Assessing the Threats from Climate Change to Marion’s Vulnerable Wastewater Pumping Infrastructure

Board of Selectman Meeting
Agenda

- Project Team
- Study Objective
- Funding Source
- Scope
  - Task 1 – Review and Compilation of Data
    - Data Compilation
    - Pump Station Site Visit
    - Desktop Analysis / Climate Change Assessment
    - Public Outreach
  - Task 2 – Vulnerability and Risk Assessment
    - Project Progress Meeting #1 (Task 5B)
  - Task 3 – Action for Each Pump Station
    - Project Progress Meeting #2 (Task 5C)
  - Task 4 – Report Development
  - Task 5 – Meetings and Outreach
    - Public Meeting (Task 5D)
- Schedule
Project Team

- Lauren Klonsky – Project Manager
- Frannie Bui – Mitigation Engineer
- Jesse Herman – Civil / Environmental Engineer
- Bryan Bucchianeri – Plumbing / HVAC Engineer
- Beth Charis-Molling – Electrical Engineer
- Caitlin Carbonello – Structural Engineer
Study Objective

- Complete a vulnerability assessment of eight critical pump stations and grinder pump neighborhoods, and recommend improvements and climate adaptation strategies for each pumping station
Funding Source

- Awarded under the Coastal Resilience Grant 2018 by the Office of Coastal Zone Management and the Executive Office of Energy and Environmental Affairs
Scope - Task 1
Task 1 – Data Compilation

Goal: Obtain a complete understanding of present and future conditions at each pumping station by collecting and reviewing readily available information and data.

Operations Staff Interviews: Interview questions to be provided to Gil & Frank to review. Survey Monkey as a potential way to compile information or in person during site visit.

Datasets to consider:
- FEMA Flood Studies
- Massachusetts Downscaled Climate Projections for Marion
- Marion Financial Sustainability Study
- Marion Asset Management Plan
- Marion MVP Risk Matrix & Report
- Marion Wastewater Pumping Stations, Force Mains and Low Pressure Sewers Issues and Impacts Memorandum
Task 1 – Data Compilation

Marion Wastewater Pumping Station System Schematic:
Task 1 – Data Compilation

Grinder Pump Neighborhoods

Private
Task 1 – Pump Station Site Visit

- **Goal:** Visit 8 pump stations
- **Target Date:** December 10
- **Survey:** NGVD29
- **Obtain CAD record drawings of pump stations**
- **Site Visit Materials:**
  - Field Sheets
  - Design Flood Elevation
  - Record Drawings of Pump Stations
  - Survey Information
  - List of potential management measures
All recommended mitigation measures presented in this report should be designed to withstand the Base Flood, plus additional sea level rise estimated for the end of that mitigation measures useful life.

### 2.2 Design Flood Elevation

The DFE for mitigation measures is determined by the following equation:

\[
\text{DFE} = \text{BFE} + \text{SLR} + \text{ASCE 24-14 Minimum Freeboard Requirement}
\]

DFE = Design Flood Elevation

BFE = Base Flood Elevation (commonly known as the 100 year storm)

SLR = Sea Level Rise

#### Table 3 ASCE 24-14 Minimum Freeboard Requirements for Flood Design Class 3 and Flood Design Class 4 Structures

<table>
<thead>
<tr>
<th>Condition</th>
<th>ASCE 24-14 Minimum Freeboard Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum elevation below which flood damage-resistance materials shall be used.</td>
<td></td>
</tr>
<tr>
<td>Zone AE</td>
<td>BFE + 1 foot or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Zone VE and Coastal Zone AE</td>
<td>BFE + 2 feet or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Minimum elevation of utilities and equipment.</td>
<td></td>
</tr>
<tr>
<td>Zone AE</td>
<td>BFE + 1 foot or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Zone VE and Coastal Zone AE</td>
<td>BFE + 2 feet or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Minimum elevation of dry flood-proofing of non-residential portions of mixed-use buildings.</td>
<td></td>
</tr>
<tr>
<td>Zone AE</td>
<td>BFE + 1 foot or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Zone VE and Coastal Zone AE</td>
<td>BFE + 2 feet or DFE, whichever is higher.</td>
</tr>
<tr>
<td>Minimum elevation of wet flood-proofing.</td>
<td></td>
</tr>
<tr>
<td>Zone AE, Zone VE and Coastal Zone AE</td>
<td>BFE + 1 foot or DFE, whichever is higher.</td>
</tr>
</tbody>
</table>
“The evaluation of flood conditions, potential impacts and warranted improvements should consider all potential impacts on flood-water elevations including... potential future sea level rise”

