# Town of Wareham
# Risk and Vulnerability Assessment

January 2016

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# Glossary of Common Acronyms and Definitions

**Acronyms:**

| | |
|---|---|
| ASCE | American Society of Civil Engineers |
| AWWA | American Water Works Association |
| BCA | Benefit Cost Analysis |
| BCR | Benefit Cost Ratio |
| BFE | Base Flood Elevation |
| CZM | Massachusetts Office of Coastal Zone Management |
| DEM | Digital Elevation Model |
| DFE | Design Flood Elevation |
| EPA | United States Environmental Protection Agency |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| HAZUS | Hazards Untied States |
| IBC | International Building Code |
| LiMWA | Limit of Moderate Wave Action |
| MCC | Motor Control Center |
| MGD | Million Gallons Per Day |
| NEIWPCC | New England Interstate Water Pollution Control Commission |
| NOAA | National Oceanographic and Atmospheric Administration |
| NWS | National Weather Service |
| SFHA | Special Flood Hazard Area |
| SLOSH | Sea, Lake, and Overland Surges from Hurricanes |
| SLR | Sea Level Rise |
| USACE | United States Army Corps of Engineers |
| WPCF | Water Pollution Control Facility |

**FEMA Definitions:**

| | |
|---|---|
| Base Flood | The one percent annual chance flooding event, commonly known as the 100 year flood. |
| Special Flood Hazard Area (SFHA) | The land area covered by the floodwaters of the Base Flood. |

# 1. Introduction

## 1.1 Background and Scope

The Town of Wareham (Town) is a coastal community in Southeastern Massachusetts. The Town operates a wastewater system that serves approximately sixty percent of the Town. The system consists of 57 miles of gravity sewer and force mains, 43 pump stations, and a 1.5 million gallon per day (MGD) design capacity Water Pollution Control Facility (WPCF). The collection system has significant environmental and economic importance to the Town. It serves the most populated portion of the Town as well as the Town's large seasonal summer population and day-trippers. In addition, the collection system and treatment facility serve as an important environmental line of defense against wastewater contamination of groundwater, local rivers, streams, and Buzzards Bay.

The recently updated Federal Emergency Management Agency (FEMA) flood maps show that the majority of the Town's pump stations are in vulnerable areas with respect to the 100-year flood event and subsequent anticipated wave action. With anticipated sea level rise due to climate change, the pump stations vulnerability with respect to coastal flooding is expected to increase.

The Town of Wareham retained GHD to develop a Risk and Vulnerability assessment of the Town's wastewater infrastructure, as related to coastal flooding. The following tasks are included in the scope of the project:

1. Conduct an assessment of the existing conditions of the major infrastructure (pump stations and wastewater treatment facility) as it relates to vulnerability to coastal flooding and climate change. The analysis will utilize survey data provided by Green Seal Environmental, Inc.
2. Complete a Risk and Vulnerability Assessment as it relates to coastal flooding and climate change for the Town's major wastewater infrastructure.
3. Develop recommended improvements related to coastal flooding and climate change and budgetary costs.

## 1.2 Codes and Guidance Documents

The following codes and industry guidance documents were used to develop the methodology for the Town of Wareham Risk and Vulnerability Analysis Report:

### State and Local Regulations

- Massachusetts Building Code – 8th Edition
- Massachusetts Building Code – Draft 9th Edition
- Zoning By-Laws - Town of Wareham Massachusetts – Revised May 2014

### Town of Wareham Planning Documents

- Town of Wareham Comprehensive Emergency Management Plan

### FEMA Guidance Documents

- 2014 FEMA Flood Insurance Rate Maps (FIRM)

- '2012 Flood Insurance Study for Plymouth County, Massachusetts (All Jurisdictions)' Flood Insurance Study Number 25023CV001A', FEMA – effective July 17, 2012
- 'State and Local Mitigation Planning How-To Guide – Understanding Your Risks, Identifying Hazards and Estimating Losses;' FEMA 386-2, August 2001

#### Massachusetts Office of Coastal Zone Management (CZM) Guidance Documents

- 'Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning', CZM, December 2013

#### American Water Works Association (AWWA) Guidance Documents

- 'Risk Analysis and Management for Critical Asset Protection (RAMPCAP®) Standard for Risk and Resilience Management of Water and Wastewater Systems Using the ASME-ITI RAMCAP Plus® Methodology, 1st Edition (ANSI/AWWA J100-10(R13)) – this document is commonly referred to as J100

#### United States Environmental Protection Agency (EPA) Guidance Documents

- 'Flood Resilience: A Basic Guide for Water and Wastewater Utilities,' Office of Water (4680T) – EPA 817-B-14-006-September 2014

#### New England Interstate Water Pollution Control Commission (NEIWPCC) Guidance Documents

- TR-16: Guides for the Design of Wastewater Treatment Works; NEIWPCC, 2011 Edition

#### American Society of Civil Engineers (ASCE) Guidance Documents

- ASCE Standard 24-14 – Flood Resistant Design and Construction, 2014

#### United States Army Corps of Engineers (USACE) Guidance Documents

- USACE Sea Level Change Curve Calculator (2014.88.1)

### 1.3 Vulnerability Assessment Report Organization

This report is divided into seven chapters, as follows:

- Chapter 1 presents general introductory information on the project and summarizes the documents that were used to develop the methodology for the Vulnerability Analysis.
- Chapter 2 discusses FEMA flood classifications, incorporation of climate change effects into the proposed mitigation measures, and the methodology that was used to determine a design flood elevation for proposed mitigation measures.
- Chapter 3 summarizes the State and local code analysis that was conducted to determine the types of mitigation measures that are allowable by current regulations.
- Chapter 4 summarizes the methodology that was used to determine the flood risk associated with vulnerable pump stations.
- Chapter 5 outlines the mitigation measures that were considered for the report.
- Chapter 6 provides a vulnerability assessment for each pump station within the Special Flood Hazard Area (SFHA).
- Chapter 7 summarizes the findings of the report.

## 1.4 Limitations

This document was produced solely for the purpose of developing budgetary allowances for future improvements to the Town's wastewater infrastructure. No design guidance is expressed or implied.

# 2. Determining a Design Flood Elevation (DFE)

## 2.1 FEMA Flood Classifications

FEMA defines the land area covered by the floodwaters of the Base Flood as a Special Flood Hazard Area (SFHA). The Base Flood is the 1% annual chance flooding event, also commonly known as the 100-year flood event. The SFHA is broken down into three different coastal flood zones, which are differentiated by expected wave height. The three zones are shown in Figure 1.

