1 Paddy Creek Road (Figure 9). The station was originally constructed in 1984 and has not undergone any major upgrades. The station is equipped with two 15-HP flooded-suction centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. A dedicated 30-kW Kohler brand propane-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

**FIGURE 9 – PADDY CREEK ROAD PUMP STATION**



### 2.2.9 Cape Square (Porpoise) Pump Station (PS-10)

The Cape Square (Porpoise) pump station is a flooded-suction type pump station located at 174 Main Street (Figure 10). The station was originally constructed in 1985 and has not undergone any major upgrades. It is equipped with two 10-HP flooded-suction centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. A dedicated 25-kW Kohler brand propane-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

**FIGURE 10 – CAPE SQUARE (PORPOISE) PUMP STATION**

### 2.2.10 Mills Road Pump Station (PS-11)

The Mills Road pump station is a flooded-suction type pump station located at 47 Mills Road (Figure 11). The station was originally constructed in 1983 and has not undergone any major upgrades. It is equipped with two 2-HP flooded-suction centrifugal pumps and an above-ground electrical control panel adjacent to the station’s wet-well. Power is provided by overhead utility power lines connected to the pump station’s electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has both local alarm and radio telemetry systems.

**FIGURE 11 – MILLS ROAD PUMP STATION**

### 2.2.11 Kings Highway-Main Pump Station (PS-12)

The King's Highway- Main pump station is a suction-prime type pump station located at 200 Kings Highway (Figure 12). The station was originally constructed in 1992 and has undergone one major upgrade in 2012. It is equipped with two 45-HP suction-prime centrifugal pumps located in the lower level of the pump station building. Power is provided by overhead utility power lines connected to the pump station building via underground electrical conduit. The pump control panels are located in the lower level of the pump station building. A dedicated 38-kW Kohler brand diesel-fueled standby power generator powers the station during utility power failure. The station has both local alarm and radio telemetry systems.

**FIGURE 12 –KING'S HIGHWAY-MAIN PUMP STATION**

### 2.2.12 King's Lane Pump Station (PS-13)

The King's Lane pump station is a suction-prime type pump station located at 318 King' Highway (Figure 13). The station was originally constructed in 1992 and has not undergone any major upgrades. It is equipped with two 13.5-HP suction-prime centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has both local alarm and radio telemetry systems.

**FIGURE 13 – KING'S LANE PUMP STATION**

### 2.2.13 King's Highway Submersible Pump Station (PS-14)

The King's Highway-Submersible pump station is a submersible type pump station located at 124 Kings Highway (Figure 14). The station was originally constructed in 1992 and has not undergone any major upgrades. It is equipped with two 5-HP submersible centrifugal pumps and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has both local alarm and radio telemetry systems.

**FIGURE 14 – KING'S HIGHWAY SUBMERSIBLE PUMP STATION**


### 2.2.14 Prescott Drive Pump Station (PS-15)

The Prescott Drive pump station is a submersible type pump station located at 6 Prescott Drive (Figure 15). The station was originally constructed in 1992 and has not undergone any major upgrades. It is equipped with one 2-HP submersible centrifugal pump and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has local visual and auditory alarm system.

**FIGURE 15 – PRESCOTT DRIVE PUMP STATION**


### 2.2.15 Washington Court Pump Station (PS-16)

The Washington Court pump station is a submersible type pump station located at 9A Washington Court (Figure 16). The station was originally constructed in 1992 and has not undergone any major upgrades. It is equipped with two 2-HP submersible centrifugal pump and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has local visual and auditory alarm system.

**FIGURE 16 – WASHINGTON COURT PUMP STATION**

### 2.2.16 Wakefield Pasture Road Pump Station (PS-17)

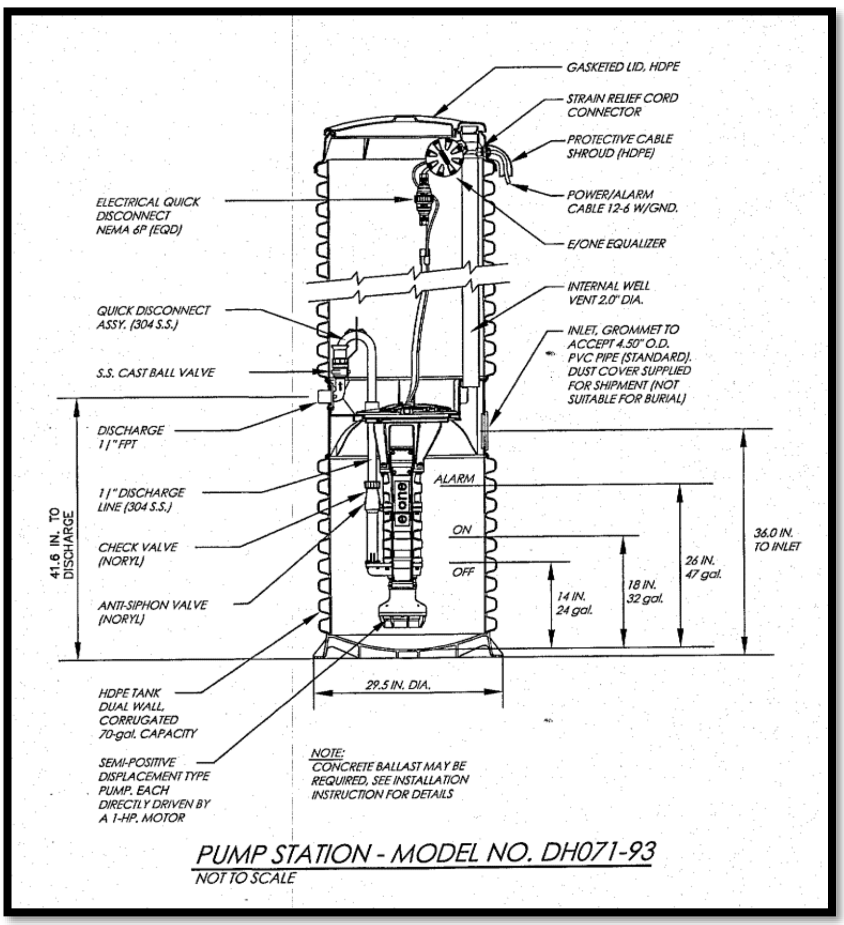
The Wakefield Pasture Road pump station is a submersible type pump station located at 22 Wakefield Pasture Road (Figure 16). The station was originally constructed in 1992 and has not undergone any major upgrades. It is equipped with one 2-HP submersible centrifugal pump and an above-ground electrical control panel adjacent to the station's wet-well. Power is provided by overhead utility power lines connected to the pump station's electrical panel via underground electrical conduit. The station is equipped with a stand-by power portable generator connection port. The station has local visual and auditory alarm system.

**FIGURE 17 – WAKEFIELD PASTURE ROAD PUMP STATION**


### 2.2.17 Grinder Pump Stations

There are over 100 semi-positive displacement grinder pump stations serving individual residences or a small cluster of residences throughout the community, 93 of which are owned by the Town of Kennebunkport. The installation dates for these stations vary depending on the construction dates for the houses being served and whether the pump has been replaced since initial installation. The Town provides maintenance and replacement services to both the Town-owned and privately-owned grinder pump stations connected to the sewer collection system. Pump sizes vary with each individual pump but are typically around 1 HP. Power is typically provided by underground electrical service lines fed to the pump station from the residence being served. The pump stations generally do not have dedicated back-up power systems or equipment redundancy. They are equipped with local visual and auditory alarms to alert the residents of alarm conditions. Labels including the phone number for the WWTF and the Kennebunkport Police Department are also provided on the privately-owned pump stations so that residents can contact WWTF staff or the Police Department in the event of pump alarm conditions. Figure 18 shows a profile view of a typical grinder station. A map of the current grinder pump stations connected to the sewer collection system is included in Figure 1 Appendix A.

**FIGURE 18 – TYPICAL GRINDER PUMP STATION**



## 2.3 COLLECTION SYSTEM

The collection system consists of approximately 10 miles of gravity sewer and 16 miles of force main piping ranging in size from 6 inches to 18 inches (Figure 18). Pipe materials include older vitrified clay and asbestos cement pipe segments and newer PVC pipe segments. Changes in gravity sewer main slope, direction and pipe size are accomplished with sewer manholes between gravity pipe segments. The Town has over 400 sewer manholes ranging in age from 20 to 50 years old. The manholes are a mix of precast concrete and brick-and-mortar construction materials.

Figure 1 in Appendix A includes a map of the Town's sewer collections system assets and the 100-year floodplain based on FEMA preliminary 2018 BFEs.

**TABLE 2-1**
**PUMP STATION ATTRIBUTES SUMMARY**

| Pump Station Identification | Location | Original Construction Date (Years) | Major Upgrade Date(s) (Years) | Pump Type | Motor Size (HP) | Connection to Utility Power | Emergency Power Source | Radio Telemetry Equipment? |
|---|---|---|---|---|---|---|---|---|
| **Mills Lane (PS-02)** | 5 Mill Lane | 1979 | -- | Flooded-Suction | 7.5 | Overhead | 25-kW Propane Generator/ Portable Generator Hookup | Yes |
| **Greene Street (PS-03)** | 53 Ocean Avenue | 1972 | 2018 | Submersible | 10 | Underground | 45-kW Propane Generator | Yes |
| **Chicks Creek (PS-04)** | 80 Ocean Avenue | 1972 | 2018 | Submersible | 5 | Underground | 45-kW Propane Generator | Yes |
| **South Main Street (PS-05)** | 76 South Main Street/ | 1970 | -- | Submersible | 3 | Overhead | Portable Generator Hookup | Yes |
| **Ocean Avenue (PS-06)** | 192 Ocean Avenue | 1984 | -- | Flooded-Suction | 3 | Underground | Portable Generator Hookup | Yes |
| **Turbats Creek Road (PS-07)** | 71 Turbats Creek Road | 1984 | -- | Flooded-Suction | 30 | Underground | 45-kW Diesel Generator/ Portable Generator Hookup | Yes |
| **Wildes District Road (PS-08)** | 131 Wildes District Road | 1983 | -- | Flooded-Suction | 30 | Underground | 45-kW Propane Generator/ Portable Generator Hookup | Yes |
| **Paddy Creek Road (PS-09)** | 1 Paddy Creek Road | 1984 | -- | Flooded-Suction | 15 | Underground | 30-kW Propane Generator/ Portable Generator Hookup | Yes |
| **Cape Square (PS-10)** | 174 Main Street | 1985 | -- | Flooded Suction | 10 | Underground | 25-kW Propane Generator/ Portable Generator Hookup | Yes |
| **Mills Road (PS-11)** | 47 Mills Road | 1983 | -- | Flooded-Suction | 2 | Underground | Portable Generator Hookup | Yes |
| **King’s Highway-Main (PS-12)** | 300 King’s Highway | 1992 | 2012 | Suction-Prime | 45 | Underground | 38-kW Diesel Generator | Yes |
| **King’s Lane (PS-13)** | 318 King’s Highway | 1992 | -- | Suction-Prime | 13.5 | Underground | Portable Generator Hookup | Yes |
| **King’s Highway-Submersible (PS-14)** | 124 King’s Highway/ | 1992 | -- | Submersible | 5 | Underground | Portable Generator Hookup | Yes |
| **Prescott Drive (PS-15)** | 6 Prescott Drive | 1992 | -- | Submersible | 2 | Underground | Portable Generator Hookup | No |
| **Washington Court (PS-16)** | 9A Washington Court | 1992 | -- | Submersible | 2 | Underground | Portable Generator Hookup | No |
| **Wakefield Pasture Road (PS-17)** | 22 Wakefield Pasture Road | 1992 | -- | Submersible | 2 | Underground | Portable Generator Hookup | No |
| **Grinder Pump Stations** | Varies | Varies | -- | Grinder | 1* | Underground | None | No |

*Motor size may vary but 1-HP is typical for this type of pump.

**TABLE 2-2**
**PUMP STATION FLOOD ELEVATIONS**

| Pump Station Identification | Existing Grade Elevation (ft.) | Drywell Entrance Elevation (ft.) | Electrical Control Panel Elevation (ft.) | Emergency Generator Elevation (ft.) | Effective Local FEMA BFE (ft.) | 2018 Prelim local FEMA BFE (ft.) | 100-year BFE +2ft (ft.) | 100-year BFE +3ft (ft.) |
|---|---|---|---|---|---|---|---|---|
| **Mills Lane (PS-02)** | 16 | 18 | 18 | 17.5 | 9 | 9 | 11 | 12 |
| **Greene Street (PS-03)** | 10 | N/A | 13 | 12.5 | 9 | 12 | 14 | 15 |
| **Chicks Creek (PS-04)** | 13.5 | N/A | 16.5 | 14.5 | 9 | 12 | 14 | 15 |
| **South Main Street (PS-05)** | 15 | N/A | 17 | N/A | 9 | 12 | 14 | 15 |
| **Ocean Avenue (PS-06)** | 18 | 20 | 19.5 | N/A | 16 | 21 | 23 | 24 |
| **Turbats Creek Road (PS-07)** | 10.5 | 12.5 | 11.5 | 11 | 11 | 10 | 12 | 13 |
| **Wildes District Road (PS-08)** | 22 | 24 | 24 | 23 | 9 | 10 | 12 | 13 |
| **Paddy Creek Road (PS-09)** | 12 | 14 | 13 | 13 | 9 | 12 | 14 | 15 |
| **Cape Square (PS-10)** | 18 | 20 | 20 | 18.5 | 9 | 10 | 12 | 13 |
| **Mills Road (PS-11)** | 13 | 14.5 | 14 | N/A | 9 | 12 | 14 | 15 |
| **King's Highway-Main (PS-12)** | 6.5 | 11 | -0.7 | 11 | 9 | 13 | 15 | 16 |
| **King's Lane (PS-13)** | 9.5 | 11 | 10.5 | N/A | 9 | 13 | 15 | 16 |
| **King's Highway-Submersible (PS-14)** | 9.5 | N/A | 10.5 | N/A | 12 | 12 | 14 | 15 |
| **Prescott Drive (PS-15)** | 11.8 | N/A | 12.8 | N/A | 9 | 13 | 15 | 16 |
| **Washington Court (PS-16)** | 60 | N/A | 62 | N/A | UNLISTED BY FEMA | UNLISTED BY FEMA | -- | -- |
| **Wakefield Pasture Road (PS-17)** | 68 | N/A | 71 | N/A | 9 | 9 | 11 | 12 |
| **Grinder Pump Stations** | * | * | * | * | * | * | * | * |

*Flood elevations vary. Town of Kennebunkport does not keep record drawings of privately-owned pump stations.

NOTE: elevations with red lettering indicate potential risk of inundation under one or more flood scenarios listed.

# SECTION 3
# EVALUATION OF CLIMATE CHANGE IMPACTS

## 3.1 POTENTIAL CLIMATE CHANGE IMPACTS

Climate change refers to a change in the average weather conditions or the time variation of weather patterns within a defined geographic region. These changes can have adverse impacts on human systems including service utilities and should be considered during a utility's long-term planning process. Climate change may have pronounced effects in certain geographic regions, while having minor effects in others. The first step in considering the potential impacts of climate change on a utility is to determine which impacts are most applicable to the utility's geographic region. Potential climate change impacts and the associated hazards were identified and reviewed for applicability to the Town's assets and personnel. Table 3-1 summarizes the results of the review.

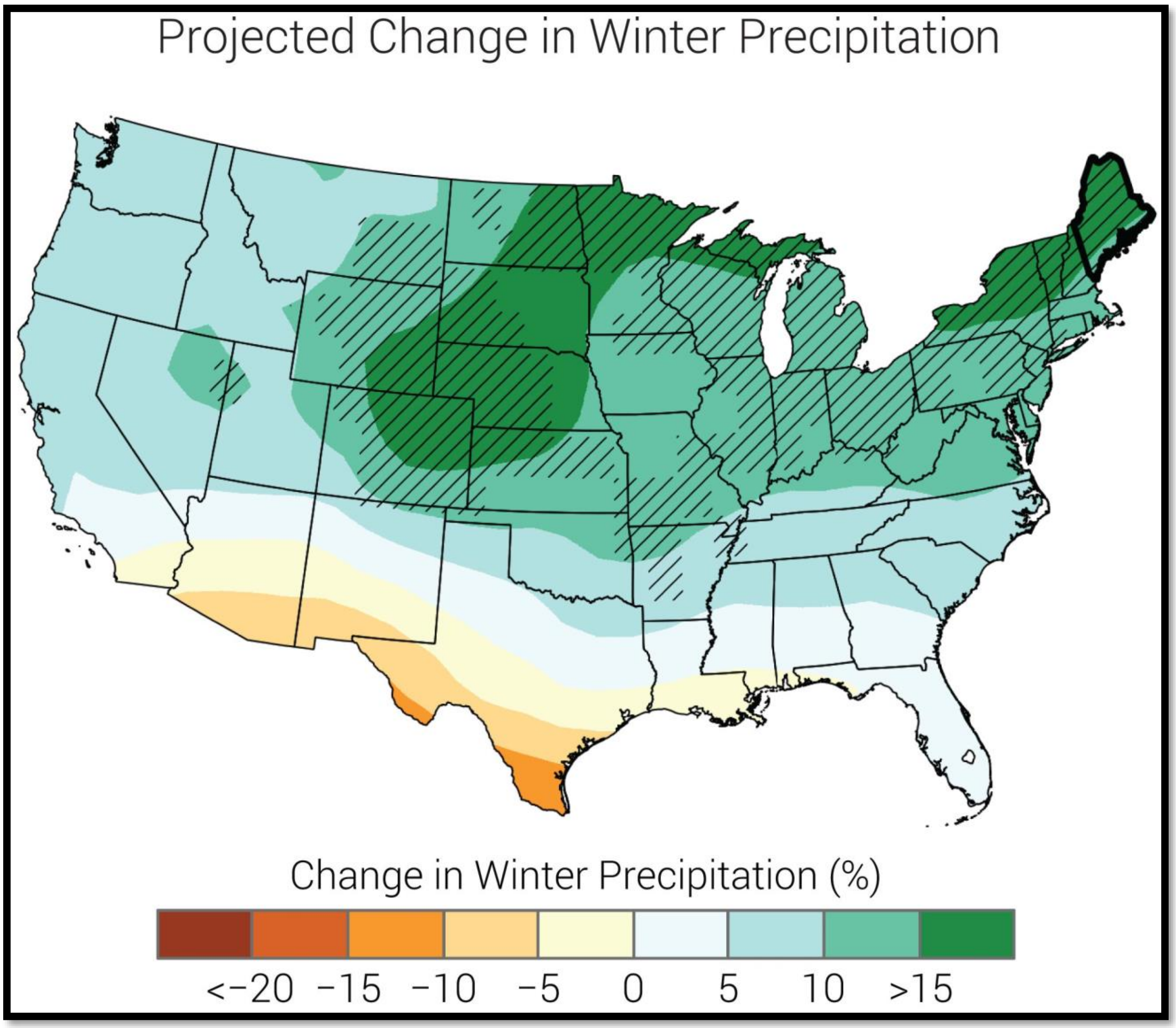
Population dynamics can have a significant impact on the potential consequences of climate change on a community or utility. Climate adaptation planning for utilities should also consider how climate change may affect possible expansion of future service capacity needs. According to projections prepared by the State of Maine Office of Policy and Management, the Town of Kennebunkport is projected to see modest population growth over the 20-year planning horizon (+4.7%, 2014-2034)[1]. The Town's wastewater treatment facility has adequate capacity to accommodate the modest population growth expected over the 20-year planning period.