“The design of wastewater conveyance and treatment facilities as well as related flood mitigation measures should reflect projections of future flooding over the planned services life of a wastewater facility”

“Existing pump stations or treatment facilities that are planned for upgrade or expansion should be improved to the maximum extent possible to meet the flood protection criteria noted herein for new facilities”

“New pump stations... should

(1) provide for uninterrupted operation of all units during conditions of a 100-year (1% annual chance) flood and

(2) be placed above, or protected against the structural, process, and electrical equipment damage that might occur in an event that results in a water elevation above the 100-year (1% annual chance) flood.”

“The level of protection depends on how critical a component of the facility is to operation of the facility. Specifically, critical equipment of these facilities should be protected against damage up to a water surface elevation that is 3 feet above the 100-year flood elevation. Non-critical equipment should be protected against damage up to a water surface elevation that is 2 feet above the 100-year flood elevation”
Task 1 – Desktop Analysis / Climate Change Assessment - Proposed Approach

Based on TR-16:

\[
\text{Design Flood Elevation} = \text{FEMA 1\% Annual Chance Stillwater elevation @ end of design life including sea level rise} + \text{FEMA 1\% Annual Chance Wave @ end of design life including sea level rise} + \text{Freeboard (+3’ for critical facilities & +2’ for non-critical facilities)}
\]

\textit{Based on TR-16}

\textit{Critical Equipment:} includes conveyance and treatment system components identified for protection including, but not limited to, all electrical, mechanical, and control systems associated with pump stations that are responsible for conveyance of wastewater to and through the treatment facility to maintain primary treatment and disinfection during the flood event. Other equipment that, if damaged by flood conditions, will prevent the facility from returning to pre-event operation after cessation of flood conditions is also critical equipment.
Task 1 – Desktop Analysis / Climate Change Assessment

Sea Level Rise (*based on the Massachusetts Climate Change Projections*)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Probabilistic projections</th>
<th>2030</th>
<th>2050</th>
<th>2070</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)</td>
<td>0.6</td>
<td>1.3</td>
<td>2.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Intermediate–High</td>
<td>Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)</td>
<td>0.8</td>
<td>1.7</td>
<td>2.9</td>
<td>5.1</td>
</tr>
<tr>
<td>High</td>
<td>Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)</td>
<td>1.1</td>
<td>2.4</td>
<td>4.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Extreme (Maximum physically plausible)</td>
<td>Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)</td>
<td>1.3</td>
<td>3.1</td>
<td>5.4</td>
<td>10.3</td>
</tr>
</tbody>
</table>
Task 1 – Desktop Analysis / Climate Change Assessment

Assuming all mechanical equipment is replaced by 2025
*(design for conditions through 2045) = 1.47’*
Assume all concrete and masonry is replaced by 2030
*(design for conditions through 2080) = 3.63’*

Relative Mean Sea Level (ft NAVD88) for Woods Hole, MA
Task 1 – Desktop Analysis / Climate Change Assessment: Example

- Oakdale Avenue

  Current 1% Annual Chance Base Flood Elevation
  = VE 17’ NAVD88
Task 1 – Desktop Analysis / Climate Change Assessment : Example

- Oakdale Avenue

Current BFE = VE 17’ NAVD88 | With SLR = VE 21’ NAVD88

Assume all concrete and masonry is replaced by 2030 (design for conditions through 2080)
### Task 1 – Desktop Analysis / Climate Change Assessment - Example

#### Oakdale Avenue

<table>
<thead>
<tr>
<th>Description</th>
<th>Equation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Flood Elevation</td>
<td>FEMA 1% Annual Chance Stillwater</td>
<td>+ Freeboard (3’ for critical facilities &amp; 2’ for non-critical facilities)</td>
</tr>
<tr>
<td>elevation @ end of design life including sea level rise</td>
<td>+ FEMA 1% Annual Chance Wave @ end of design life including sea level rise</td>
<td></td>
</tr>
<tr>
<td>Design Flood Elevation</td>
<td>= 22.7’ NAVD88</td>
<td></td>
</tr>
<tr>
<td>Design Flood Elevation</td>
<td>= 25.7’ NAVD88</td>
<td>= 26.5’ NGVD29</td>
</tr>
</tbody>
</table>