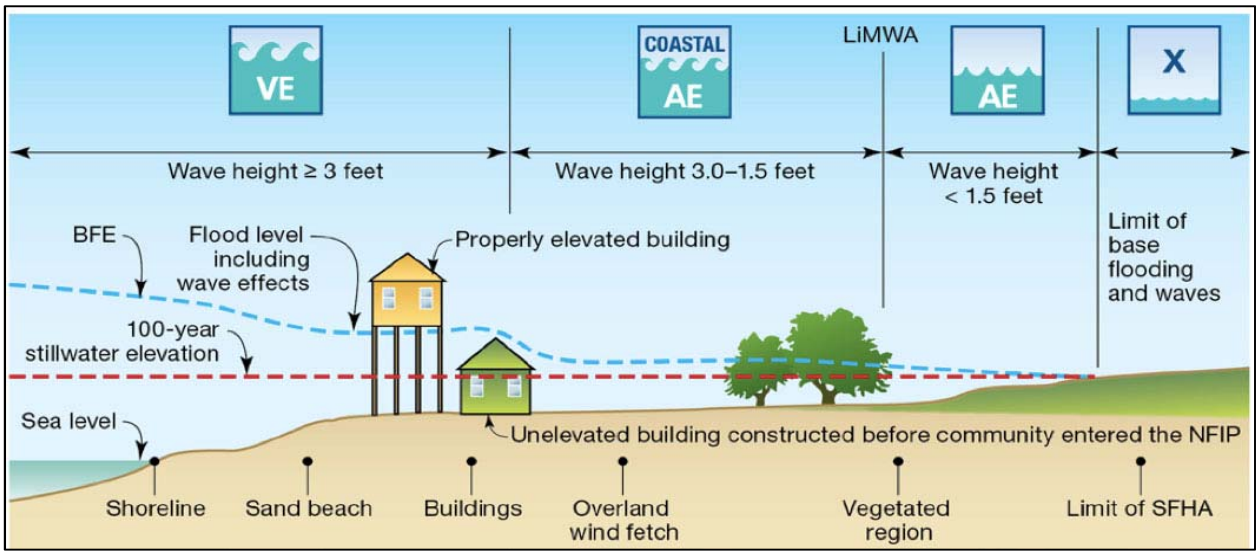



Figure 1 Coastal Flood Zones (Source: FEMA Coastal Flood Hazard Mapping Studies, May 2013)

Although at the time of this report the Coastal Zone AE is not shown on FEMA's Flood Insurance Rate Maps (FIRMs), FEMA guidance states that if a location meets the following two conditions it is located within a Coastal Zone AE:

1. A water depth sufficient to support waves between 1.5- and 3.0-feet high (stillwater depths of 2- to 4-feet at the site).
2. Wave heights between 1.5- and 3.0-feet high.

For this study it was assumed that all pump stations shown in the Zone AE on a FIRM map with more than 2-feet of standing water are within the Coastal Zone AE. Both the Zone VE and Coastal Zone AE are within the Limit of Moderate Wave Action (LiMWA), which has higher building standards for flood resilience.

Figure 2 shows the breakdown of the Wareham Pump Stations in relation to FEMA flood elevations. Twenty nine of the Town's 43 pump stations are located within the SFHA.

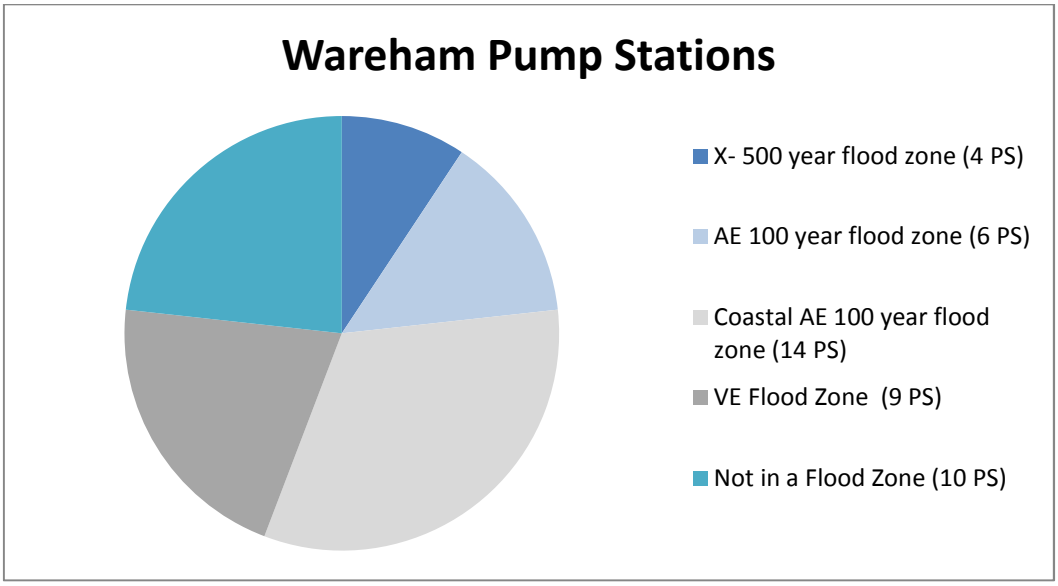



Figure 2 Wareham Pump Station Vulnerability in Relation to Flood Zones

## 2.2 Design Flood Elevation

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

DFE = BFE + SLR + 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

Each variable is discussed in further detail below.

### 2.2.1 Design Flood Determination (BFE)

Industry guidance documents recommend that wastewater infrastructure is designed to be protected from the Base Flood, unless historical flood data has shown that the area has historically experienced more severe flooding events.

The 2012 Flood Insurance Study for Plymouth County, Massachusetts (All Jurisdictions), which was developed by FEMA, identifies two major historical flooding events. Table 1 shows the still water tide elevations of both major historical flooding events and the Base Flood event shown in the 2012 FEMA maps.

Table 1 Wareham Major Flood Events

| Date | Still Water Tide Elevation | Annual Percent Chance of Occurrence |
|---|---|---|
| September 21, 1938 | 13.5 feet | 1.18% |
| August 31, 1954 | 12.9 | 1.43% |
| 2012 FEMA AE | 14 | 1% |

Since no more severe flooding events have been recorded, the Base Flood will be used as the design condition for all recommended wastewater infrastructure improvements in this report.