The Town of Kennebunkport does not have a combined sewer system, but the Kennebunkport WWTF does experience high spring peak flows, indicative of private sources of storm water inflow and groundwater infiltration (I/I) entering the collection system. Without specific I/I rates from flow metering, it would be difficult to determine if additional I/ I from changing precipitation patterns will have a significant impact on collection system capacity. In general, it can be assumed that more intense and/or prolonged storm events are likely to have an analogous effect of increasing the magnitude of peak flows and duration of elevated flow conditions in the sewers, to

[1] State of Maine Office of Policy and Management, https://www.maine.gov/dafs/economist/demographic-projections

a certain extent. This would translate to reductions in the effective capacity of the sewers during these periods. Figure 19 shows the projected changes in total annual winter precipitation across the country.

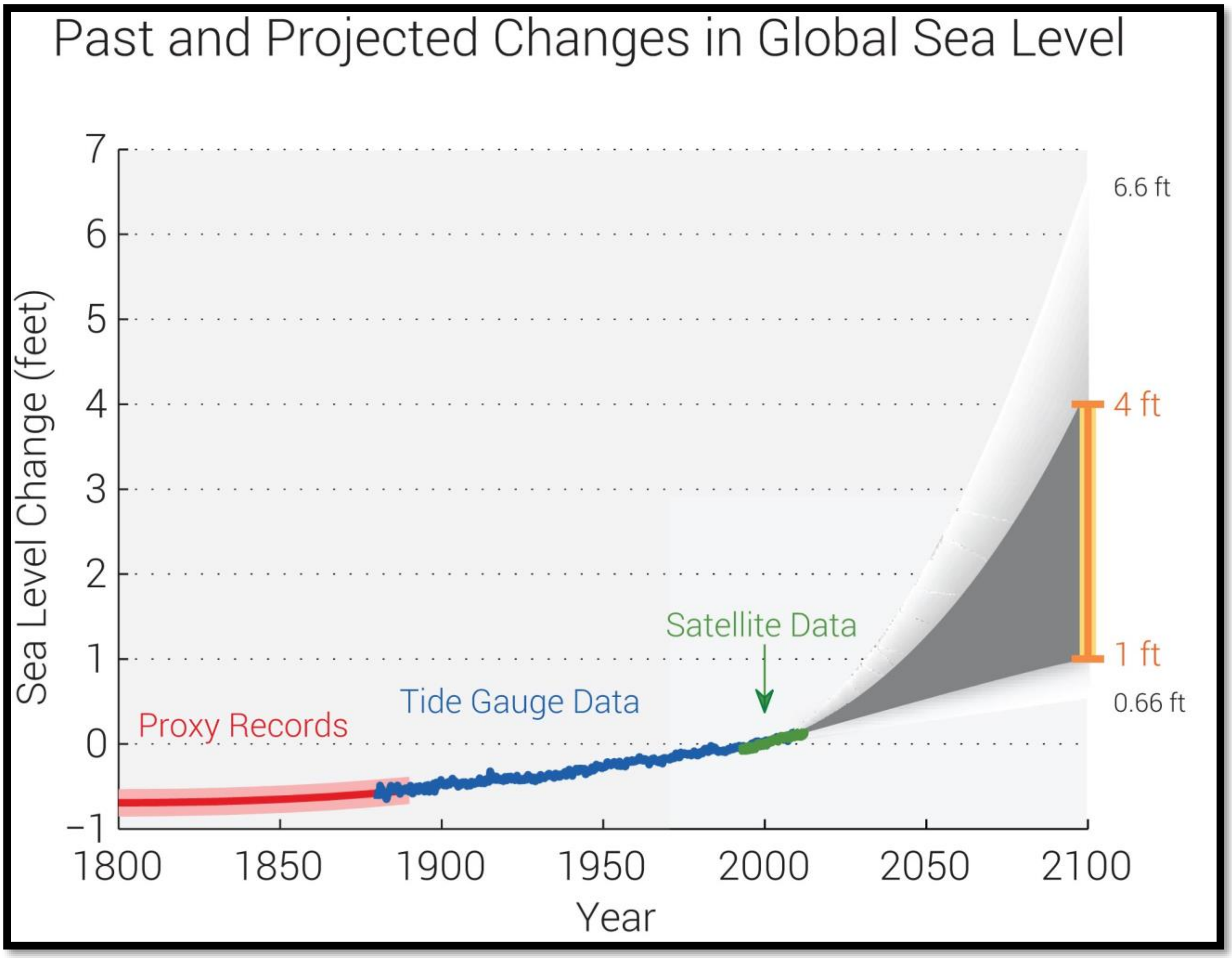
**FIGURE 19 – PROJECTED WINTER PRECIPITATION CHANGES**




Source: CICS-NC and NOAA NCEI

Climate change may also cause or contribute to sea level rise and marsh migration along Maine's coast. NOAA climatology models have been used to simulate a range of climate change scenarios including the expected magnitude of sea level rise (Figure 20). The orange line at right in Figure 20 shows the most likely range of 1 to 4 feet by 2100 based on an assessment of scientific studies, which falls within a larger possible range of 0.66 feet to 6.6 feet[2].

**FIGURE 20 – NOAA SEA LEVEL RISE SCENARIOS**




Source: Mellilo et al. 2014 and Parris et al. 2012.

The Maine Geological survey has used long-term sea level rise data from several monitoring locations along Maine's coast, the U.S. Army Corps of Engineers Sea-Level Change Curve

[2] Runkle, J., K. Kunkel, S. Champion, R. Frankson, B. Stewart, and A.T. DeGaetano, 2017: Maine State Climate Summary. NOAA Technical Report NESDIS 149-ME, 4 pp.

Calculator, NOAA climatology models and LiDAR topographic data to create GIS layers that simulate the extent of coastal inundation and marsh migration during highest astronomical tide (HAT) accounting for possible flood elevation increases from sea level rise or storm surge. Several of these GIS layers were obtained from Maine Geological Survey and superimposed on the Town of Kennebunkport's wastewater GIS layers to simulate several of these scenarios and the possible flooding threats to the Town's wastewater assets. Figure 21 includes the regional HAT elevations and 1.2, 1.6 and 3.9 feet of sea level rise or storm surge above the HAT elevation. Figure 22 shows possible tidal marsh migration from 1, 2, and 3.3 feet of sea level rise.


**Sea Level Rise / Storm Surge**

***Climate Adaptability***

**Kennebunkport, ME**

| PROJ NO: 14227 | DATE: 5/23/2019 | FIGURE: 21 |
|---|---|---|

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Utilities - GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Road Names - Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
Sea Level Rise / Storm Surge - Maine Geological Survey, 2019;
SLOSH - Maine Geological Survey, 2016;
Marsh Migration - Maine Nutural Areas Program, 2016;
ESRI World Imagery, 2019;
Map Developed by Wright-Pierce, 2019.
Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.
WWTF
PS-02
PS-03
PS-04
PS-05
PS-06
PS-07
PS-08
PS-09
PS-10
PS-11
PS-12
PS-13
PS-14
PS-15
PS-16
PS-17
WWTF
Pump Station
Grinder Pump
Sewer Manhole
Force Main
Gravity Main
3.3 Feet SLR Marsh Migration
2 Feet SLR Marsh Migration
1 Foot SLR Marsh Migration
HAT
HAT Plus 1.2 Feet
HAT Plus 1.6 Feet
HAT Plus 3.9 Feet
0 500 1,000 2,000 Feet
N
Marsh Migration with SLR
Climate Adaptability
Kennebunkport, ME
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FIGURE: 22
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The Maine Geological Survey has run numerous hurricane scenarios along Maine's coast in its Sea, Lake and Overland Surges from Hurricanes (SLOSH) computer model to simulate the potential flooding effects of Category 1, 2, 3 and 4 hurricanes hitting coastal regions during mean high tide. Based on the historical record, the Town of Kennebunkport has only experienced one major hurricane off its coast in the last 100 years (1954) and several tropical storms of note that have caused major flooding and property damage. However, climate change and increased warming of Maine coastal waters could sustain or intensify tropical storms that hit the region, increasing the likelihood of flooding and property damage. To help assess the potential threat to the Town's wastewater infrastructure, a SLOSH model GIS layer for a Category 1 hurricane hitting the region during mean high tide was obtained from the Maine Geological Survey's dataset and superimposed onto the Town's wastewater GIS layers to identify potential flooding threats to wastewater system assets (Figure 23).


**SLOSH**

***Climate Adaptability***

**Kennebunkport, ME**

| PROJ NO: 14227 | DATE: 5/23/2019 | FIGURE: 23 |
|---|---|---|

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## 3.2 EVALUATION OF HAZARDS

One of the goals of the CAP is to determine how climate change hazards could impact the Town's ability to reliably serve its customers, meet regulatory obligations and provide a safe working environment for its staff. To reach this goal, potential hazard vulnerabilities applicable to the entire wastewater collection and treatment system and specific critical systems were identified along with possible consequences. The risk of the identified potential hazard consequences occurring and their impact on the associated asset was assessed to aid in prioritizing adaptation measures. Critical systems were determined based on their importance to achieving the Town's goals of reliably serving its customers, meeting regulatory obligations, and providing a safe working environment for Town staff. Table 3-2 summarizes the identified hazard vulnerabilities applicable to the entire wastewater collection and treatment system, possible consequences, and the risk assessment of the hazard consequences. Tables 3-3, 3-4, and 3-5 summarize the identified hazards, possible consequences, and the risk assessment of the hazard consequences for the Kennebunkport WWTF, pump stations, and collection system, respectively.

**TABLE 3-1**
**CLIMATE CHANGE IMPACTS & POTENTIAL HAZARDS**

| Climate Change Impact | Potential Hazards | Hazard Description | Applicability |
|---|---|---|---|
| Increased Flood Risk | Riverine Flooding | Flooding of the land adjacent to the banks of rivers and streams because of precipitation, snow melt or a combination of both. Flooding can cause catastrophic damage to equipment and structures, render critical assets temporarily inaccessible and impact emergency response time. | Several of the Town's critical assets are adjacent to the Kennebunk River and tributary streams, warranting hazard evaluation limited to those assets. |
| | Flash Flooding | Flooding that begins within 6 hours of heavy rainfall or other causes (e.g., dam or levee breach). Flooding can cause catastrophic damage to equipment and structures, render critical assets temporarily inaccessible and impact emergency response time. Flash flooding can be a greater risk for urban areas because of the increased percentage of impervious ground cover and for low-lying areas without storm water infrastructure. | The Town would likely experience flash flooding from large thunderstorms, tropical storms and hurricanes, with the greatest risk to urban areas and low-lying areas without storm water infrastructure. Critical assets located in areas at greater risk for flash flooding will be evaluated. |
| | Coastal Flooding | Flooding of the land adjacent to the ocean and estuarine areas. Flooding can cause catastrophic damage to equipment and structures, rendering critical assets temporarily inaccessible and impact emergency response time. Salt from brackish water can corrode metals and cause severe equipment damage. | Several of the Town's critical assets are located on land adjacent to the Atlantic Ocean and salt water marsh, making coastal flooding a potential risk that warrants further hazard evaluation. |
| | Sea Level Rise | Increase in the average elevation of coastal waters. Sea level rise can change the coastal topography and destabilize coastal soils. It can also enhance other climatic hazards (e.g., coastal flooding, storm surge, marsh migration slope destabilization). | Several of the Town's critical assets are located on land adjacent to the Atlantic Ocean and salt water marsh, making sea level rise a potential risk that warrants further hazard evaluation. |
| Precipitation Changes | Excessive Precipitation | Precipitation magnitude and/or frequency that produces extended periods of saturated ground conditions and can lead to secondary hazards (e.g., flooding, poor travel conditions, power outages, SSOs, accessibility issues, soil erosion, slope destabilization). | Excessive precipitation could potentially impact all the Town's critical assets and warrants further hazard evaluation. |
| Storm Characteristics | Increased Storm Intensity | Storm intensity is a measure of precipitation magnitude over a period of time. As storm intensity increases, greater magnitudes of rainfall occur over a short period of time. This can lead to secondary hazards (e.g., flooding, storm surge, poor travel conditions, power and communication systems outages, SSOs, accessibility issues, WWTF operational issues, slope destabilization). | The secondary hazards associated with increased storm intensity could potentially impact several the Town's critical assets and operational procedures. |
| | Increased Storm Duration | Storm duration is the amount of time elapsed between the start and end of precipitation. An increase in average storm duration could lead to secondary hazards (e.g., flooding, poor travel conditions, power outages, SSOs, accessibility issues, WWTF operational issues) | Secondary hazards from increased storm duration could potentially impact several of the Town's critical assets and therefore warrant further hazard evaluation. |
| | Increased Storm Frequency | Storm frequency is a measure of the period of time between each storm event. As storms become more frequent, secondary hazard conditions (e.g., flooding, poor travel conditions, power and communication systems outages, SSOs, accessibility issues, WWTF operational issues) occur more frequently or may be exacerbated. | The secondary hazards associated with increased storm duration could potentially impact several of the Town's critical assets and therefore warrant further hazard evaluation. |
| Wind-related Impacts | Excessive Wind Speeds | Excessive wind speeds can result in direct damage to buildings, enclosures or equipment exposed to the outdoors, can lead to secondary hazards from downed trees, utility poles and power lines (e.g., dangerous working conditions, structural damage, power and communication systems outages, accessibility issues) and can potentially cause operational issues. | Critical assets that are directly exposed to the outdoors, located near trees, utility poles and/or power lines and electrically-operated equipment may be impacted as well as operational procedures. |

**TABLE 3-2**
**SYSTEM-WIDE POTENTIAL VULNERABILITIES**

| Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|
| Excessive Precipitation | • Water leaks into enclosures, electrical equipment and conduits<br>• Poor travel conditions<br>• Utility power outages<br>• Hazardous working conditions<br>• Increased I/I to collection system, pump stations and WWTF<br>• Increased snow loading to enclosures<br>• Accessibility issues from excess snowfall | • All system components exposed to the outdoors have been constructed to be weather resistant. Water leaks are not expected to have a significant impact.<br>• Poor travel conditions would be limited to relatively large and infrequent storms or hurricanes.<br>• Utility power outages would impact electrical and mechanical equipment. Most of the Town's critical assets have electrical and mechanical components that would be adversely affected by utility power loss, however the Town has provisions for emergency power supply at the WWTF and all 16 pump stations.<br>• Working outdoors during wet-weather conditions increases the risk of slips, trips and falls.<br>• The collection system, pump stations and WWTF experience high wet-weather flows. Increased wet-weather flows could accelerate wear on system components and impact operational procedures and treatment.<br>• Existing enclosures that do not meet updated snow loading codes may be at greater risk for structural failure as they age.<br>• Increased snowfall could impact accessibility of the collection system and pump stations. |
| Increased Storm Intensity, Duration & Frequency | • Localized flooding or ponding<br>• Soil erosion<br>• Water leaks into enclosures, electrical equipment and conduits<br>• Poor travel conditions<br>• Utility power outages<br>• Hazardous working conditions<br>• Increased I/I to collection system, pump stations and WWTF | • Localized flooding or ponding would be limited to periods of saturated soil conditions in areas with poor drainage. This could also result in issues accessing pump stations for O&M and hook-up of trailer-mounted generator during periods of power outage.<br>• Soil erosion would be limited to areas with steep topography or little to no vegetative cover. No system components are in areas expected to be impacted by significant soil erosion.<br>• All system components exposed to the outdoors have been constructed to be weather resistant. Water leaks are not expected to have a significant impact.<br>• Poor travel conditions would be limited to relatively large and infrequent storms and hurricanes.<br>• Utility power outages would impact electrical and mechanical equipment. Most of the Town's critical assets have electrical and mechanical components that would be adversely affected by utility power loss, however the Town has provisions for emergency power supply at the WWTF and all 16 pump stations.<br>• Working outdoors during wet-weather conditions increases the risk of slips, trips and falls.<br>• The collection system, pump stations and WWTF experience high wet-weather flows. Increased wet-weather flows could accelerate wear on system components and impact operational procedures. |
| Excessive Wind Speeds | • Utility power outages<br>• Increased wind loading to enclosures and panels | • Utility power outages would impact electrical and mechanical equipment. Most of the Town's critical assets have electrical and mechanical components that would be adversely affected by utility power loss, however the Town has provisions for emergency power supply at the WWTF and all 16 pump stations.<br>• All enclosures and panels have been constructed to code for local wind loading. Increased wind loading is not expected to have a significant impact. |