Task 1 – Public Outreach

- October 9, 2018 – King Tide Event
- Photos collected
- MyCoast Publication
- CDM Smith to review information to be posted on Town of Marion Website.
Task 1 Summary

- Data will be collected and detailed information at each pump station will be obtained, and general grinder pump neighborhood information will be collected, to help assess pump station and grinder pump vulnerability and potential mitigation measures.
Scope - Task 2
Task 2 – Vulnerability and Risk Assessment with Respect to Coastal Flooding

- Approach to be discussed further at Progress Meeting #1
- Determine Vulnerability
  - Identify and evaluate stresses from coastal flooding
  - Evaluate sensitivity to each location / grinder pump neighborhoods
  - Assess the adaptive capacity
- Assess Risk
- Develop Report Section
Scope - Task 3
Task 3 – Action for Each Pumping Station & Grinder Pump Service Area

- To be discussed further at Progress Meeting #2
- Menu of options will be identified
- Relevant Report Sections to be drafted

<table>
<thead>
<tr>
<th>Option</th>
<th>Mitigation Measure</th>
<th>Unit Cost</th>
</tr>
</thead>
</table>
| A      | Install flood door.| 2-foot flood door - $30,000  
                      Full flood door - $60,000 |
| B      | Install watertight hatch on a submersible station. | $30,000 |
| C      | Flood-proof painting. | $200,000 |
| D      | Raise control panel above the DFE. | Relocate existing panel - $30,000  
                      Replace panel - $50,000 |
| E      | Raise generator above the DFE. | Less than 1-foot - $50,000  
                      1-foot to 3-feet - $125,000 |
| F      | Raise vent above DFE. | $5,000 |
| G      | Install a louver to allow water to enter the station and equalize hydrostatic pressure. | $150,000 |
| H      | Raise louver above the DFE or install a flood door in front of louver to protect to the DFE. | $150,000 |

Potential Grinder Pump Actions:
- Pre-storm communications
- Retrofits
- Post-storm restoration of operations
Scope - Task 4
Task 4 – Report Development

- Draft report sections will be developed as part of Task 2 & Task 3.
- Will use the Wareham Report as an example for this report.
- Draft report will be delivered for comment.
- Comments from Town of Marion, public, and Massachusetts Coastal Zone Management will be considered for incorporation into final report.
Scope - Task 5
Task 5 – Public Meetings & Outreach

- Kickoff Meeting
- Progress Meeting #1 – discuss the vulnerability/risk assessment approach (mid January 2019)
- Progress Meeting #2 – discuss the adaptation strategy identification approach (end February 2019)
- Public Meeting – CDM Smith to help prepare any materials and provide a 1-page handout which will also be delivered to CZM (May 2019)
Schedule
## Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Estimated Delivery Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>MyCoast Public Outreach</td>
<td>End Oct 2018</td>
</tr>
<tr>
<td>Pumping Station Site Visits</td>
<td>Early Dec 2018</td>
</tr>
<tr>
<td>Desktop Analysis / Data Compilation / Climate Change Assessment</td>
<td>Early Jan 2019</td>
</tr>
<tr>
<td>Progress Meeting #1 – Discuss Vulnerability / Risk Assessment Approach</td>
<td>Mid Jan 2019</td>
</tr>
<tr>
<td>Draft Report Section On Vulnerability and Risk Assessment</td>
<td>Mid Feb 2019</td>
</tr>
<tr>
<td>Progress Meeting #2 – Discuss Adaptation Strategy Identification</td>
<td>End Feb 2019</td>
</tr>
<tr>
<td>Draft Report Section Summarizing Adaptation Actions</td>
<td>Mid Mar 2019</td>
</tr>
<tr>
<td>Prepare Draft Report &amp; Cost Estimates</td>
<td>Mid April 2019</td>
</tr>
<tr>
<td>Hold Public Meeting</td>
<td>Mid May 2019</td>
</tr>
<tr>
<td>Prepare Final Report</td>
<td>Mid June 2019</td>
</tr>
<tr>
<td>Prepare Final Case Study Report For CZM</td>
<td>End June 2019</td>
</tr>
</tbody>
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QUESTIONS?