### 2.2.2 Climate Change and Sea Level Rise (SLR)

The Base Flood is expected to be impacted by Sea Level Rise (SLR) in future years. In order to be effective, any infrastructure improvements (mechanical or structural) that are made to the existing pump stations need to be designed to withstand the Base Flood at the end of that mitigation measures useful life, taking into account SLR. This approach is consistent with the 2011 FEMA Climate Change Adaption Policy Statement (Administrator Policy 2011-OPPA-01) and the 2014-2018 FEMA Strategic Plan.

In 2013 the Massachusetts Office of Coastal Zone Management (CZM) published a report entitled "Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning" which outlines several sea level rise scenarios using different assumptions for ocean warming and ice sheet melting rates.

The document recommends local conditions be determined for the specific planning area from long-term continuously operating reference stations or other available data. The nearest continuously operating reference station to the planning area is the National Oceanographic and Atmospheric Administration (NOAA) gauge in Woods Hole, Massachusetts. The NOAA sea level change projections output by the United States Army Corp of Engineers (USACE) Sea Level Change Curve Calculator (2014.88) was used to estimate relative sea level change projection for the planning area and is shown in Figure 3.

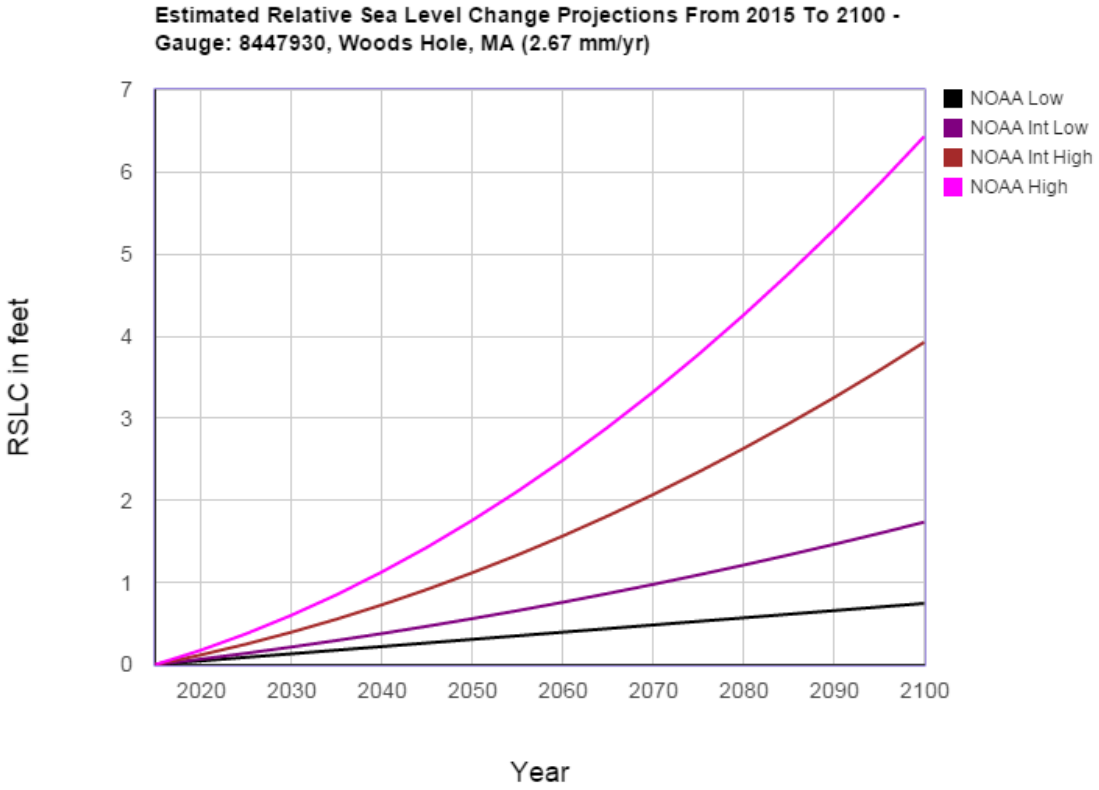



Figure 3 USACE Sea Level Change Curve Calculator (2014.88.1) Predicted Sea Level Rise

NOAA has published four different sea level rise scenarios, based on different assumptions of ocean warming and ice sheet loss. The document notes that based on historical observations both the "Low " and "Intermediate Low" scenarios may considerably underestimate actual sea level rise,

especially for plans or projects with time horizons beyond 25 years. This leaves two scenarios. It would seem that a moderate approach to sea level rise would be reflected in the "Intermediate-high" scenario. This has a projected sea level rise of up to 3.9-feet by Year 2100.

Wastewater infrastructure components typically have the following life expectancies:

- Mechanical equipment, wooden buildings – 20 years
- Concrete and masonry – 50+ years

Table 2 outlines the estimated sea level rise at the end of each type of infrastructure's useful life, based on the "Intermediate-high" scenario produced by the USACE Sea Level Change Curve Calculator.

Table 2 Estimated Sea Level Rise at Infrastructure's End of Useful Life

| Infrastructure | Year Infrastructure Reaches End of its Useful Life | Estimated Sea Level Rise |
|---|---|---|
| New mechanical equipment, wooden building | 2035 | 0.6 feet |
| Concrete and masonry | 2063 | 1.8 feet |

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.

### 2.2.3 Minimum Freeboard Requirements (ASCE 24-14)

ASCE24-14 – Flood Resistant Design and Construction is a referenced standard in the 2015 International Building Code® (IBC) which classifies infrastructure by its criticality and designates a minimum freeboard requirement for each category of infrastructure. Minimum freeboard requirements are provided for the following two FEMA zones:

1. Zone AE
2. Coastal High Hazard Zones (Zone VE and Coastal Zone AE)

ASCE 24-14 outlines four flood design classes, ranking infrastructure from least critical (Class 1) through most critical (Class 4). The Town's pump stations fall into two of these categories:

1. **Flood Design Class 3** structures are considered to be buildings and structures that pose a high risk to the public or a significant disruption to the community if they are unable to perform their intended function due to flooding. ASCE 24-14 specifically includes water and sewage treatment plants in this category. The majority of the Town's pump stations are categorized as Flood Design Class 3.
2. **Flood Design Class 4** includes "buildings and structures that contain essential facilities and services necessary for emergency response and recovery" and ancillary structures that allow continued functioning of a Flood Design Class 4 facility after an emergency. Class 4 structures include hospitals, fire stations, police stations, emergency shelters, emergency operating centers, and structures that handle hazardous substances. Pump stations are considered ancillary structures essential to the continued functioning of Class 4 structures; therefore any pump station that either serves a Class 4 structure, or is in the critical

pathway between the Class 4 structure and the wastewater treatment facility, is categorized a Flood Design Class 4 structure.