**TABLE 3-3**
**WWTF POTENTIAL VULERNABILITIES**

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| WWTF Buildings | • Excessive wind speeds | • Excessive wind loading from major storms and hurricanes could cause structural damage to roof systems of WWTF buildings. | • The WWTF buildings are at risk of experiencing excessive winds if a hurricane were to make landfall on nearby coast.<br>• Some of the roof systems for the WWTF buildings were constructed over 20 years ago and may not adequately account for current wind loading standards for Category 1 hurricanes. |
| Influent/Effluent Wet Wells | • Riverine flooding | • Localized flooding from nearby stream combined with snow melt. | • Historically staff observed one localized flooding event when stormwater drainage culvert for nearby stream plugged and snow melt and runoff could not drain off WWTF site. Stormwater infrastructure has been upgraded since and no other flooding events have been observed. |
| WWTF Stand-by Generator | • Riverine flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Localized flooding from nearby stream combined with snow melt.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • Existing WWTF emergency stand-by power generator has reached the end of its expected useful life, increasing the risk of failure if called into service during utility power loss to WWTF. The Town is currently in the process of replacing the existing stand-by generator.<br>• The existing generator pad is elevated approximately 6 inches above existing grade. Localized flooding from a nearby stream could be a risk if stormwater drainage systems do not properly transport runoff away from WWTF site. |
| Secondary Clarifiers | • Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Excessive precipitation and increased storm intensity, duration and frequency could cause increased flows into the collection system and subsequently to the secondary clarifiers, increasing the risk of sludge blanket washout.<br>• Excessive precipitation in the form of snow could lead to collapse of the existing clarifier domes which do not meet current snow load code standards.<br>• Excessive winds from major storms and hurricanes could knock down trees adjacent to the secondary clarifiers. The falling trees could damage the clarifier superstructures. | • The WWTF experiences high peak flows during spring runoff conditions and periods of extended precipitation. Increased precipitation and storm intensity, frequency and duration could result in more frequent and prolonged peak flows to the secondary clarifiers, increasing the risk of sludge blanket washout.<br>• Excess snow loads<br>• Large trees adjacent to the secondary clarifier superstructure pose a structural damage risk if they were to blow over from excessive wind speeds. |

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| Composting Structure | • Excessive wind speeds | • Excessive winds from major storms and hurricanes could knock down trees adjacent to the composting structure. The falling trees could damage the structure's metal roof. | • Large trees adjacent to the solids composting structure pose a structural damage risk if they were to blow over from excessive wind speeds. |

**TABLE 3-4**
**PUMP STATION POTENTIAL VULNERABILITIES**

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| Pump Stations Radio Communications/Telemetry System | • Coastal flooding<br>• Sea level rise<br>• Flash flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Equipment damage from falling trees during large storms and hurricanes.<br>• Alarm conditions at remote stations go unnoticed for extended periods of time due to lack of communications equipment present and/or limited equipment range, capabilities and coordination with WWTF SCADA system. | • All pump stations are equipped with a portable generator hook-up and several have stand-by generators at the stations as well. Therefore, the risk of radio communications equipment failure during utility power loss is somewhat mitigated.<br>• At stations where large trees overhang the site, damage to above-ground communications equipment is a potential risk if they were to fall during large storms, excessive winds and/or hurricanes. |
| Mills Lane (PS-02) | • Excessive precipitation<br>• Increased storm intensity<br>• Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Equipment damage from falling trees during large storms and hurricanes. | • The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal.<br>• Large trees overhang the pump station and could damage above-ground equipment if they were to fall during large storms, excessive winds and/or hurricanes. |
| Greene Street (PS-03) | • Riverine flooding<br>• Increased storm intensity<br>• Excessive wind speeds | • Electrical equipment failure as a result of flooding from nearby Kennebunk River.<br>• Flooding as a result of sea level rise coupled with high astronomical tides.<br>• Accessibility issues at pump station as result of flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • The bottom of the electrical control panel is 1.0 feet above the preliminary FEMA 100-year BFE for this area. The station's pumps are submersible and are at low risk of flood damage. The emergency generator is 0.5 feet above the preliminary FEMA 100-year BFE.<br>• Based on SLOSH model mapping, the pump station could be at risk of partial inundation if a Category 1 hurricane were to hit the region during mean high tide.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• Access to the station could be limited if a Category 1 hurricane were to hit the region during mean high tide.<br>• The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal. |
| Chicks Creek (PS-04) | • Riverine flooding<br>• Increased storm intensity<br>• Excessive wind speeds | • Electrical equipment failure as a result of flooding from nearby Chicks Creek.<br>• Flooding as a result of sea level rise coupled with high astronomical tides.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • The bottom of the pump station electrical panel is 4.5 above the 100-year flood elevation for this area. The station's pumps are submersible and are at low risk of flood damage. The emergency generator is 2.5 feet above the 100-year flood elevation.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal. |
| South Main Street (PS-05) | • Riverine flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency | • Electrical equipment failure as a result of flooding from nearby unnamed brook.<br>• Accessibility issues at pump station as result of flooding. | • Historical inland flooding has been observed at the pump station when debris has clogged the unnamed brook's culvert that crosses under the road adjacent to the pump station, coupled with tidal influence on the unnamed brook. Flooding to the level of the existing road surface has been observed. Staff could not recall historical equipment failure due to flooding. Submersible pumps are a low risk of failure as a result of flooding. The pump station electrical control panel is elevated more than 3 feet above the preliminary FEMA 100-year BFE. |

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| | • Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses. | • Historical flooding at the pump station has not reached elevations that would cause accessibility issues.<br>• Large trees adjacent to the pump station are a risk for utility power loss and/or equipment damage if they fall during major storms, hurricanes or excessive winds. The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel. |
| Ocean Avenue (PS-06) | • Coastal flooding<br>• Sea level rise<br>• Flash flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Electrical equipment failure as a result of coastal flooding and storm surge.<br>• Flooding as a result of sea level rise coupled with storm surge<br>• Flash flooding via runoff from adjacent steeply sloped topography.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Electrical control equipment damage during wet-weather conditions | • The bottom of the pump station electrical control panel and drywell entrance are below the preliminary FEMA 100-year BFE. Staff have not observed any historical flood water encroachment near the pump station.<br>• The pump station footprint is relatively flat with no visible drainage for runoff. Localized ponding in this area after intense rainstorms and hurricanes could pose a potential risk to the electrical control panel, causing equipment failure.<br>• The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port on the pump station control panel.<br>• The pump station electrical control panel is somewhat dilapidated and is a concern as to it being weather-tight. |
| Turbats Creek Road (PS-07) | • Riverine flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Electrical equipment failure as a result of flooding from nearby Turbats Creek.<br>• Flooding as a result of sea level rise coupled with high astronomical tides.<br>• Accessibility issues at pump station as result of flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • Small wetland with a plugged culvert was observed near the pump station. Historical flood water has been observed near the pump station during high tide events. The sewer manhole upstream of the pump station is partially plugged during the winter to prevent salt water intrusion from encroaching estuarine waters. Staff could not recall historical equipment failure due to flooding. The bottom of the pump station electrical control panel is 1.5 feet above the preliminary 100-year BFE and the bottom of the emergency generator is 1.0 feet above the BFE.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• Historical flooding of Turbats Creek Road has not reached elevations that have caused accessibility issues at the pump station. However, sea level rise may cause accessibility issues to the station during high astronomical tides.<br>• The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal. |
| Wildes District Road (PS-08) | • Riverine flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Electrical equipment failure as a result of flooding from nearby unnamed brook.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Equipment damage or failure from falling trees during large storms, hurricanes and excessive wind speeds. | • There is small brook adjacent to the pump station that could pose a risk for localized flooding during spring snow melt and high flow conditions. Staff have not observed any localized flooding from the brook, so the risk of flooding is considered minimal.<br>• The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds. |
| Paddy Creek Road (PS-09) | • Riverine flooding<br>• Flash flooding<br>• Coastal flooding<br>• Sea level rise<br>• Excessive precipitation | • Electrical equipment failure as a result of flooding and sea level rise from nearby Paddy Creek.<br>• Accessibility issues at pump station as result of flooding. | • The bottom of the pump station electrical panel is 1.0 feet above the preliminary FEMA 100-year BFE. The entrance hatch to the pump station drywell is 2 feet above the preliminary FEMA 100-year BFE. The bottom of the emergency generator is 1.0 feet above the preliminary FEMA 100-year BFE. Staff have not observed any historical flooding of the pump station from Paddy Creek, but water levels have reached the elevation of the pump station access road. |

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| | • Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Localized flooding from drainage ditch abutting pump station site.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Equipment damage or failure from falling trees during large storms, hurricanes and excessive wind speeds. | • Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• Sea level rise coupled with riverine flooding could pose a risk of accessibility issues at the pump station.<br>• A drainage ditch runs adjacent to the pump station and could pose a risk for localized flash flooding during spring snow melt and high flow conditions. Staff have not observed any localized flooding from the brook, so the risk of flash flooding is considered minimal.<br>• Staff have observed staining on the inside of the station's drywell structure. This could be a sign of groundwater infiltration into the drywell.<br>• The pump station is equipped with a stand-by generator and portable generator hook-up, therefore risk of electrical equipment failure during utility power loss is minimal.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds. |
| Mills Road (PS-11) | • Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Equipment damage or failure from falling trees during large storms, hurricanes and excessive wind speeds. | • The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds. |
| King's Highway-Main (PS-12) | • Coastal flooding<br>• Sea level rise<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Flooding due to sea level rise and large storms and/or hurricanes.<br>• Marsh migration as a result of sea level rise.<br>• Accessibility issues at pump station as result of sea level rise and flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Damage to pump station building roof system due to hurricane-force wind loading. | • Large salt water marsh abuts the pump station. A concrete barrier wall and permeable road subgrade materials have been installed to reducing flooding risk. The entrance to the lower level pump room and the elevation of emergency generator are both 2 feet below the preliminary FEMA 100-year BFE. The air intake louver on the pump station building for the stand-by generator is at the 100-year BFE.<br>• Based on SLOSH model mapping, the pump station could be at risk of partial inundation if a Category 1 hurricane were to hit the region during mean high tide.<br>• Based on the potential 1.2, 1.6 and 3.9 feet of sea level rise scenarios for the region, the pump station may be at risk of partial inundation during high astronomical tides under all three scenarios.<br>• Sea level rise coupled with localized flooding of the salt water marsh could pose a risk of accessibility issues at the pump station.<br>• According to marsh migration modeling, 2-3.3 feet of sea level rise may cause salt marsh migration onto the pump station property.<br>• The pump station is equipped with a stand-by generator. However, the electrical control panel and pumps are located in the lower level pump room of the pump station building. If floodwaters enter the pump station building, they will migrate to the lower level pump room through the aluminum grated hatch entrance. The pump room is equipped with a sump pump to protect against flooding. If the sump pump fails due to power loss, the pump room could become inundated.<br>• The pump station building roof system was constructed around 1992 and may not adequately account for current wind loading standards for Category 1 hurricanes. |

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| King's Lane (PS-13) | • Coastal flooding<br>• Sea level rise<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Flooding due to sea level rise and large storms and/or hurricanes.<br>• Marsh migration as a result of sea level rise.<br>• Accessibility issues at pump station as result of sea level rise and flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • The bottom of the pump station electrical panel is 2.5 feet below the preliminary FEMA 100-year BFE. The entrance hatch to the pump station drywell is 2 feet below the preliminary FEMA 100-year BFE. Staff have observed historical flooding reach the elevation of the pump station access road.<br>• Based on SLOSH model mapping, the pump station could be at risk of partial inundation if a Category 1 hurricane were to hit the region during mean high tide.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• According to marsh migration modeling, 2-3.3 feet of sea level rise may cause salt marsh migration onto the pump station property.<br>• Sea level rise coupled with localized flooding could pose a risk of accessibility issues at the pump station.<br>• The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds. |
| King's Highway-Submersible (PS-14) | • Coastal flooding<br>• Sea level rise<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Flooding due to sea level rise and large storms and/or hurricanes.<br>• Marsh migration as a result of sea level rise.<br>• Accessibility issues at pump station as result of sea level rise and flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • The bottom of the pump station electrical panel is 1.5 feet below the preliminary FEMA 100-year BFE. Staff have not observed historical flooding reach the elevation of the pump station access road.<br>• Based on SLOSH model mapping, the pump station could be at risk of partial inundation if a Category 1 hurricane were to hit the region during mean high tide.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• According to marsh migration modeling, 2-3.3 feet of sea level rise may cause salt marsh migration onto the pump station property.<br>• Sea level rise coupled with localized flooding could pose a risk of accessibility issues at the pump station.<br>• The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds. |
| Prescott Drive (PS-15) | • Flash flooding<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Flash flooding due to large storms and/or hurricanes coupled with poor site drainage.<br>• Accessibility issues at pump station as result flooding and poor site drainage.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • Staff have observed historical localized flooding around the pump station site and access road due to poor site drainage.<br>• Based on the potential 3.9 feet of sea level rise scenario for the region, the pump station may be at risk of partial inundation during high astronomical tides.<br>• Localized flooding coupled with poor site drainage could pose a risk of accessibility issues at the pump station.<br>• The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• Large trees adjacent to the pump station are a potential risk for equipment damage if they fall during major storms, hurricanes or excessive winds.<br>• The pump station does not have radio telemetry equipment capable of notifying Town personnel of alarm conditions. The station relies on local visual and auditory alarm system to notify nearby residents who notify Town personnel. |

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| Washington Court (PS-16) | • Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses. | • The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• The pump station does not have radio telemetry equipment capable of notifying Town personnel of alarm conditions. The station relies on local visual and auditory alarm system to notify nearby residents who notify Town personnel. |
| Wakefield Pasture Road (PS-17) | • Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Inoperable electrical equipment due to storm- and wind-related utility power losses.<br>• Electrical control equipment damage during wet-weather conditions | • The risk of equipment failure during utility power loss at the pump station is somewhat mitigated by the portable generator hookup port installed on the pump station control panel.<br>• The pump station does not have radio telemetry equipment capable of notifying Town personnel of alarm conditions. The station relies on local visual and auditory alarm system to notify nearby residents who notify Town personnel.<br>• The pump station electrical control panel is somewhat dilapidated and is a concern as to it being weather-tight. |
| Grinder Pump Stations | • Coastal flooding<br>• Sea level rise<br>• Excessive precipitation<br>• Increased storm intensity<br>• Increased storm duration<br>• Increased storm frequency<br>• Excessive wind speeds | • Flooding due to sea level rise and large storms and/or hurricanes.<br>• Accessibility issues at pump station as result of sea level rise and flooding.<br>• Inoperable electrical equipment due to storm- and wind-related utility power losses. | • Many of these individual stations are located within the 100-year BFE and are located below grade. Sea level rise and storm surge will likely increase the risk of pump failure.<br>• Salt water intrusion, mechanical equipment damage and chloride attack on concrete structures as a result of coastal flooding and/or storm surge into the grinder pump stations and subsequently the sewer collection system is a potential risk where stations are located in flood-prone coastal areas.<br>• Accessibility will likely be an issue for many of the stations located in flood-prone coastal areas. Sea level rise and storm surge will likely exacerbate accessibility issues at these locations.<br>• The individual grinder pumps are not typically equipped with stand-by power or a portable power supply connection port. If utility power to the residence associated with a grinder pump fails, the grinder pump motor will fail. This risk may be somewhat mitigated at some locations if the private residence has a stand-by or portable emergency power generator. Failure of an individual grinder pump station is not considered a significant risk to the co |

**TABLE 3-5**
**SEWER COLLECTION SYSTEM POTENTIAL VULNERABILITIES**

| Critical Assets | Potential Vulnerabilities | Potential Consequences | Assessment of Hazard Consequences |
|---|---|---|---|
| Sewer Mains | • Riverine flooding<br>• Flash flooding<br>• Coastal flooding<br>• Sea level rise<br>• Excessive precipitation | • Increased infiltration into pipe cracks and off-set joints from elevated groundwater table.<br>• Pipe embedment undermining from soil erosion.<br>• Increased inflow from sump pumps, roof and perimeter drains connected to the sewer. | • Riverine flooding could increase the risk of infiltration into older leaky sections of the sewer system that are located within the floodplain of nearby rivers, streams and brooks by elevating the local groundwater table and increasing hydrostatic pressure on sewer mains.<br>• Flash flooding could increase the risk of localized infiltration into older leaky sections of the sewer system by elevating the local groundwater table and increasing hydrostatic pressure on sewer mains.<br>• Coastal flooding could increase the risk of localized infiltration into older leaky sections of the sewer system located in coastal flood zones by elevating the local groundwater table and increasing hydrostatic pressure on sewer mains.<br>• Sea level rise could enhance the risk of infiltration into older leaky sections of the sewer system located in coastal flood zones by elevating the local groundwater table and increasing hydrostatic pressure on sewer mains.<br>• Staff have not observed signs of significant embedment undermining of the gravity sewer mains or force mains. Sea level rise could increase the risk of embedment undermining for segments located in coastal flood zones.<br>• Increased inflow due to flooding and excessive precipitation is possible in older sections of the sewer system that have not been surveyed for private inflow sources. |
| Manholes | • Riverine flooding<br>• Flash flooding<br>• Coastal flooding<br>• Excessive precipitation | • Increased inflow from flood and precipitation runoff water ponding on top of the manhole structures.<br>• Increased infiltration into manhole seams. from elevated groundwater table.<br>• SSOs out of manhole structures from elevated wet-weather flows exceeding sewer main capacity. | • Water ponding on top of sewer manholes would be limited to low-lying and slow-draining areas and manholes within coastal flood zones.<br>• Chloride attack on concrete structures from infiltrating brackish water in flood-prone coastal areas.<br>• Increased infiltration into the sewer manhole seams and cracks would be limited to manholes in poor condition.<br>• Historical SSO problems from excessive I/I have been very infrequent. It is expected that SSO issues would be limited to very large and infrequent storms. |

# SECTION 4
# ADAPTATION MEASURES

## 4.1 EVALUATION OF ADAPTATION MEASURES

Possible adaptation measures were identified and evaluated based on the likelihood of hazard consequences occurring. Adaptation measures can be grouped into two major categories: operational and specialized measures. Operational adaptation measures are tasks or procedural changes that Town staff could undertake at minimal cost to the Town to prevent or mitigate potential hazard consequences. Specialized measures are adaptation measures requiring non-routine or one-time tasks, in-depth studies or evaluations, design modifications, or capital expenditures. Table 4-1 summarizes potential hazard vulnerabilities applicable to the entire wastewater collection and treatment system and identified adaptation measures. Table 4-2 summarizes identified adaptation measures for WWTF assets with potential hazard vulnerabilities. Table 4-3 summarizes identified adaptation measures for pump stations with potential hazard vulnerabilities. Table 4-4 summarizes identified adaptation measures for possible collection system hazards.