The Town's Emergency Management Plan includes a list of the Town's critical infrastructure, health and medical facilities, fixed hazardous facilities, emergency operations shelters, and mass care shelters. The location of the infrastructure included in this list is shown in Figure 1 "Critical Infrastructure Facilities" included in Appendix A. Three pumping stations directly serve Flood Design Class 4 infrastructure:

1. The Narrows Pump Station serves Tobey Hospital and the Wareham Fire Station.
2. Onset Pier Pump Station serves the Onset Fire Department.
3. Cohasset Narrows Pump Station serves the Bourne Fire Station and Bourne Police Department through an inter-municipal agreement.

Figure 3-1 "ASCE 24-14 Wareham Pump Stations Flood Design Classes" included in Appendix A shows an interdependency diagram of Wareham's pump stations. All pump stations in the critical path between Flood Design Class 4 infrastructure and the Wareham WPCF are also considered Flood Design Class 4 infrastructure. The following pump stations are in this critical path:

- Depot Street Pump Station (serves Cohasset Narrows Pump Station).
- Dick's Pond Pump Station (serves Cohasset Narrows Pump Station).
- Hynes Field Pump Station (serves Onset Pier Pump Station).

All mitigation measures proposed for these stations will be designed to the Flood Design Class 4 minimum freeboard requirement. The remainder of the pump stations mitigation measures will be designed to Flood Design Class 3 minimum freeboard requirements.

Minimum freeboards for Class 3 and Class 4 structures DFEs, that are applicable to retrofit projects, are outlined in Table 3.

### 2.2.4 Sea, Lake, and Overland Surges from Hurricanes (SLOSH) Zones

The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model is a computerized numerical model developed by the National Weather Service (NWS) to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes by taking into account the atmospheric pressure, size, forward speed, and track data. This is another tool that the Town can use for disaster preparedness. However, this model is presented herein for information only because the FEMA flood maps are still the resource that is referenced in codes and standards.

Figure 4 "Hurricane Inundation Zones" in Appendix A indicates the four categories of hurricane zones, based on the category of hurricane. The hurricane categories that were considered range from a Category 1 which can cause the lowest degree of damage to the Category 4 which can cause the highest degree of damage. The Inundation Zones indicate which areas have the potential to be flooded during the corresponding hurricane event. Table 3 includes a list of each pump station and what SLOSH category it falls into.

Critical pump stations that fall into any SLOSH category along with flood zones (as shown in Table 3) should be considered having an elevated risk of failure during hurricane events of Category 1 or greater.

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

| Condition | | ASCE 24-14 Minimum Freeboard Requirement | |
|---|---|---|---|
| | | Flood Design Class 3 | Flood Design Class 4 |
| Minimum elevation below which flood damage-resistance materials shall be used. | Zone AE | BFE + 1 foot or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |
| | Zone VE and Coastal Zone AE | BFE + 2 feet or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |
| Minimum elevation of utilities and equipment. | Zone AE | BFE + 1 foot or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |
| | Zone VE and Coastal Zone AE | BFE + 2 feet or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |
| Minimum elevation of dry flood-proofing of non-residential portions of mixed-use buildings. | Zone AE | BFE + 1 foot or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |
| | Zone VE and Coastal Zone AE | Not permitted. | Not permitted. |
| Minimum elevation of wet flood-proofing. | Zone AE, Zone VE and Coastal Zone AE | BFE + 1 foot or DFE, whichever is higher. | BFE +2 feet or DFE, or 500 year flood elevation, whichever is higher. |

## 2.3 Summary

The following calculation is used to determined design elevations for recommended mitigation measures:

Design Elevation = (Base Flood Elevation) + (Expected Sea Level Rise) + (ASCE 24-14 specified freeboard)

- Base Flood Elevation – taken from 2014 FEMA flood maps
- Sea Level Rise
  - 0.6 feet for mechanical equipment and wooden buildings
  - 1.8 feet for concrete and masonry
- Freeboard—recommended freeboard per ASCE 24-14

The DFE for each pump station is outlined in Table 4 .

Table 4 Pump Station Design Flood Elevations

| Pump Station | SLOSH Zone | Flood Zone | BFE | ASCE 24-14 Freeboard | Mechanical Equipment | | Structural Improvements | |
|---|---|---|---|---|---|---|---|---|
| | | | | | SLR | DFE | SLR | DFE |
| Bay Street | 1 | VE | 17 | 2 ft | 0.6 ft | **19.6** | 1.8 ft | **20.8** |
| South Boulevard | 2 | VE | 22 | 2 ft | 0.6 ft | **24.6** | 1.8 ft | **25.8** |
| Hill Street Jefferson Shores | 2 | VE | 21 | 2 ft | 0.6 ft | **23.6** | 1.8 ft | **24.8** |
| Saltworks Road | 2 | VE | 21 | 2 ft | 0.6 ft | **23.6** | 1.8 ft | **24.8** |
| Smith | 1 | VE | 18 | 2 ft | 0.6 ft | **20.6** | 1.8 ft | **21.8** |
| Cohasset Narrows | 1 | VE | 21 | 2 ft | 0.6 ft | **23.6** | 1.8 ft | **24.8** |
| South Water Street | 1 | VE | 19 | 2 ft | 0.6 ft | **21.6** | 1.8 ft | **22.8** |
| Onset Pier | 1 | VE | 22 | 2 ft | 0.6 ft | **24.6** | 1.8 ft | **25.8** |
| Ruggles | 1 | VE | 20 | 2 ft | 0.6 ft | **22.6** | 1.8 ft | **23.8** |
| Cromesset | 1 | Coastal AE | 16 | 2 ft | 0.6 ft | **18.6** | 1.8 ft | **19.8** |
| Leonard Street | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Apple Street | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Onset Heights | 2 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Riverside | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Avenue A | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Briarwood | 1 | Coastal AE | 15 | 2 ft | 0.6 ft | **17.6** | 1.8 ft | **18.8** |
| Arnold | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Narrows | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Pinehurst | 2 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Dick's Pond | 1 | Coastal | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |

| Pump Station | SLOSH Zone | Flood Zone | BFE | ASCE 24-14 Freeboard | Mechanical Equipment | | Structural Improvements | |
|---|---|---|---|---|---|---|---|---|
| | | | | | SLR | DFE | SLR | DFE |
| | | AE | | | | | | |
| North Boulevard | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Hynes Field | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| East Boulevard | 1 | Coastal AE | 14 | 2 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Parkwood | 2 | AE | 15 | 1 ft | 0.6 ft | **16.6** | 1.8 ft | **17.8** |
| Indian Neck | 1 | AE | 14 | 1 ft | 0.6 ft | **15.6** | 1.8 ft | **16.8** |
| Linwood | 2 | AE | 14 | 1 ft | 0.6 ft | **15.6** | 1.8 ft | **16.8** |
| Hathaway | 2 | AE | 14 | 1 ft | 0.6 ft | **15.6** | 1.8 ft | **16.8** |
| Pine Tree Estates (Terry Lane) | 2 | AE | 14 | 1 ft | 0.6 ft | **15.6** | 1.8 ft | **16.8** |
| Green Street | 2 | AE | 16 | 1 ft | 0.6 ft | **17.6** | 1.8 ft | **18.8** |
| Depot Street | 2 | X | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Kennedy Lane | 2 | X | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| French Street | 2 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Kendrick (Industrial Park 1) | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Mattapoisett Road | 3 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Minot | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Nanumette Air Station | 4 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Oak Street | 4 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Peter Cooper | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Police Station | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Springborn | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Thatcher (Industrial Park 2) | - | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Thirteenth Street | 2 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |
| Woodbury | 2 | N/A | N/A | N/A | N/A | **N/A** | N/A | **N/A** |

# 3. State and Local Code Analysis

State and local building codes were reviewed to determine what mitigation options are allowable by these codes.

## 3.1 Massachusetts Building Code

The current Building Code in effect for the State of Massachusetts is the Eighth Edition (August 2010). In accordance with the Commonwealth of Massachusetts Web site, the Massachusetts State Building Code (780 CMR) – Ninth Edition, Base Volume (2015 International Building Code (IBC) with amendments) is to be released sometime before mid-2016. Due to the time it would take to implement recommendations in this report, the assessment of Wareham's pump stations is based upon the Ninth Edition of the Building Code, which references the ASCE 24-14: Flood Resistant Design and Construction design standard. Additionally, FEMA requires applicants for all structure elevation projects to comply with ASCE 24-14 (or latest edition) as a minimum design criterion.

### 3.1.1 Applicability of ASCE 24-14 to Flood Mitigation Measures

As illustrated in Figure 4, the provisions of ASCE 24-14 are only applicable for new structures and for existing structures that are to undergo substantial improvements that cost fifty percent or more of the structure's pre-improvement market value.

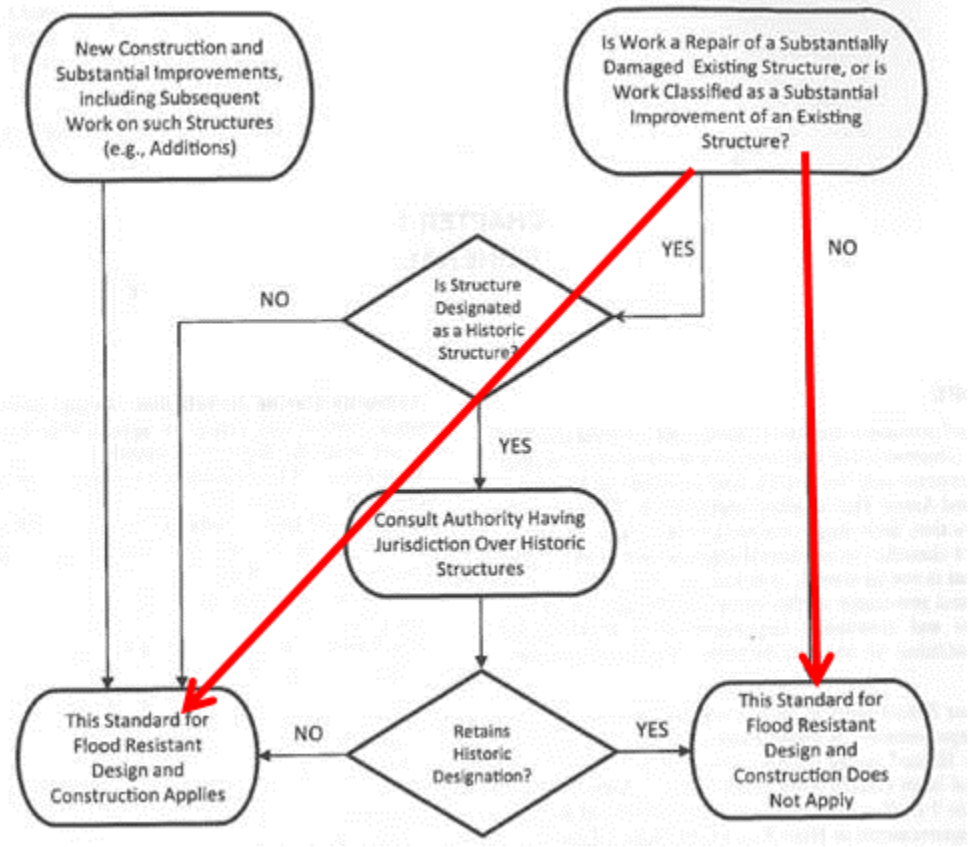



Figure 4 Applicability of ASCE 24-14 to Proposed Mitigation Measures (Source: ASCE 24-14)

ASCE 24-14 outlines two different mitigation options for structures within a flood plain:

- "**Dry flood-proofing**" entails a combination of measures that results in a structure being able to withstand forces of a hydrostatic flood load while keeping the structure watertight.
- "**Wet flood-proofing**" entails provisions to relieve forces of a hydrostatic flood load by allowing the flood water to infiltrate into the structure, but making sure the exposed materials and utilities of the structure are not susceptible to water damage.

Both types of mitigation are discussed in further detail below.

### Dry Flood-Proofing

ASCE 24-14 does not allow structures in High Hazard Flood Areas/Zones (defined as Zone VE and Coastal Zone AE) to be dry flood-proofed. This standard applies to any structure where flood-proofing the building is expected to cost 50% or more of the structures pre-improvement market value.

A preliminary structural review was conducted on the existing pump stations with superstructures to determine the approximate maximum hydrostatic pressure that the structures could withstand, prior to potential collapse. Based on assumed conditions typical of similar structures, the majority of the pump stations superstructures are constructed with a concrete sub-structure and an un-reinforced concrete masonry wall superstructure. It was estimated that the existing structures are not capable of withstanding more than 2.5-feet of hydrostatic pressure on the unreinforced masonry walls without the need to reinforce the structure.

Onset Pier Pump Station is shown in Figure 5 as an example of a pump station that would in danger of collapsing during the Base Flood if it were dry-flood proofed without being reinforced.