## 4.2 PRIORITIZATION OF ADAPTATION MEASURES

The identified operational adaptation measures listed in Table 4-1 are considered best management practices and because of their low cost and ease of implementation, were given top priority. "Passive" adaptation measures specific to the WWTF, pump stations and sewer collection system assets including monitoring current conditions and/or trends over time in Tables 4-2, 4-3 and 4-4 were also given top priority. Adaptation measure effectiveness, criticality to system performance and reliability, and estimated cost were considerations in determining the priority of the "active" specialized adaptation measures listed in Tables 4-2, 4-3 and 4-4. Table 5-1 in Section 5 of the report summarizes the priority of the recommended "active" specialized adaptation measures for the WWTF, pump stations and sewer collection system.

**TABLE 4-1**
**SYSTEM-WIDE ADAPTATION MEASURES**

| Potential Vulnerabilities | Adaptation Measures |
|---|---|
| Excessive Precipitation &<br>Increased Storm Intensity, Duration & Frequency | • Perform routine inspections of exposed equipment after heavy or intense precipitation events.<br>• Monitor influent flow trends during wet-weather events and snow-melt conditions.<br>• Exercise extreme caution and limit travel time during poor travel conditions.<br>• Perform routine stand-by generator maintenance tasks and schedule routine service inspections with manufacturers/dealers.<br>• Continue to exercise standby generators in accordance with manufacturers recommendations.<br>• Discuss utility power restoration priorities with utility power supply company.<br>• Exercise caution and use proper PPE while working outdoors in wet-weather conditions.<br>• Evaluate I/I reduction in the collection system.<br>• Review written wet-weather management plan to ensure it is up-to-date and make any necessary adjustments.<br>• Review wet-weather management plan with current operations staff and any new hires.<br>• Routinely remove excess snow to facilitate access to critical assets. |
| Excessive Wind Speeds | • Monitor large trees adjacent to utility power lines and discuss potential risks with utility power supply company.<br>• Perform routine stand-by generator maintenance tasks and schedule routine service inspections with manufacturer/dealer.<br>• Exercise standby generators in accordance with manufacturers recommendations.<br>• Discuss utility power restoration priorities with utility power supply company. |

**TABLE 4-2**
**WWTF ADAPTATION MEASURES**

| Critical Assets | Adaptation Measures |
|---|---|
| WWTF Buildings | • Confirm if roofing systems for permanent WWTF buildings are constructed to adequately withstand wind loads from Category 1 hurricane. Perform roof system assessment as needed to determine any necessary roof system upgrades. |
| Influent/Effluent Wet Wells | • Provide flood doors and water-tight access hatches to influent and effluent wetwell entrances. |
| WWTF Stand-by Generator | • Replace aging stand-by power generator replacement to reduce risk of equipment failure in the event of utility power loss during intense storms and evaluate raising stand-by power generator by increasing concrete pad thickness to mitigate flood risk during upgrade. |
| Secondary Clarifiers | • Continue to monitor elevated spring wastewater flow conditions for upward flow trends.<br>• Continue phased approach to replacing aging and leaking sewer pipes and manholes in the collection system to reduce infiltrating groundwater and runoff from being treated at the WWTF.<br>• Upgrade 35-year old clarifier mechanisms to decrease risk of imminent mechanical failure and increase treatment reliability into the future.<br>• Complete house-to-house survey of elicit sump pump and cellar drain connections to the sanitary sewer system and increase enforcement of sewer ordinances (refer to Sewer System Adaptation Measures, Table 4-4).<br>• Monitor snow accumulation on the existing secondary clarifier domes and increase snow removal frequency as snow accumulation increases.<br>• Complete structural evaluation of clarifier domes superstructure including recommendations for increasing roof reinforcement or dome upgrades.<br>• Remove large trees adjacent to the secondary clarifiers showing signs of disease or rot to reduce risk of a blow down on the clarifier dome superstructures. |
| Composting Structure | • Remove adjacent large trees showing signs of disease or rot that present a blow-down risk to the biosolids composting structure.<br>• Replace damaged structural roof support beam and deteriorating concrete anchoring inside composting structure. |

**TABLE 4-3**
**PUMP STATION ADAPTATION MEASURES**

| Critical Assets | Adaptation Measures |
|---|---|
| Pump Stations Radio Communications/Telemetry System | • Perform evaluation study for upgrading pump station radio communications system including coordination with WWTF SCADA system.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on communications equipment. |
| Mills Lane (PS-02) | • Monitor any changes to Kennebunk River floodplain as sea level continues to rise.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. |
| Greene Street (PS-03) | • Monitor any changes to Kennebunk River floodplain as sea level continues to rise.<br>• Provide temporary barrier around pump station as needed if water levels appear to threaten electrical panel or emergency power generator at the station. |
| Chicks Creek (PS-04) | • Monitor any changes to Chicks Creek floodplain as sea level continues to rise.<br>• Provide temporary barrier around pump station as needed if water levels appear to threaten electrical panel or emergency power generator at the station. |
| South Main Street (PS-05) | • Monitor any changes to unnamed brook floodplain as sea level continues to rise.<br>• Monitor and request increased maintenance of the adjacent culvert pipe to avoid plugging and back-ups of flow from the unnamed brook.<br>• Perform assessment to determine if adjacent culvert is adequately sized for potential future flow conditions.<br>• Provide temporary barrier around the pump station as needed if water levels appear to threaten electrical panel.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. |

| Critical Assets | Adaptation Measures |
|---|---|
| Ocean Avenue (PS-06) | • If flood water appears to threaten electrical panel, construct temporary barrier and evaluate raising electrical panel to a higher elevation.<br>• Evaluate construction of permanent enclosure around electrical control panel to reduce risk of flooding and water damage from intense storms and/or hurricanes.<br>• Evaluate improving site drainage or constructing a barrier around the back side of the pump station to direct runoff drainage from the nearby hill away from the pump station.<br>• Evaluate upgrading aging electrical control panel and pumping equipment to reduce the risk of imminent mechanical failure at the pump station during adverse weather conditions. |
| Turbats Creek Road (PS-07) | • Monitor any coastal floodplain changes as sea level continues to rise.<br>• Monitor small wetland adjacent to pump station and condition of adjacent culvert pipe under the road and request increasing the frequency of pipe maintenance.<br>• If flood waters appear to threaten electrical panel, construct temporary barrier and evaluate raising electrical panel and emergency generator to a higher elevation.<br>• Work with seasonal homeowners to remove any illicit drainage connections to sanitary sewer system and to upgrade house service connection to reduce saltwater intrusion. |
| Wildes District Road (PS-08) | • Monitor flood elevations of small brook adjacent to pump station during wet weather conditions and spring runoff and construct temporary barriers as needed to reduce the risk to electrical control panel and emergency generator.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. |
| Paddy Creek Road (PS-09) | • Monitor flood elevations of Paddy Creek adjacent to pump station as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical control panel and emergency generator.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. |
| Mills Road (PS-11) | • Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. |
| King's Highway-Main (PS-12) | • Monitor flood elevations of salt water marsh adjacent to pump station as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical equipment, pumps and emergency generator in the pump station building.<br>• Evaluate installing removable stop logs or flood doors for the pump station building entrance to reduce risk of flood encroachment.<br>• Evaluate design modifications to the stand-by generator intake louver to reduce risk of flood encroachment through the louver while the generator is operating.<br>• Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station.<br>• Confirm that lower level pump room sump pump is connected to stand-by generator power and make necessary wiring modifications if it is not connected to stand-by generator circuit.<br>• Evaluate replacing the open aluminum grating access hatch to lower level pump room with water-tight access hatch to mitigate flood risk to the lower level electrical control panels and pumps.<br>• Confirm if pump station building roofing system is constructed to adequately withstand wind loads from Category 1 hurricane. Perform roof system assessment as needed to determine any necessary roof system upgrades. |
| King's Lane (PS-13) | • Monitor flood elevations as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical control panel.<br>• Evaluate permanently raising electrical control panel at least 2-3 feet above the preliminary FEMA BFE and providing a water-tight drywell access hatch cover to reduce the risk of mechanical equipment failure during flooding, severe storms and/or hurricanes.<br>• Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. |
| King's Highway-Submersible (PS-14) | • Monitor flood elevations as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical control panel.<br>• Evaluate permanently raising electrical control panel at least 2-3 feet above the preliminary FEMA BFE.<br>• Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station. |

| Critical Assets | Adaptation Measures |
|---|---|
| | • Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. |
| Prescott Drive (PS-15) | • Monitor flood elevations in poorly draining areas adjacent to the pump station during wet weather conditions and construct temporary barriers as needed to reduce flooding risk to electrical control panel.<br>• Work with local housing developers to ensure site drainage adjacent to the pump station is addressed during design in order to mitigate future flooding risks.<br>• Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station.<br>• Evaluate installing radio telemetry equipment as part of pump stations communication system upgrade to notify WWTF staff remotely of alarm conditions at the pump station.<br>• Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. |
| Washington Court (PS-16) | • Evaluate installing radio telemetry equipment as part of pump stations communication system upgrade to notify WWTF staff remotely of alarm conditions at the pump station. |
| Wakefield Pasture Road (PS-17) | • Evaluate installing radio telemetry equipment as part of pump stations communication system upgrade to notify WWTF staff remotely of alarm conditions at the pump station.<br>• Upgrade dilapidated electrical controls equipment and panel box to be weather-proof in order to decrease risk of failure due to moisture infiltration. |
| Grinder Pump Stations | • Monitor weather reports for large coastal storms and high tide conditions and increase inspection frequency during these periods in flood-prone areas with grinder pump stations to reduce risk of extended pump downtime.<br>• Evaluate providing protective coatings for downstream concrete structures at manholes, pump stations and WWTF to mitigate chloride attack and extend useful life of assets.<br>• Draft an emergency access plan and procedures for flood-prone areas with grinder pump stations. |

**TABLE 4-4**
**SEWER COLLECTION SYSTEM ADAPTATION MEASURES**

| Critical Assets | Adaptation Measures |
|---|---|
| Sewer System | • Evaluate drainage improvements in areas with significant local flooding or ponding of water on sewer manholes.<br>• Complete a house-to-house private inflow sources survey and enforce illicit sewer connection ordinance to reduce I/I.<br>• Frequent cleaning and CCTV inspection of areas suspected of high I/I and grit build-up.<br>• Evaluate identified high I/I areas for sewer system rehabilitation or replacement upgrades.<br>• Monitor cross-country sewer lines for signs of ponding on manholes and embedment erosion.<br>• Evaluate and install water-tight manhole covers in low-lying and flood-prone areas, as needed. |

# SECTION 5
# RECOMMENDED ADAPTATION PLAN

## 5.1 IMPLEMENTATION PLAN

The identified operational adaptation measures were given top priority because of their low cost and ease of implementation and are therefore recommended for immediate implementation. Specialized adaptation measures were prioritized considering measure effectiveness, criticality to system performance and reliability, and estimated cost. A summary of the recommended adaptation measures, timeline for implementation and planning-level project costs have been prepared and are presented in Table 5-1. The planning-level costs were developed using standard cost estimating procedures consistent with industry standards. The project cost information presented herein is in current dollars and is based on ENR Index 11213 (Feb, 2019). These estimates have been developed primarily for evaluating alternative solutions and are generally reliable for determining the relative costs of various options. Many factors arise during final design (e.g. owner selected features and amenities, code issues, etc.) that cannot be definitively identified and estimated at this time.

## 5.2 POTENTIAL FUNDING SOURCES

### 5.2.1 Internal Reserves

The Town has internal budget reserves for minor capital expenditures that could be used to fund limited climate adaptation measures. Reserve funds could be used for relatively low-cost operational or process modifications and/or minor capital improvement projects. This would be the preferred funding mechanism for the recommended CAP measures as utilizing reserve funds does not impact sewer user rates.

### 5.2.2 Local Revenue

For adaptation measures that cannot be covered by budget reserves alone, the Town could raise the revenues needed to cover costs by implementing a structured rate increase. Generated revenues could be used for low-cost operational or process modifications, and both minor and significant capital improvements. This would be a less desirable funding mechanism than using budgeted reserves because it would require increasing sewer user rates.

### 5.2.3 State Funding

Some adaptation measures requiring capital improvements may be eligible for financial assistance from the State of Maine through the Community Development Block Grant (CDBG) program or the CWSRF loan program.

The Maine Department of Economic and Community Development administers the CDBG program for the State of Maine. Grants are provided to municipalities and quasi-municipal entities for eligible capital improvement projects. The Town could apply for CDBG funds to implement recommended CAP specialized adaptation measures with a significant capital cost. CDBG funding would be preferable to CWSRF loan funding because grant funds would not need to be repaid. To be eligible for CDBG funds, the Town would need to complete a grant application and other CDBG program requirements including an environmental review report and a preliminary engineering report. The Town would be competing in a state-wide pool of applicants for limited grant funds. The next round of applications for CDBG funding is the first quarter of 2020.

The CWSRF program provides low-interest loans to local communities and quasi-municipal entities for wastewater infrastructure improvement projects. CAP specialized adaptation measures with a significant capital cost would likely be eligible for CWSRF loan funding. CWSRF loan principal and interest would need to be fully repaid over the term of the loan (typically 20 years or the expected life of the asset) unless the Town qualified for partial principal forgiveness. To be eligible for a CWSRF loan, the Town would need to complete a CWSRF loan application with the Maine Municipal Bond Bank and other CWSRF program requirements including an environmental impact review report and preliminary design report.

Maine Emergency Management Agency administers the Hazard Mitigation Grant Program (HMGP) for the State of Maine. HMGP funding is made available by Federal Disaster Declaration. to qualifying communities who can show that they have been negatively impacted by a Federally Declared Disaster. This one-time funding source may be available to the Town of Kennebunkport because of Federal Declared Disaster DR-4367 for the York County Severe Storm that occurred between March 3, 2018 and March 8, 2018. Approximately $900,000 in disaster funds are available to qualifying communities.

In order for the Town of Kennebunkport to qualify for HMGP funding, it would need to show that the identified natural disaster caused damage or negative impacts to the Town's wastewater treatment and collection system. Additional prerequisites to this funding would include:

1. Participation in the County Hazard Mitigation Program
2. The Town would need to show that the measures undertaken using the grant funds would provide a greater savings than the cost of implementing them.
3. The project would need to comply with environmental and historic preservation laws.
4. The Town would need to be compliant with the National Flood Insurance Program (NFIP).

The deadline to apply for this funding is March 29, 2019. Top-scoring applications will be submitted by MEMA to FEMA for final review May 30, 2019.

The Town has previously expressed interest in possibly pursuing this grant funding source. Any grant awarded to the Town would be used to completely or partially fund qualifying projects, depending on the amount of the grant award.

### 5.2.4 Federal Funding

The U.S. Department of Agriculture (USDA) Rural Development (RD) offers Water & Waste Disposal Predevelopment Grants to eligible communities to assist with the initial planning and development of RD Water & Waste Disposal direct loans/grants. RD also offers Water & Waste Disposal direct loans/grants for sanitary sewage disposal, solid waste disposal and storm water drainage projects. The Town would likely qualify for RD water & waste disposal loan funding. only.

For CDBG, CWSRF and RD funding, applicants are required to prepare an environmental review report and preliminary engineering report. The State of Maine's CDBG and CWSRF programs are willing to accept an environmental impact review report and preliminary engineering report prepared for RD funding to satisfy their requirements. Therefore, if the Town intends to seek outside funding for the recommended CAP specialized adaptation measures, it is recommended that an environmental impact review report and preliminary engineering report be prepared to RD standards to satisfy the preliminary requirements of all three funding programs.

FEMA Flood Mitigation Assistance (FMA) grants are available for planning and construction projects that reduce or eliminate long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP). The Town would be required to submit a project application to the State Hazard Mitigation Officer to then be forwarded on to the Regional FEMA office for review and approval. The hazard mitigation project would also be required to conform with the State and local Hazard Mitigation Plans to be eligible for FMA grants. The Town would be competing for HMA grant funds within a national pool of applicants. Although grant funding is a preferable method to implement CAP adaptation measures, the amount of time and effort required to complete the FEMA FMA grant application process and to receive Federal, State and local approval is probably not in the Town's best interest, given the competition for FMA grant funds nationally and the uncertainty of federal grant funding levels.