Figure 5 Example of Pump Station that Requires Structural Reinforcement if Dry Flood-Proofed

The costs associated with reinforcing structures where the BFE is more than 2.5-feet above the unreinforced masonry wall will likely exceed the 50% cost threshold which triggers the need for these particular existing structures to follow the guidelines of ASCE 24-14. Therefore, dry flood-proofing is not considered as a mitigation measure for pump stations that fall within this category.

Structures with less than 2.5-feet of hydrostatic pressure can likely be flood-proofed for less cost. Therefore, these structures do not need to follow the provisions of ASCE 24-14. However certain elements of ASCE 24-14, including designing to recommended ASCE 24-14 freeboards, will be implemented for good practice.

### Wet Flood-Proofing

Although ASCE 24-14 also limits the use of wet flood-proofing in these zones, it is interpreted that the existing pump stations can be "wet flood-proofed" on the basis that they are "structures that are functionally dependent on close proximity to water" as allowed per ASCE 24-14. This principle has been applied to pump stations in this report since they have a functional need at their location and cannot be moved. The close proximity of the pump stations to water might be coincidental, but they need to be close to water in order to serve their function.

## 3.2 Town of Wareham Zoning Bylaws

The Town of Wareham Zoning Bylaws, updated May 2014, outlines development regulations for the flood plain district. The bylaws stipulate that structural requirements in floodplains and coastal high hazard areas, including substantial improvements, shall conform to the Massachusetts State Building Code (780 CMR).

## 3.3 Variances from Code Regulation

When possible, recommended mitigation measures will comply with the guidance provided in ASCE 24-14. However, the Town has several dry pit/wet pit pumping stations with motor control centers (MCCs) that cannot be moved above the DFE. Four of these stations—Cohasset Narrows, South Water Street, Narrows, and Hynes Field—serve Flood Design Class 4 infrastructure.

Since there is no feasible way to wet flood-proof these stations, it is recommended that the stations with MCC panels are dry flood-proofed and that the unreinforced masonry walls for these stations be structurally reinforced to withstand the hydrostatic pressure of the Base Flood for 2065. This is a variance from the future 9$^{th}$ Edition of the Massachusetts Building Code and should be reviewed with local building officials prior to any implementation.

## 3.4 Summary

Based on an analysis of State and local codes, the following flood mitigation measures are recommended for further consideration in this report:

- Superstructures with more than 2.5-feet of water on the building wall without MCC—wet flood-proofing.
- Superstructures with less than 2.5-feet of water on the building wall—dry flood-proofing.
- Superstructures with more than 2.5-feet of water and equipment that cannot be flood-proofed—dry flood-proofing and structural reinforcement of walls.

# 4. Determining Flood Risk

A Risk and Vulnerability Assessment was conducted using the risk and consequence approach outlined in "Risk Analysis and Management for Critical Asset Protection (RAMCAP®) Standard for Risk and Resilience Management for Risk and Resilience Management of Water and Wastewater Systems Using the ASTM-ITI RAMCAP Plus® Methodology, 1st Edition (ANSI/AWWA J100-10(R13))", a document commonly referred to as "J100". This document provides a methodology for communities, such as the Town of Wareham, to identify vulnerabilities within their system (as related to coastal flooding and climate change) and the risk associated with these vulnerabilities.

Flood risk is calculated for each pump station based on the expected monetary total loss for vulnerable infrastructure for both the Town and its citizens.

Since no as-built drawings were available for any of the pump stations for this report, vulnerabilities were determined based on observations made during field visits.

J-100 defines flood risk as a function of the 1) likelihood of a specific natural disaster and 2) the total estimated loss that can be anticipated from the disaster.

In equation form: (Flood Risk) = (Threat Likelihood) x (Total Loss)

The parameters used to determine the two variables used in the Flood Risk equation are outlined below.

## 4.1 Determining Threat Likelihood

AWWA J100-10 recommends that flood zones should consider a 1% annual chance of flooding (Base Flood). The threat of likelihood for this scenario is 0.01 events per year.

## 4.2 Determining Total Loss

AWWA J-100 defines total loss as the 'sum of repair and replacement costs and losses due to lost production capability and other first effects'. This section outlines the methodology that was used to determine Total Loss for each pump station.

### 4.2.1 HAZUS Modelling

The Hazards United States (HAZUS) model was developed by FEMA to estimate potential losses in disasters. The HAZUS flood model has the ability to perform flood loss estimations at three levels of complexity, which are separated by the completeness and precision of user input incorporated into the model. User input generally falls into two categories:

1) Information on the buildings and/or structures that are being affected, and
2) Information on the physical surroundings and makeup of the study area (e.g., coastline type, elevations, and channel sections).

Both of these inputs work in tandem to determine what the effects of a disaster will be and the relative accuracy of the results. To determine wastewater pump station losses the model uses damage functions which are based on the type of pump station (wet well/dry well or submersible) and the size of the lift station (measured as daily pumping capacity). These damage functions assume that pump stations become compromised once flood water has entered the base floor of the structure (commonly the elevation of the access door or hatch), and are reported as a percent

damage of the total structure. It is assumed at this depth of flooding, all electrical components have been compromised, and in the case of a wet well/dry well pump station the pump has also been compromised (the model assumes no damage to submersible wastewater pumps due to flooding). It is assumed that once flooded no additional damage is incurred.

When detailed coastline information is not available for a study area, the user can perform a level one analysis, wherein the HAZUS model performs an internal algorithm to determine the flood depth grid resulting from a user specified digital elevation model (DEM), flood stillwater elevations and wave setup, flood return period, and approximated coastal boundary. Although this can be a useful tool for getting a general understanding of the flood depths in an area, the hydraulic engine within HAZUS does not have the ability to accurately model and produce a flood depth grid on parity with other hydraulic modeling tools (e.g., HEC-RAS from the USACE). This can be especially common in areas with complex coastlines such as Wareham (i.e., bays and inlets, uneven coastlines with sheltered areas) where inlet channel cross-sections, wind fetch, and coastal compositions largely dictate the wave-driven depth contributions of a flood, and are not well represented in a level one analysis.

To more accurately produce the flooding depths that would be anticipated in an area such as Wareham, the user would generally increase the level of analysis by obtaining an established hydraulic model from a previous flood study (e.g., FIRM analysis from FEMA), or produce one internally, which is typically not time-effective or cost-effective. It was decided not to use the model and to pursue an alternative methodology to determine expected total losses to the Town's pump stations during a Base Flood event.