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) established the WIFIA program, a federal credit program administered by EPA for eligible water and wastewater infrastructure projects. Eligible borrowers include local, state, tribal, and federal government entities, partnerships and joint ventures, corporations and trusts and Clean Water and Drinking Water State Revolving Fund (SRF) programs.

The WIFIA program can fund projects that are eligible for the Clean Water SRF including development phase activities such as planning, preliminary engineering, design, environmental review, revenue forecasting, and other pre-construction activities, construction, reconstruction, rehabilitation, and replacement work, acquisition of real property or an interest in real property, environmental mitigation, construction contingencies, and acquisition of equipment.

Although design and construction costs of the recommended adaptation measures in Table 5-1 would be categorically eligible for federal WIFIA program funds, the WIFIA program can only fund up to 49% of project costs and requires a minimum project size of $5 million for small communities such as Kennebunkport. In addition, typical SRF program requirements including an Environmental Review, Davis-Bacon wage rates and American Iron and Steel requirements would apply to WIFIA funding. Given these eligibility criteria and funding limitations, WIFIA program financing would not be a preferred funding source when compared to USDA Rural Development, CDBG and the Maine SRF funding programs.

**TABLE 5-1**
**CAP IMPLEMENTATION PLAN & ESTIMATED COSTS**

1—Highest Priority | 2—High Priority | 3—Moderate Priority | 4—Lower Priority

| Priority | Critical Asset | Specialized Adaptation Measures | Timeline for Implementation | Estimated Capital Cost* |
|---|---|---|---|---|
| 1 | System-wide | Implement at-risk asset monitoring and all operational adaptation measures identified in the CAP report. | 1-5 years | <$1,000 |
| 1 | WWTF Stand-By Generator | Replace aging stand-by power generator replacement to reduce risk of equipment failure in the event of utility power loss during intense storms and evaluate raising stand-by power generator by increasing concrete pad thickness to mitigate flood risk during upgrade. | 1-5 years | TBD** |
| 1 | King's Lane (PS-13) | Permanently raise electrical control panel at least 2-3 feet above the preliminary FEMA BFE and provide a water-tight drywell access hatch cover to reduce the risk of mechanical equipment failure during flooding, severe storms and/or hurricanes. | 1-5 years | $35,000-$40,000 |
| 1 | King's Highway-Submersible (PS-14) | Permanently raise electrical control panel at least 2-3 feet above the preliminary FEMA BFE. | 1-5 years | $35,000-$40,000 |
| 1 | Sewer System | Install water-tight manhole covers in low-lying and flood-prone areas, as needed. | 1-5 years | $1,000-$2,000/manhole |
| 2 | Pump Stations Radio Communications/Telemetry System | Perform evaluation study for upgrading pump station radio communications system including coordination with WWTF SCADA system. | 6-10 years | $5,000 |
| 2 | Secondary Clarifiers | Continue phased approach to replacing aging and leaking sewer pipes and manholes in the collection system to avoid increasing clarifier capacity to handle increasing peak flows to WWTF. | 6-10 years | $125,000-$200,000/year |
| 2 | Secondary Clarifiers | Upgrade 40+-year old clarifier mechanisms to decrease risk of imminent mechanical failure and increase treatment reliability into the future. | 6-10 years | TBD** |
| 2 | Ocean Avenue (PS-06) | Improve site drainage or construct a barrier around the back side of the pump station to direct runoff drainage from the nearby hill away from the pump station. | 6-10 years | $15,000-$20,000 |
| 2 | Ocean Avenue (PS-06) | Upgrade aging electrical control panel and pumping equipment to reduce the risk of imminent mechanical failure at the pump station during adverse weather conditions. | 6-10 years | $350,000-$550,000 |
| 2 | King's Highway-Main (PS-12) | Evaluate installing removable stop logs or flood doors for the pump station building entrance to reduce risk of flood encroachment. | 6-10 years | $5,000 |
| 2 | King's Highway-Main (PS-12) | Evaluate replacing the open aluminum grating access hatch to lower level pump room with water-tight access hatch to mitigate flood risk to the lower level electrical control panels and pumps. | 6-10 years | $10,000 |
| 2 | King's Highway-Main (PS-12) | Evaluate design modifications to the stand-by generator intake louver to reduce risk of flood encroachment through the louver while the generator is operating. | 6-10 years | $10,000 |

| Priority | Critical Asset | Specialized Adaptation Measures | Timeline for Implementation | Estimated Capital Cost* |
|---|---|---|---|---|
| 2 | King's Highway-Main (PS-12) | Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station. | 6-10 years | $2,500-$5,000 |
| 2 | King's Lane (PS-13) | Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station. | 6-10 years | $2,500-$5,000 |
| 2 | King's Highway-Submersible (PS-14) | Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station. | 6-10 years | $2,500-$5,000 |
| 2 | Prescott Drive (PS-15) | Draft an emergency pump station access plan and procedures with Wastewater Department operations staff in case flooding blocks typical access route to pump station. | 6-10 years | $2,500-$5,000 |
| 2 | Sewer System | Complete house-to-house private inflow sources survey and enforce illicit sewer connection ordinance to reduce I/I. | 6-10 years | $20,000-$50,000 |
| 2 | Turbats Creek Road (PS-07) | If flood waters appear to threaten electrical panel, construct temporary barrier and evaluate raising electrical panel and emergency generator at least 2-3 feet above the preliminary FEMA BFE. | As needed | $5,000—temporary barrier<br>$35,000-$40,000—raise electrical panel and generator |
| 2 | Wildes District Road (PS-08) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. | As needed | $5,000 |
| 2 | Paddy Creek Road (PS-09) | Monitor flood elevations of Paddy Creek adjacent to pump station as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical control panel and emergency generator. | As needed | $5,000 |
| 2 | Paddy Creek Road (PS-09) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. | As needed | $5,000 |
| 2 | Mills Road (PS-11) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel and/or emergency generator. | As needed | $5,000 |
| 2 | King's Highway-Main (PS-12) | Confirm if pump station building roofing system is constructed to adequately withstand wind loads from Category 1 hurricane. Perform roof system assessment as needed to determine any necessary roof system upgrades. | As needed | $5,000 |
| 2 | King's Lane (PS-13) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. | As needed | $5,000 |
| 2 | King's Highway-Submersible (PS-14) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. | As needed | $5,000 |
| 2 | Prescott Drive (PS-15) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. | As needed | $5,000 |
| 3 | Composting Structure | Replace damaged structural roof support beam and deteriorating concrete anchoring inside composting structure. | 11-15 years | $15,000 |
| 3 | Ocean Avenue (PS-06) | Construct permanent enclosure around electrical control panel to reduce risk of flooding and water damage from intense storms and/or hurricanes. | 11-15 years | $50,000-$150,000*-Construction |

| Priority | Critical Asset | Specialized Adaptation Measures | Timeline for Implementation | Estimated Capital Cost* |
|---|---|---|---|---|
| 3 | Sewer System | Evaluate identified high I/I areas for sewer system rehabilitation or replacement upgrades. | 11-15 years | $10,000-$20,000 |
| 3 | WWTF Buildings | Confirm if roofing systems for permanent WWTF buildings are constructed to adequately withstand wind loads from Category-1 hurricane. Perform roof system assessment as needed to determine any necessary roof system upgrades. | As needed | $5,000 |
| 3 | Influent/Effluent Wet Wells | Provide flood doors and water-tight access hatches to influent and effluent wetwell entrances. | 11-15 years | $15,000 |
| 3 | Secondary Clarifiers | Remove large trees adjacent to the secondary clarifiers showing signs of disease or rot to reduce risk of a blow down on the clarifier dome superstructures. | As needed | $5,000 |
| 3 | Composting Structure | Remove adjacent large trees showing signs of disease or rot that present a blow-down risk to the biosolids composting structure. | As needed | $5,000 |
| 3 | Mills Lane (PS-02) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. | As needed | $5,000 |
| 3 | Greene Street (PS-03) | Provide temporary barrier around pump station as needed if water levels appear to threaten electrical panel or emergency power generator at the station. | As needed | $5,000 |
| 3 | Chicks Creek (PS-04) | Provide temporary barrier around pump station as needed if water levels appear to threaten electrical panel or emergency power generator at the station. | As needed | $5,000 |
| 3 | South Main Street (PS-05) | Remove large trees adjacent to the pump station showing signs of disease or rot to reduce risk of a blow down on electrical equipment panel. | As needed | $5,000 |
| 3 | Wildes District Road (PS-08) | Monitor flood elevations of small brook adjacent to pump station during wet weather conditions and spring runoff and construct temporary barriers as needed to reduce the risk to electrical control panel and emergency generator. | As needed | $5,000 |
| 3 | King's Highway-Main (PS-12) | Confirm that lower level pump room sump pump is connected to stand-by generator power and make necessary wiring modifications if it is not connected to stand-by generator circuit. | As needed | $2,000 |
| 3 | Wakefield Pasture Road (PS-17) | Upgrade dilapidated electrical controls equipment and panel box to be weather-proof in order to decrease risk of failure due to moisture infiltration. | 11-15 years | $10,000 |
| 3 | King's Highway-Main (PS-12) | Monitor flood elevations of salt water marsh adjacent to pump station as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical equipment, pumps and emergency generator in the pump station building. | As needed | $5,000 |
| 3 | King's Highway-Submersible (PS-14) | Monitor flood elevations as sea level continues to rise and construct temporary barriers as needed to reduce the risk to electrical control panel. | As needed | $5,000 |
| 3 | Prescott Drive (PS-15) | Monitor flood elevations in poorly draining areas adjacent to the pump station during wet weather conditions and construct temporary barriers as needed to reduce flooding risk to electrical control panel. | As needed | $5,000 |
| 4 | Secondary Clarifiers | Complete structural evaluation of clarifier domes superstructure including recommendations for increasing roof reinforcement or dome upgrades. | 16-20 years | $5,000 |

| Priority | Critical Asset | Specialized Adaptation Measures | Timeline for Implementation | Estimated Capital Cost* |
|---|---|---|---|---|
| 4 | South Main Street (PS-05) | Perform assessment to determine if adjacent culvert is adequately sized for potential future flow conditions. | 16-20 years | $5,000-$10,000 |
| 4 | Turbats Creek Road (PS-07) | Work with seasonal homeowners to remove any illicit drainage connections to sanitary sewer system and to upgrade house service connection to reduce saltwater intrusion. | 16-20 years | $5,000 |
| 4 | Sewer System | Evaluate drainage improvements in areas with significant local flooding or ponding of water on sewer manholes. | 16-20 years | $10,000-$20,000 |
| 4 | South Main Street (PS-05) | Provide temporary barrier around the pump station as needed if water levels appear to threaten electrical panel. | As needed | $5,000 |
| 4 | Ocean Avenue (PS-06) | If flood water appears to threaten electrical panel, construct temporary barrier and evaluate raising electrical panel to a higher elevation. | As needed | $5,000 |
| 4 | Sewer System | Frequent cleaning and CCTV inspection of areas suspected of high I/I and grit build-up. | As needed | $3.00-$5.00/LF |
| 4 | Grinder Pump Stations | Evaluate providing protective coatings for downstream concrete structures at manholes, pump stations and WWTF to mitigate chloride attack and extend useful life of assets. | As needed | $3.00-$5.00/SF |
| 4 | Grinder Pump Stations | Draft an emergency access plan and procedures for flood-prone areas with grinder pump stations. | 16-20 years | $2,500-$5,000 |

*Final cost will depend on scope of work, the extent of which is beyond the scope of this report.

**Engineer's estimate of probable construction cost will be prepared as the current project moves into final design phase.

## Appendix A

## A-1: Sewer Collection & Treatment System 100-Year Floodplain Map


GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;
Map Developed by Wright-Pierce, 2019.
Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.
WWTF
PS-02
PS-03
PS-04
PS-05
PS-06
PS-07
PS-08
PS-09
PS-10
PS-11
PS-12
PS-13
PS-14
PS-15
PS-16
PS-17
WWTF
Pump Station
Grinder Pump
Sewer Manhole
Force Main
Gravity Main
Flood Hazard Zone Boundary
Elevation (Ft)
10
12
14
16
18
20
22
24
26
28
30
32
BFE Line
Flood Hazard Zone
1% Annual Chance Flood Hazard
Regulatory Floodway
0.2% Annual Chance Flood Hazard
Area with Reduced Risk Due to Levee
0 500 1,000 2,000 Feet
N
Sewer System
Kennebunkport, ME
PROJ NO: 14227
DATE: 2/26/2019
FIGURE: 1
WRIGHT-PIERCE
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## A-2: Major Pump Station Service Areas Map


GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;
Map Developed by Wright-Pierce, 2019.
Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.
WWTF
PS-02
PS-03
PS-04
PS-05
PS-06
PS-07
PS-08
PS-09
PS-10
PS-11
PS-12
PS-13
PS-14
PS-15
PS-16
PS-17
School St
Main St
Mills Rd
Kings Hwy
Arundel Rd
Goose Rocks Rd
Dyke Rd
Winter Harbor Rd
New Biddeford Rd
Wildes District Rd
Ocean Ave
Agamenticus Ave
Skipper Joes Point Rd
Marshall Point Rd
Cape Woods Rd
Back Harbor Rd
0 500 1,000 2,000 Feet
N
WWTF
Pump Station
Grinder Pump
Sewer Manhole
Force Main
Gravity Main
Building Footprint
PS-02
PS-03
PS-04
PS-05
PS-06
PS-07
PS-08
PS-09
PS-10
PS-11
PS-12
PS-13
PS-14
PS-15
PS-16
PS-17
WWTF
Parcel
Pump Station Sewersheds
Sewer System
Kennebunkport, ME
PROJ NO: 14227
DATE: 5/24/2019
FIGURE: 2
WRIGHT-PIERCE
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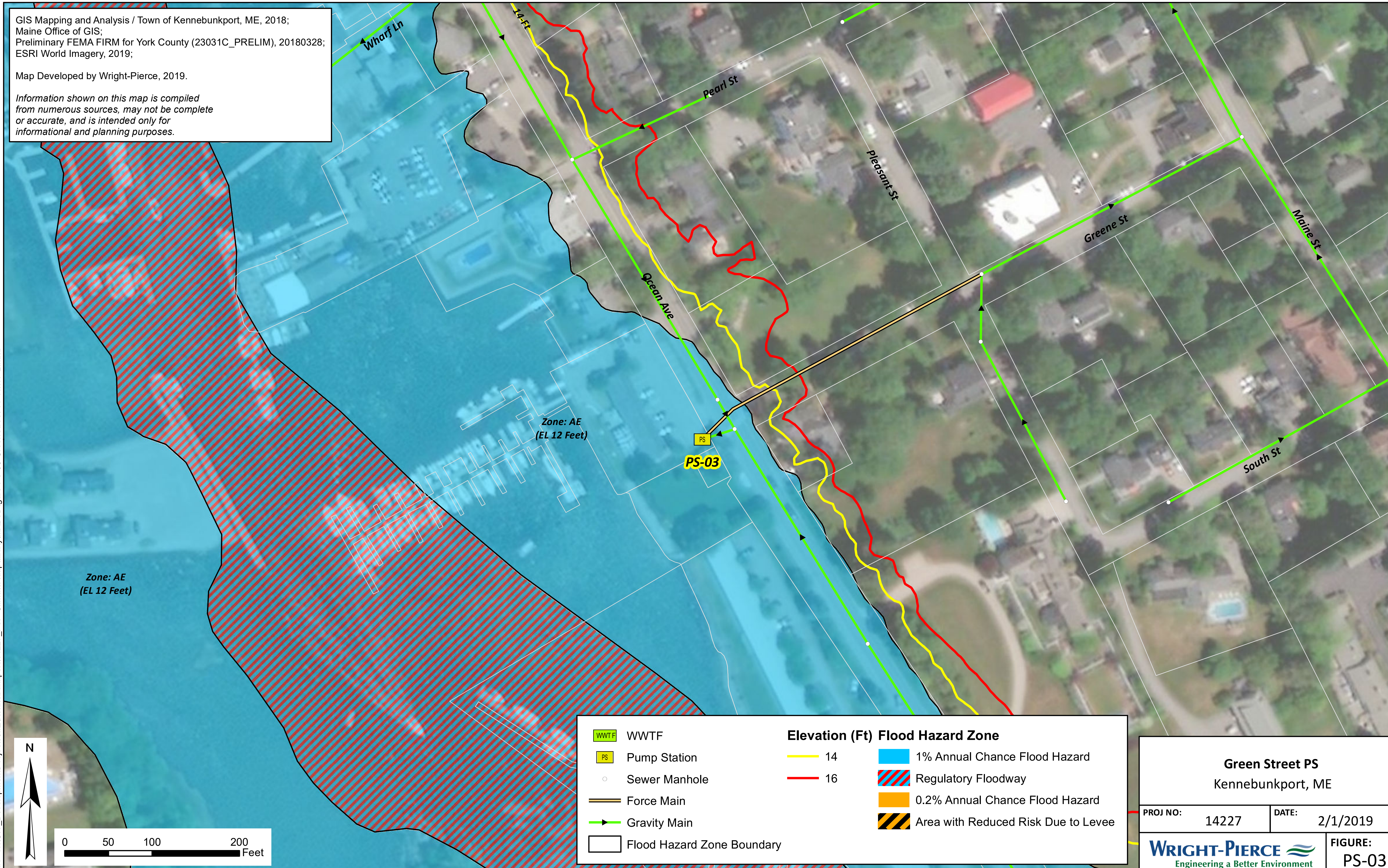
## Appendix B

## Individual Pump Station 100-Year Floodplain Maps


TAH W:\GIS_Development\Projects\ME\Kennebunkport\14227_FSP-ClimateAdaptability\MXDs\Figure-PS-02-MillsLane-v1-11x17-L.mxd




**Green Street PS**
Kennebunkport, ME

PROJ NO: 14227
DATE: 2/1/2019
FIGURE: PS-03

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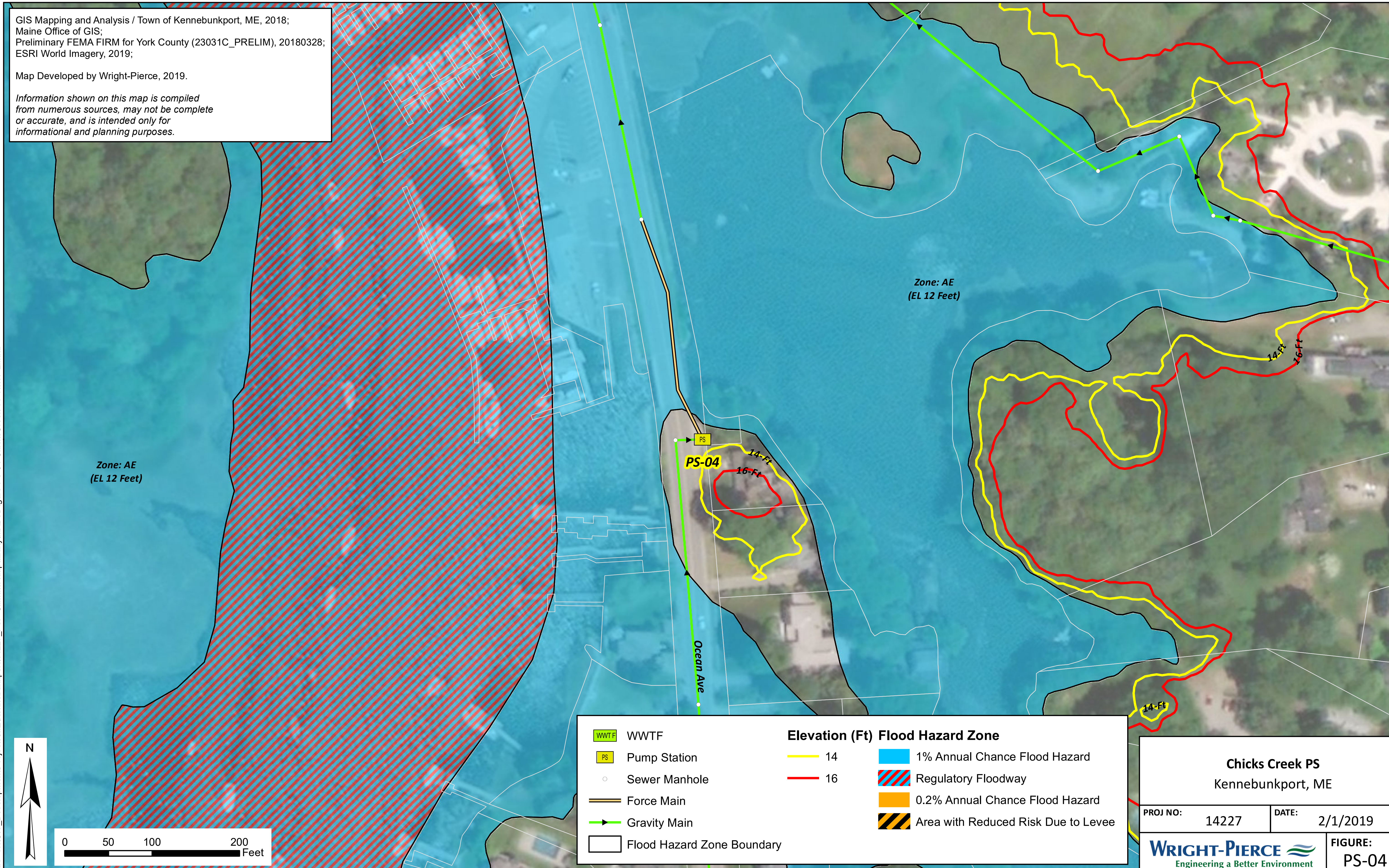


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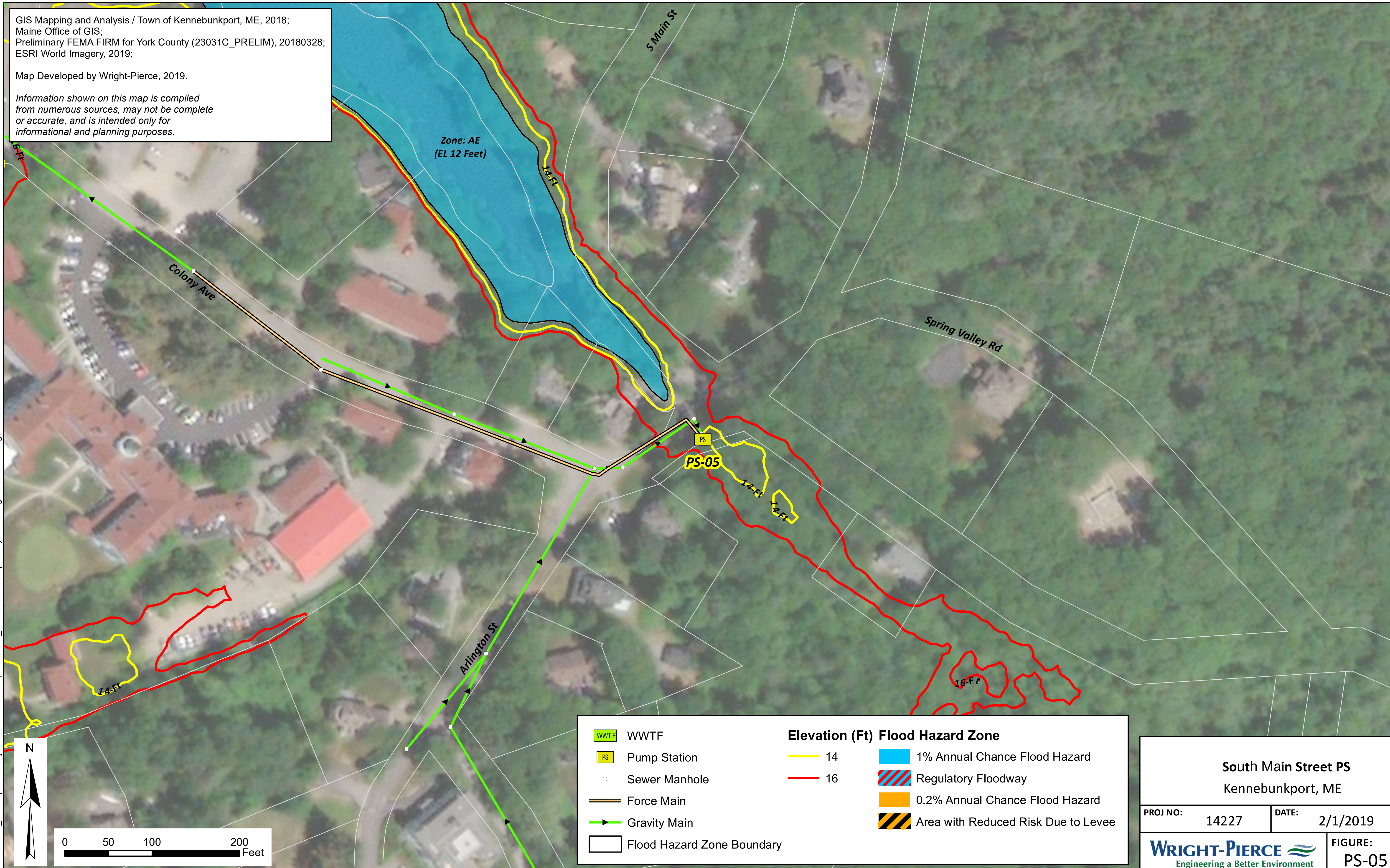


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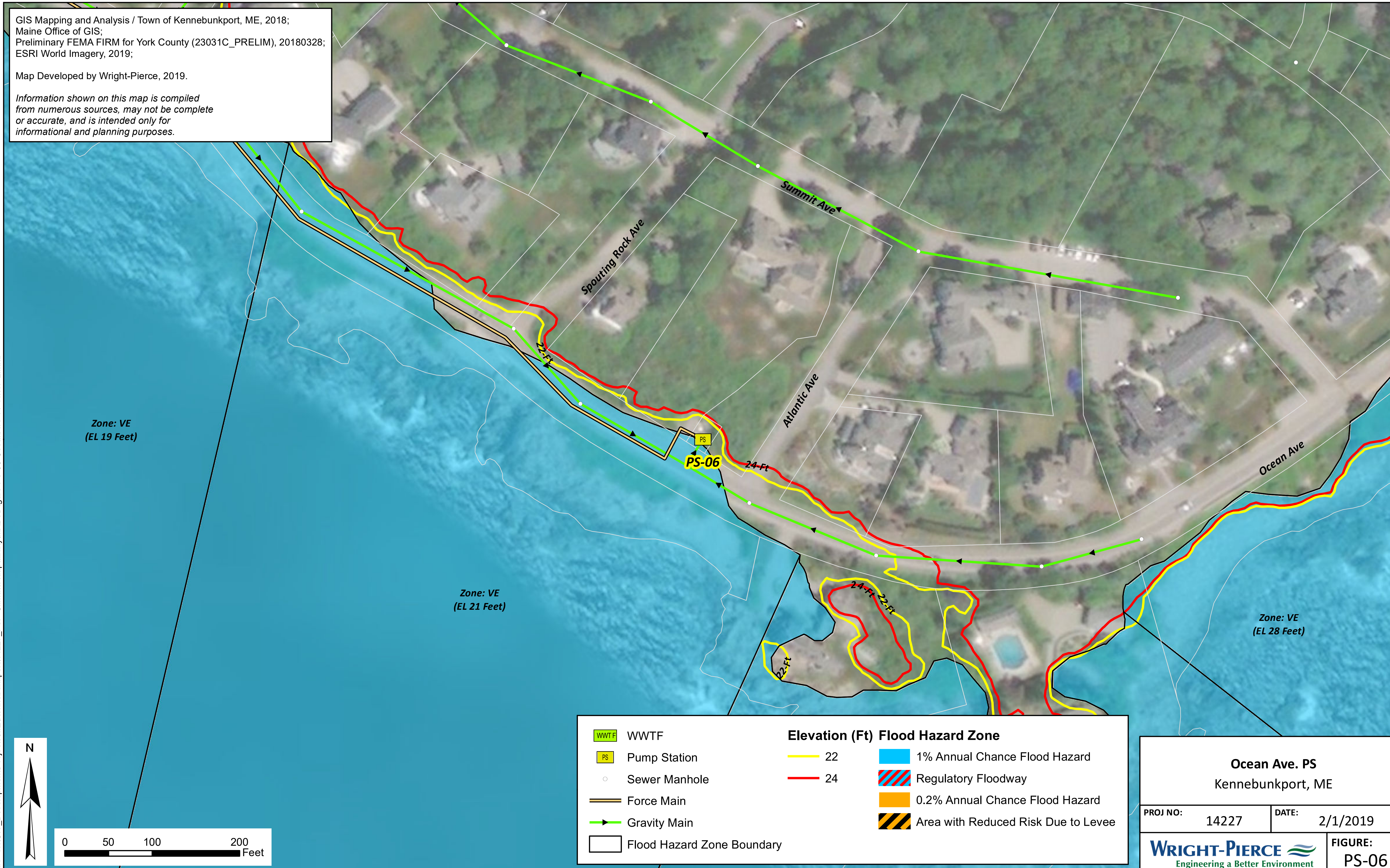

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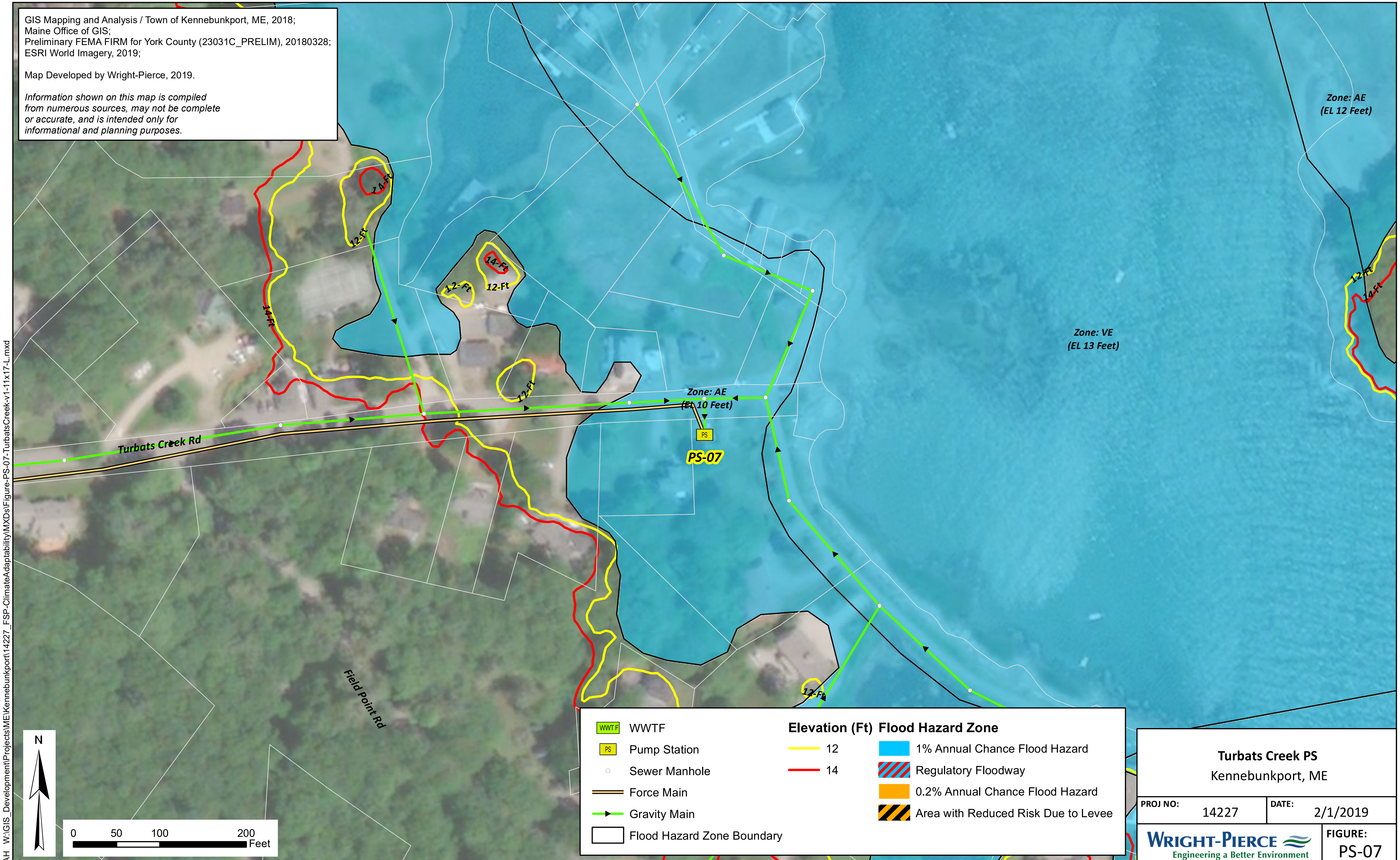
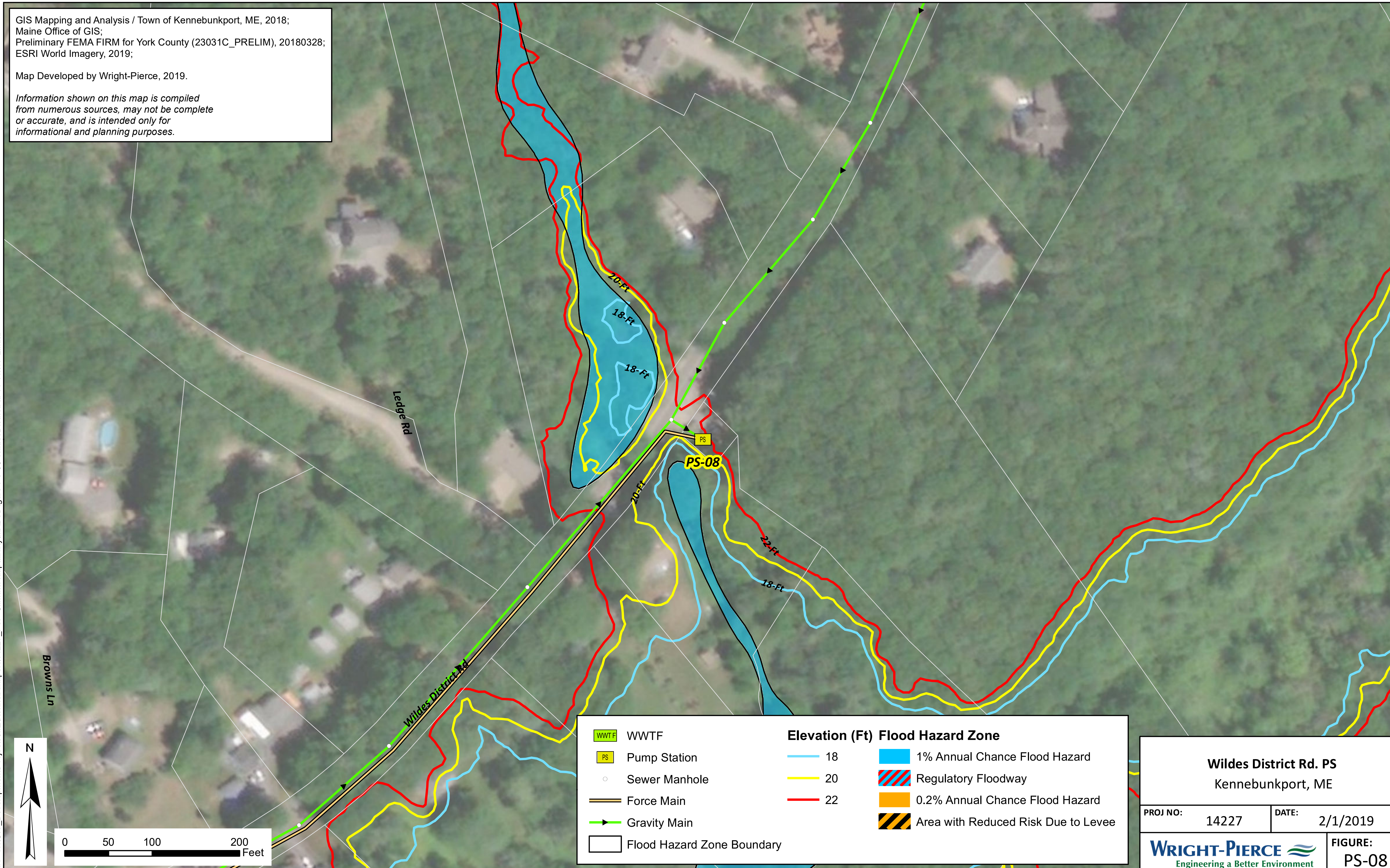

GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;
Map Developed by Wright-Pierce, 2019.
Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.
Zone: AE (EL 12 Feet)
Zone: VE (EL 13 Feet)
Zone: AE (EL 10 Feet)
PS
PS-07
Turbats Creek Rd
Field Point Rd
14-Ft
12-Ft
N
0 50 100 200 Feet
WWTF
Pump Station
Sewer Manhole
Force Main
Gravity Main
Flood Hazard Zone Boundary
Elevation (Ft)
12
14
Flood Hazard Zone
1% Annual Chance Flood Hazard
Regulatory Floodway
0.2% Annual Chance Flood Hazard
Area with Reduced Risk Due to Levee
Turbats Creek PS
Kennebunkport, ME
PROJ NO: 14227
DATE: 2/1/2019
WRIGHT-PIERCE
Engineering a Better Environment
FIGURE: PS-07
TAH W:\GIS_Development\Projects\ME\Kennebunkport\14227_FSP-ClimateAdaptability\MXDs\Figure-PS-07-TurbatsCreek-v1-11x17-L.mxd

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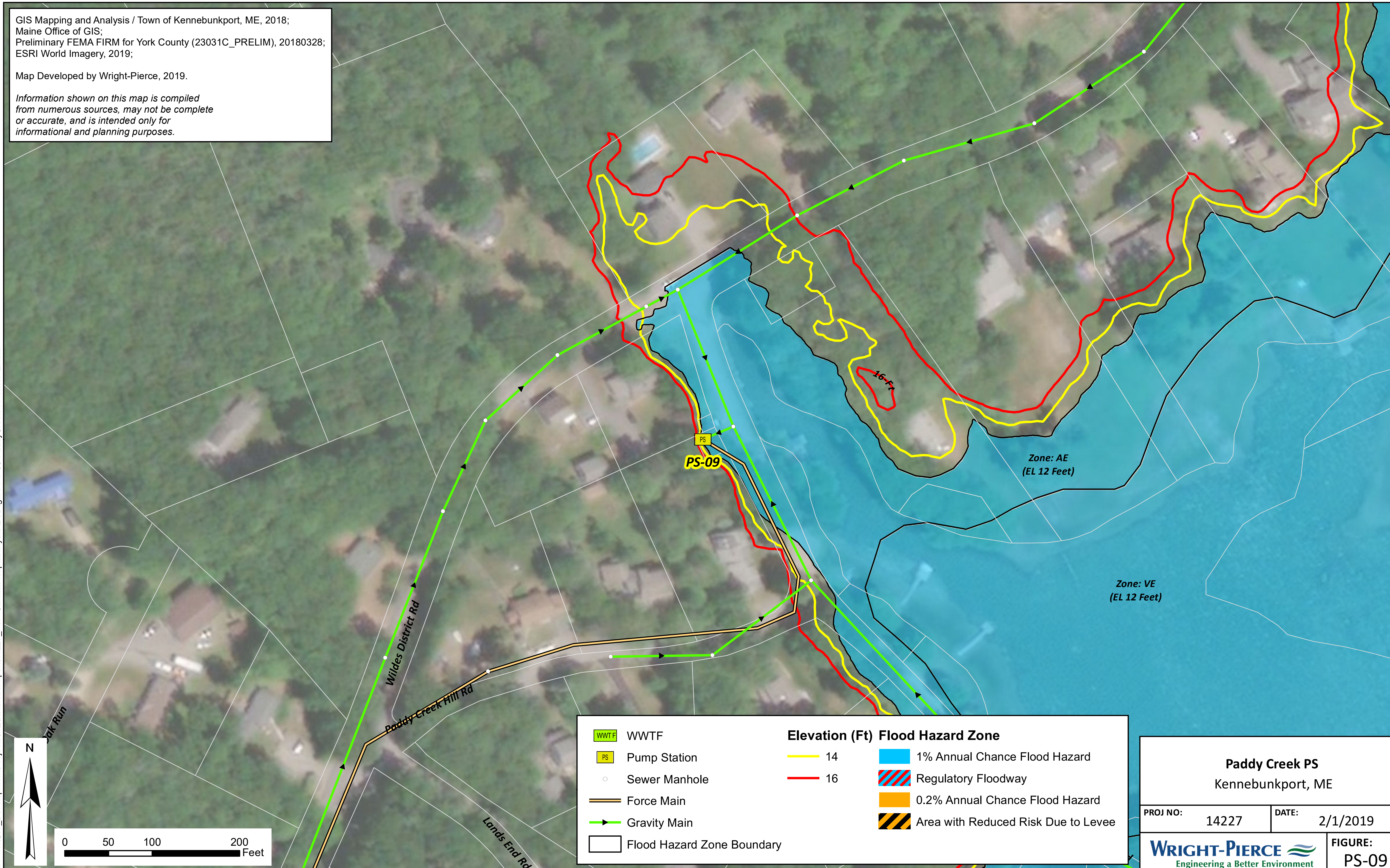
GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;

Map Developed by Wright-Pierce, 2019.

*Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.*




| Legend | | |
|---|---|---|
| WWTF | **Elevation (Ft)** | **Flood Hazard Zone** |
| Pump Station | 14 | 1% Annual Chance Flood Hazard |
| Sewer Manhole | 16 | Regulatory Floodway |
| Force Main | | 0.2% Annual Chance Flood Hazard |
| Gravity Main | | Area with Reduced Risk Due to Levee |
| Flood Hazard Zone Boundary | | |

**Paddy Creek PS**
Kennebunkport, ME

PROJ NO: 14227
DATE: 2/1/2019
FIGURE: PS-09

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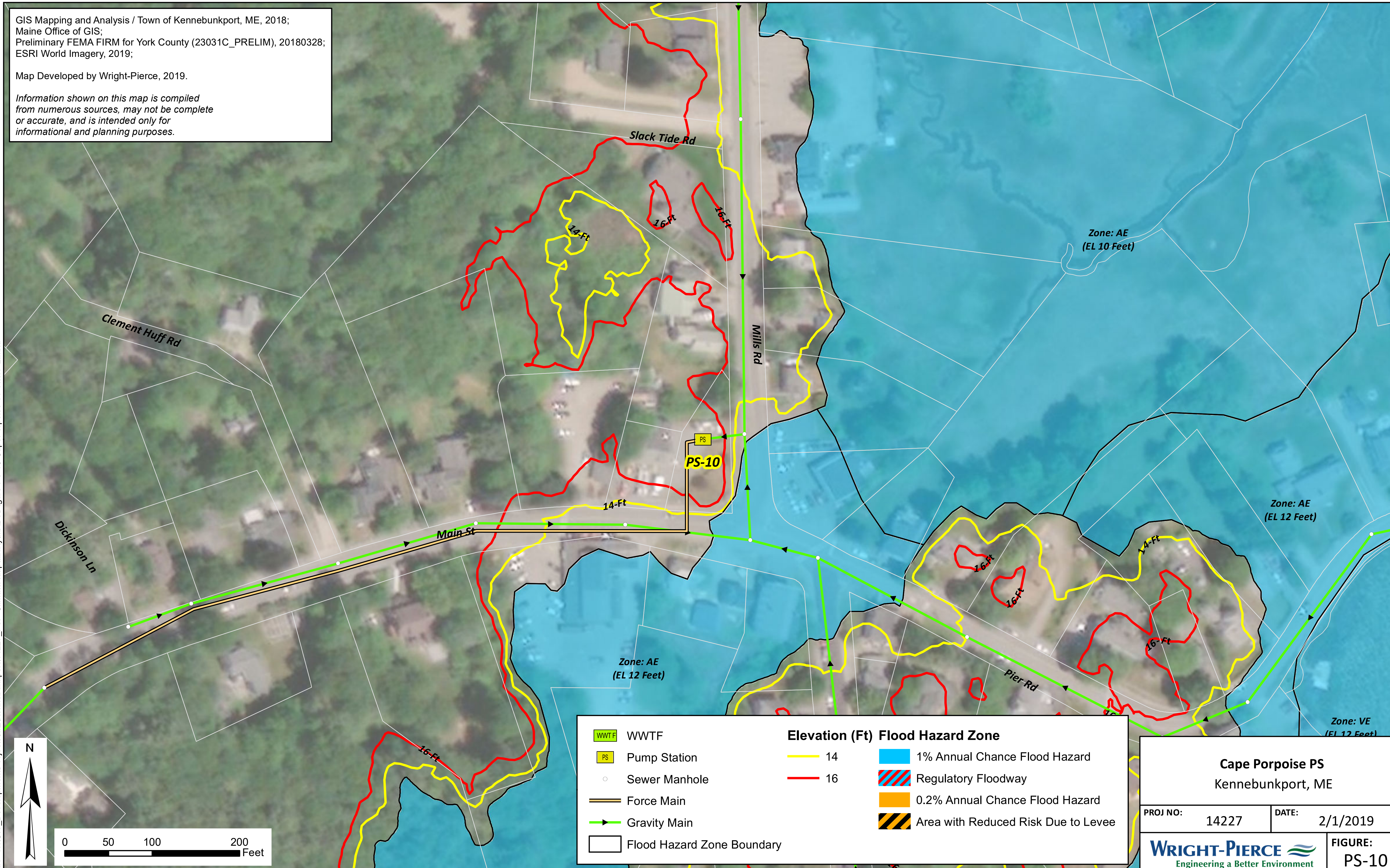


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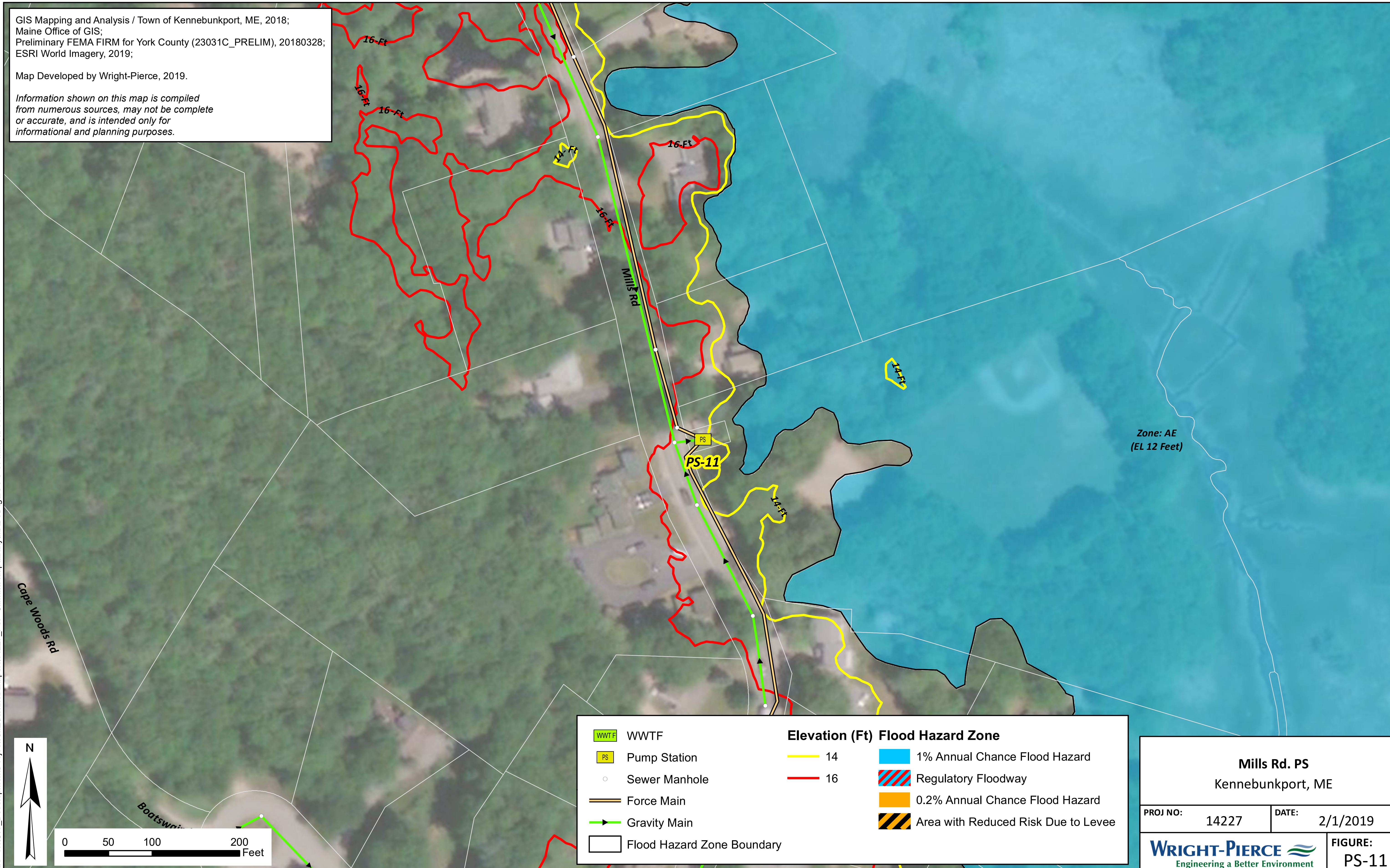