### 4.2.2 FEMA Benefit Cost Analysis (BCA)

A Benefit Cost Analysis was developed using the FEMA software program BCA 5.1. This software analyzes a proposed projects costs and benefits, and produces a benefit-cost ratio (BCR). A project with a BCR great than or equal to 1.0 indicates that the benefits of the proposed mitigation measures justify the proposed costs of the project.

A project's costs and benefits are calculated by the program based on a series of user input variables. The benefits in the BCA analysis represent the total loss that would be incurred if the pump station failed during the Base Flood event and includes both direct and indirect economic losses.

A BCA was developed for each pump station with a superstructure. BCA only allows the user to run a flooding scenario if the infrastructure has a building associated with it. Costs and benefits for submersible pump stations with no superstructure were estimated using hand calculations based on the BCA methodology and the same assumptions that were used in the BCA analysis of pump stations with superstructures. The output reports for the BCA analyses and input parameters for all pump stations within the SFHA are included in Appendix B.

#### BCA Input Assumptions

The following assumptions were made for the BCA analysis:

**Extent of Damage**

The following assumptions were made about the extent of damage suffered during a Base Flood event:

1. Once flood water has entered the base floor of the structure, all electrical components have been compromised and in the case of wet well/dry well pump station the pump has also been compromised.
2. Once the hydrostatic pressure on an unreinforced masonry wall is greater than 2.5-feet the structure has been comprised.

**Volunteer Costs**

It was assumed that approximately twenty five percent of Wareham's firefighters would be required to assist in laying down sandbags prior to the flooding event, and cleanup services for approximately one month after the flooding event.

**Social Benefits**

It was assumed that social benefit losses (mental stress, anxiety, and lost productivity) are equal to the number of people served by the sewershed and all sewersheds upstream of the pump station whose functionality would be impacted if the pump station was not operational.

**Displacement Costs**

The monthly displacement cost was estimated for each pump station as the number of people dependent on that pump station and all sewersheds upstream of the pump station whose functionality would be affected if the pump station was not operational

**Loss of Services**

A monetary cost was calculated for any station that is downstream of a fire department, police station, or hospital based on available data for each essential service.

### 4.2.3 Erosion Considerations

Pump stations that are within the immediate vicinity (on or within the immediate coastal bank, beach, or other area near the high water line of a tidal waterbody) of the coastline may also be subject to damage from coastal erosion during large storm events. Pump stations that have no buffer (trees, vegetation, manmade structures, etc.) between the pump station foundation and coastal water body include:

- Ruggles
- Smith
- Narrows
- South Boulevard
- Onset Pier
- South Water
- Cohasset Narrows

As these stations are selected for proposed improvements, both hard and soft measures to protect against erosions should be considered.

## 4.3 Summary

Flood risk for each pump station within the SFHA is calculated using the following formula:

(Flood Risk) = (Threat Likelihood) x (Total Loss)

Threat Likelihood (Base Flood) = 0.01 events per year

Total Loss = Benefits output of FEMA BCA 5.1

Results of the flood risk analysis are presented in Chapter 7.

# 5. Mitigation Measures

In order to reduce the impact of a flooding event, the Town can proactively make improvements to vulnerable infrastructure in order to protect it from flood damage. Mitigation measures can be implemented for one of two main objectives:

1. Keep the pump station operational during a flooding event.
2. Allow service to be restored rapidly following a storm or flooding event.

Mitigation measures for both options are discussed in this Chapter.

The Design Flood Elevation (DFE) for each mitigation measure is calculated through the formula described in Section 2:

Design Flood Elevation = (Base Flood Elevation) + (Expected Sea Level Rise) + (ASCE 24-14 specified freeboard)

- Base Flood Elevation – taken from 2014 FEMA flood maps
- Sea Level Rise
  - 0.6 feet for mechanical equipment and wooden buildings
  - 1.8 feet for concrete and masonry
- Freeboard—recommended freeboard per ASCE 24-14

## 5.1 EPA Recommended Mitigation Measures

The EPA guidance document “Flood Resilience: A Basic Guide for Water and Wastewater Utilities” recommends four options for mitigating flood risk at pump stations:

1. Prevent pump stations from flooding.
2. Protect critical components if pump stations do flood.
3. Maintaining pump station operations when the electrical grid is down.
4. Having a means of bypassing normal pump station operations when necessary.

### 5.1.2 Preventing a Pump Station from Flooding (Dry Flood-Proofing)

Flood risk can be mitigated at a pump station through infrastructure improvements intended to prevent flood water from entering the station. This option is also referred to as “dry flood-proofing” a building. As discussed in Section 2.3 dry flood-proofing entails a combination of measures that results in a structure being able to withstand forces of a hydrostatic flood load, which keeping the structure watertight.

Examples of EPA recommended measures that can be taken are outlined below:

1. Procure temporary flood barriers, such as sandbags, for use in minor floods.
2. Extend vent lines above the anticipated flood stage to prevent water from entering the pump station.
3. Install gates and backflow prevention devices on influent and emergency overflow lines to prevent inundation of the pump station by the collection system and the overflow.

4. Install permanent physical barriers, such as flood walls, levees, and sealed doors.
5. Install green infrastructure to attenuate or divert flood water and storm surges away from pump stations.

As discussed in Chapter 3, this mitigation alternative will only be considered for pump stations that have less than 2.5-feet of hydrostatic pressure on their walls during the Base Flood.

#### Recommended Mitigation Options

The following dry flood-proofing mitigation options are considered in this report:

- Replace submersible station hatch with a watertight hatch.
- Seal the interior surfaces and interfaces (joints) of the floor slab and walls (up to 2-feet high) to help prevent water seeping into the building. Any louvers or other wall openings below 2-feet should be raised up accordingly.
- Raise the pump station vent above the DFE.
- Install a flood wall around vulnerable equipment.
- Raise louvers or other points of water entry above the DFE or install a flood door in front of the louver.
- For pump stations where the DFE is less than two feet above the lowest water entry point :
    - Install a 2-foot high stop plate (or flood door) inside the building. With this stop plate installed inside the building, the existing door can swing out into flood waters and a trapped individual can step over the stop plate. This arrangement would relieve the need to provide an emergency means of egress above the Base Flood Elevation (BFE).
- For pump stations where the DFE is more than two feet above the lower water entry point:
    - Install a watertight flood door. Structurally reinforce pump station walls to withstand the BFE in 2065 (end of structural improvements design life). Note – this option would require a code variance as discussed in Section 3.3.