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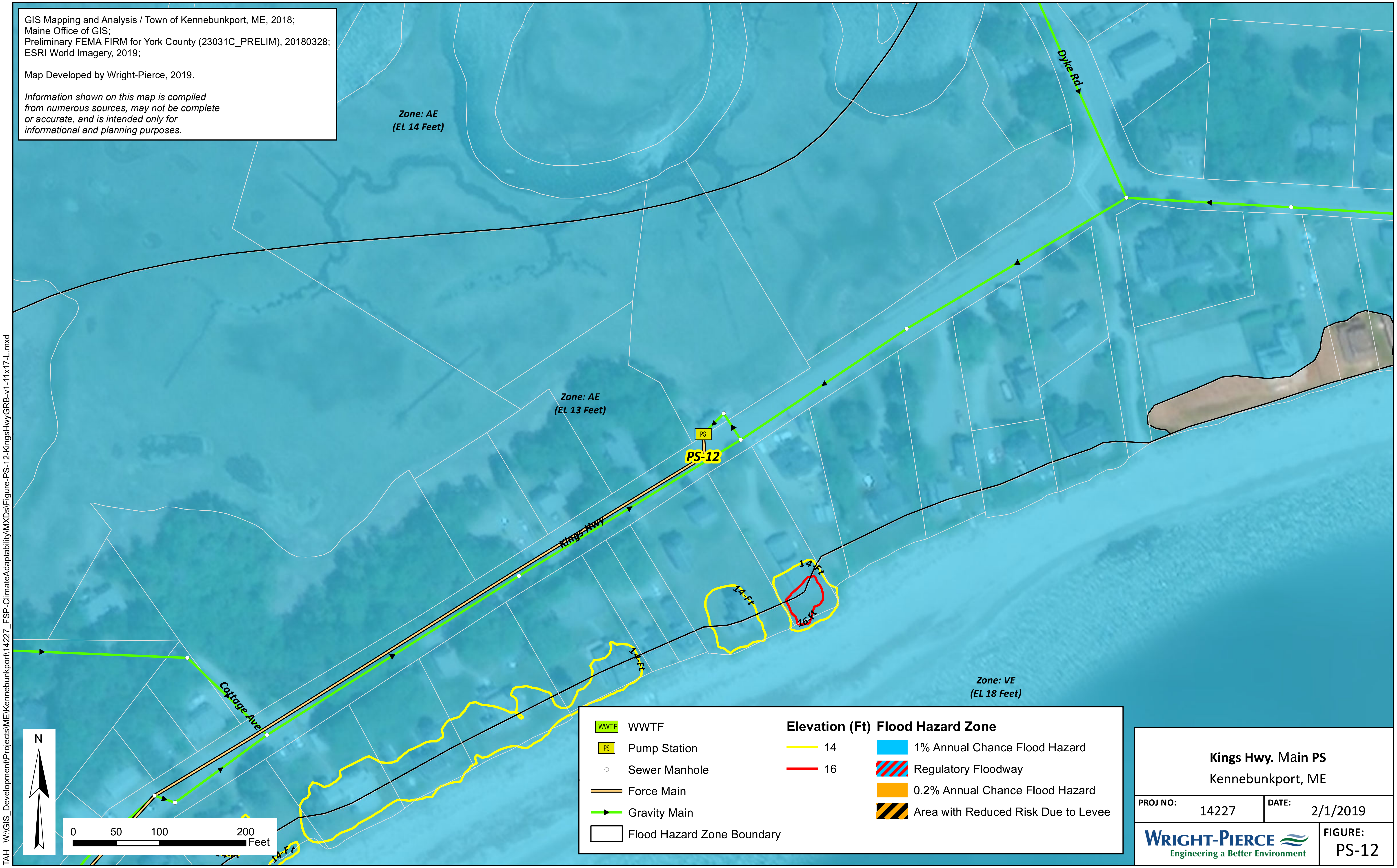
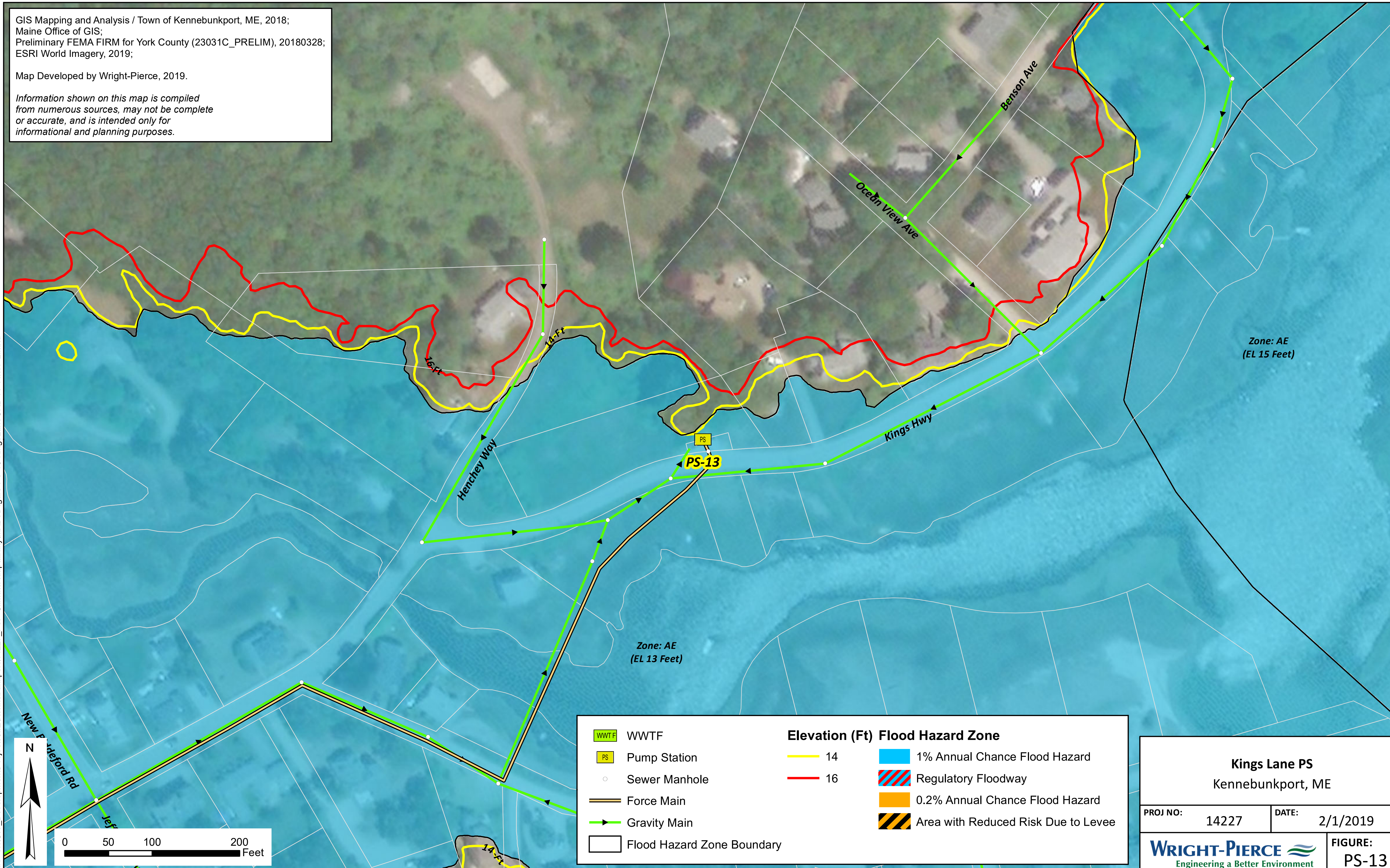


GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;
Map Developed by Wright-Pierce, 2019.
Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.
Zone: AE (EL 14 Feet)
Zone: AE (EL 13 Feet)
Zone: VE (EL 18 Feet)
Dyke Rd
Kings Hwy
Cottage Ave
PS
PS-12
14-Ft
16-Ft
N
0 50 100 200 Feet
WWTF
Pump Station
Sewer Manhole
Force Main
Gravity Main
Flood Hazard Zone Boundary
Elevation (Ft)
14
16
Flood Hazard Zone
1% Annual Chance Flood Hazard
Regulatory Floodway
0.2% Annual Chance Flood Hazard
Area with Reduced Risk Due to Levee
Kings Hwy. Main PS
Kennebunkport, ME
PROJ NO: 14227
DATE: 2/1/2019
WRIGHT-PIERCE Engineering a Better Environment
FIGURE: PS-12
TAH W:\GIS_Development\Projects\ME\Kennebunkport\14227_FSP-ClimateAdaptability\MXDs\Figure-PS-12-KingsHwyGRB-v1-11x17-L.mxd

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GIS Mapping and Analysis / Town of Kennebunkport, ME, 2018;
Maine Office of GIS;
Preliminary FEMA FIRM for York County (23031C_PRELIM), 20180328;
ESRI World Imagery, 2019;

Map Developed by Wright-Pierce, 2019.

*Information shown on this map is compiled from numerous sources, may not be complete or accurate, and is intended only for informational and planning purposes.*


**Kings Hwy. Submersible PS**
Kennebunkport, ME

PROJ NO: 14227
DATE: 2/1/2019

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FIGURE: PS-14

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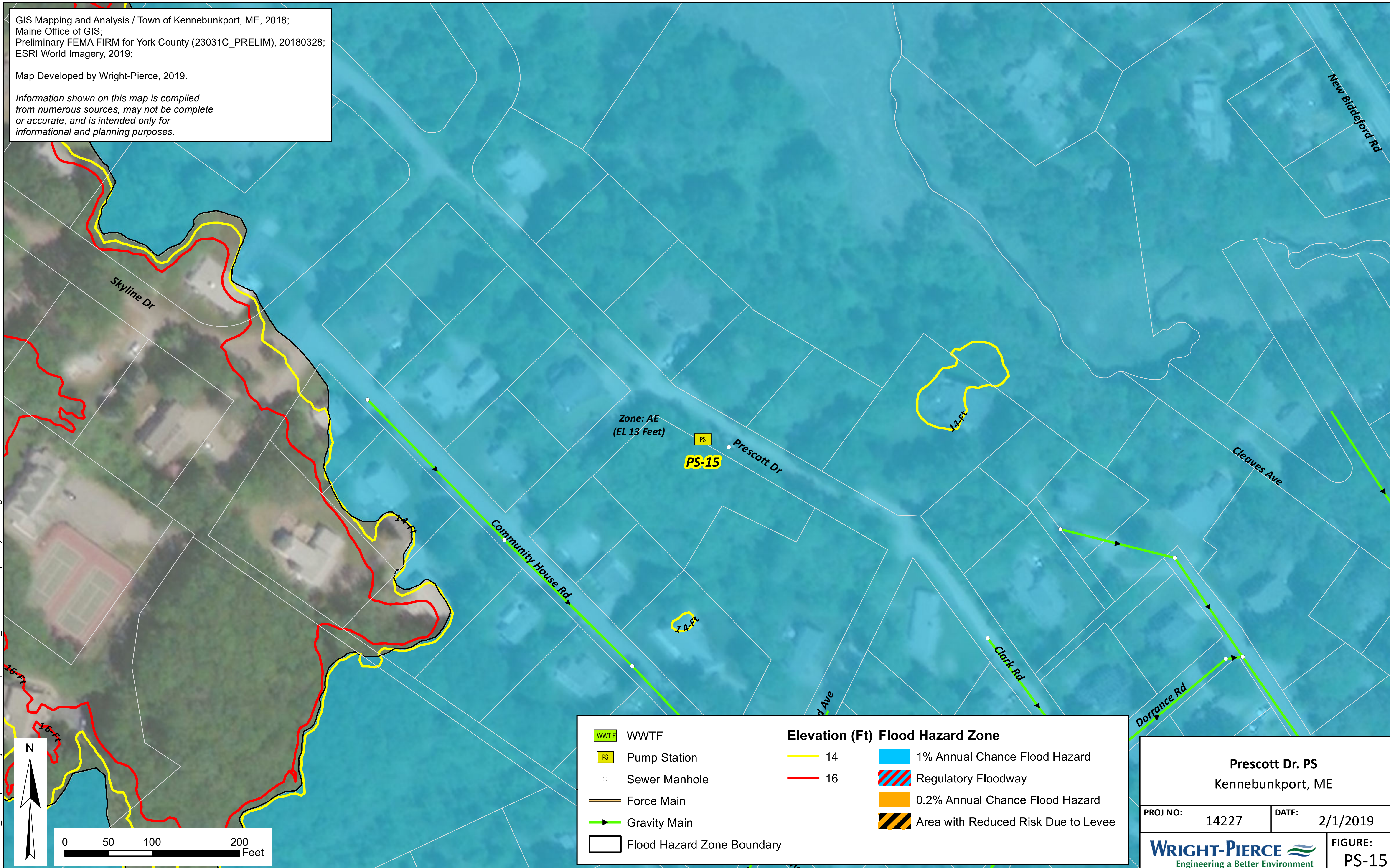


**Prescott Dr. PS**
Kennebunkport, ME

| PROJ NO: 14227 | DATE: 2/1/2019 |
|---|---|
| WRIGHT-PIERCE Engineering a Better Environment | FIGURE: PS-15 |

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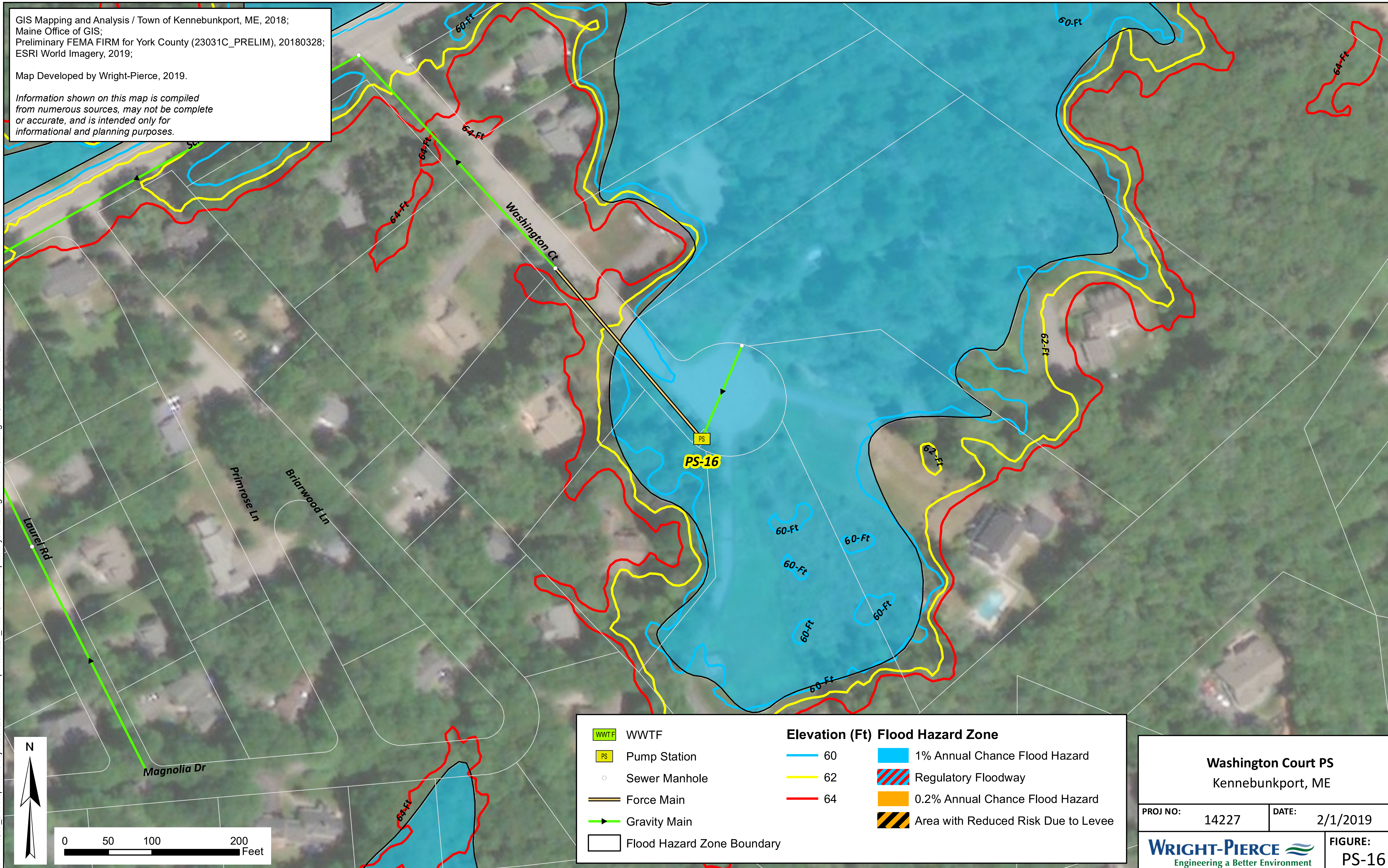


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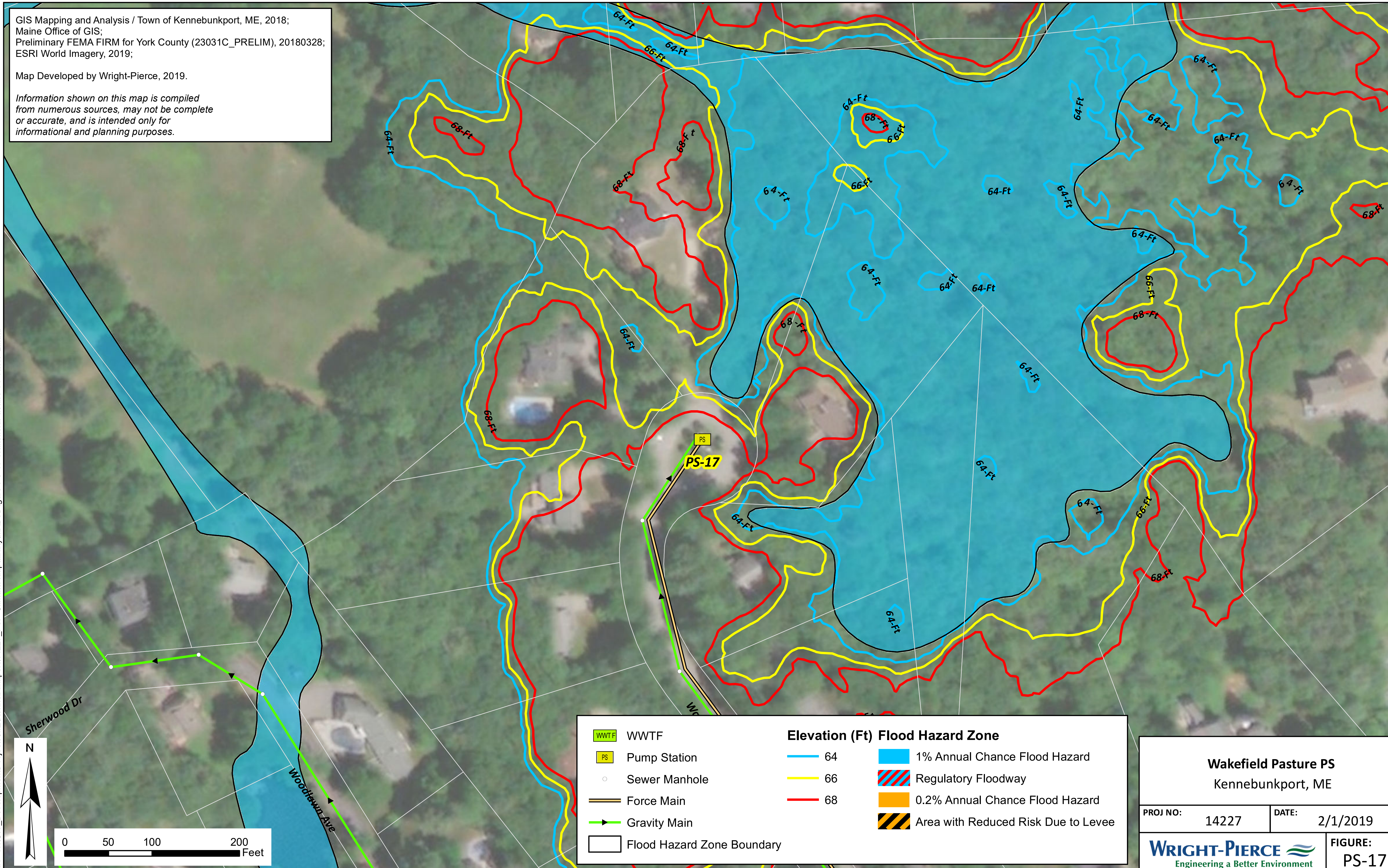


TAH W:\GIS_Development\Projects\ME\Kennebunkport\14227_FSP-ClimateAdaptability\MXDs\Figure-PS-17-WakefieldPasture-v1-11x17-L.mxd

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