### 5.1.3 Protecting Critical Components if a Pump Station Does Flood

There are several situations where it may not be feasible, or advisable, to prevent flood water from entering the pump station. For example, required pump station improvements may not be deemed cost-effective. Secondly, if the expected flood level is more than a couple of feet, it may be advantageous to allow the water into the pump station in order to equalize the water pressure through the structure and avoid potential structural failure.

If flood water is allowed to enter the station it is imperative that critical components be protected from damage. EPA recommended mitigation options are outlined below:

1. Install unions in the conduit system to reduce the time required to repair damaged sections.
2. During upgrades or design of new equipment, develop capability to temporarily remove and safely store vulnerable components before a flood when there is enough advanced notice to do so.
3. Waterproof electrical components, controls, and circuitry.
4. Relocate or elevate electrical components above the flood stage.

5. Replace vulnerable components with a submersible option.
6. Replace a below-grade pump station with an above-grade station elevated above the flood elevation.

**Recommended Mitigation Options**

The following options are considered in this report:

- Raise generator above the DFE.
- Install louvered openings in the wall in order to allow water into the building to equalize the hydrostatic pressure on the structure.
- Replace equipment with immersible equipment (ex. replace dry pit pumps with wet pit/dry pit pumps).
- Install immersible or watertight enclosures around critical electrical equipment.
- Relocate pump station control panel to above the DFE.
- Relocate pump station generator to above the DFE.

### 5.1.4 Maintaining Operations When Electrical Grid is Down

Provisions should be made to maintain pump station operations, if possible, if the electrical grid is damaged by the flooding event. EPA recommended mitigation options are outlined below:

1. Consider options to procure either portable or permanent generators, increase fuel storage capacity, or install an alternative energy supply. The generators should be elevated above the flood elevation, have automated controls, and be sized appropriately. On-site fuel storage should also be elevated and secured to prevent flotation.
2. Install energy efficient equipment to increase the longevity of the fuel supply for backup generators.
3. Replace pumps with diesel drive or dual-option counterparts.

**Recommended Mitigation Options**

The following options are considered in this report:

- Install a portable generator hook-up at stations that do not have a dedicated standby generator.
- Replace past useful life generator with a new generator.

### 5.1.5 Means to Bypass Normal Pump Operations When Necessary

EPA-recommended options to bypass normal pump operations when necessary are outlined below:

1. Maintain a call-list of multiple vendors that can provide “pump around” services in an emergency or enter into an agreement with one.
2. Procure portable pumps to restore operation of a damaged pump station following an event.
3. Implement a regionalization project to enable diversion of wastewater flows to an alternative system for emergency wastewater collection and conveyance.

**Recommended Mitigation Options**

The Town of Wareham currently has an agreement with Godwin pumps to provide rental equipment, including bypass pumps and backup electrical equipment, during an emergency situation.

### 5.1.6 Additional Mitigation Measures

Approximately half of the Town's pump stations have critical equipment which is past its design life. It is recommended that all equipment past its design life be replaced in order to increase the reliability of the station.

### 5.1.7 Summary

The 17 mitigation options considered in this report are outlined in Table 4. A cost allowance was developed for each option which includes the cost of design, construction and contingency for larger projects and of only construction for smaller projects.

Mitigation measures are recommended for all pump stations where critical equipment is not elevated to the DFE for 2035.

If a pump station requires structural improvements (structural reinforcement of superstructure) it is recommended that the improvement be designed to the DFE for 2065.

Table 5 Mitigation Measures

| Option | Mitigation Measure | Unit Cost |
|---|---|---|
| A | Install flood door. | 2-foot flood door - $30,000<br>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<br>Replace panel - $50,000 |
| E | Raise generator above the DFE. | Less than 1-foot - $50,000<br>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 |
| I | Replace equipment with immersible equipment. | Small station - $1,800,000<br>Medium station - $2,300,000<br>Large station - $2,900,000 |
| J | Install immersible or watertight enclosure on an existing control panel. | $50,000 |
| K | Relocate control panel above the DFE. | $50,000 |
| L | Relocate generator above the DFE. | Less than 1-foot - $75,000<br>1-foot to 3-feet - $150,000<br>3-feet to 5-feet - $200,000<br>5 feet + - $300,000 |
| M | Install a portable generator hook-up. | Non-submersible option - $30,000<br>Submersible option - $50,000 |
| N | Replace past useful life equipment. | Small station - $1,600,000<br>Medium station - $2,100,000<br>Large station - $2,600,000 |
| O | Install watertight manhole cover. | $10,000 |
| P | Structurally reinforce walls. | $500,000 |
| Q | Install flood wall around vulnerable equipment | 6-inch Curb - $4,000<br>1-foot to 2-foot wall - $30,000<br>2-foot to 3-foot wall - $40,000 |

# 6. Vulnerability Assessment

A vulnerability assessment was conducted for the Wareham Water Pollution Control Facility (WPCF) and the pump stations within the SFHA. In this section, existing conditions and vulnerabilities are documented and mitigation measures from Table 5 are suggested for each station. For each station the BFE from the most current FEMA FIRM maps is shown.

As-built drawings were not available for any pump stations during the development of this report. The assessments and recommendations are based on survey data collected by Green Seal Environmental, Inc. and measurements obtained during site visits. All field data should be verified prior to final design of any of the proposed recommendations. Additionally, it should be noted that this Vulnerability and Risk Assessment was conducted for the sole purpose of establishing budgetary estimates to shore up vulnerable infrastructure. No design guidance is expressed or implied.

## 6.1 Wareham Water Pollution Control Facility (WPCF)

The Wareham WPCF is located outside the SFHA. However the WPCF will be affected by the increased amount of flow entering the facility during a coastal flooding event, which could potentially wash out the biological process at the facility. During a flooding event, additional flow will enter the system from non-watertight manholes and non-watertight submersible station hatches.

Many of the manholes within the SFHA have watertight manholes. It is recommended that a survey be conducted to identify which manholes are equipped with watertight manhole covers. Watertight covers should be installed on all manholes within the SFHA which do not currently have them. Additionally, existing watertight manhole covers should be inspected to determine whether the gasket has been damaged, then damaged covers should be replaced. Elevated vents at regular intervals will need to be considered during design for areas with watertight manholes.

## 6.2 Pump Stations within the VE Zone

The Town of Wareham has nine pump stations within the VE zone. The pump stations are located in areas subject to inundation by the Base Flood, with expected additional hazards due to storm-induced velocity wave action. These areas are expected to experience wave action greater than 3-feet.

The following design elevations are recommended for mechanical and structural components, respectively:

Mechanical equipment DFE = BFE + 0.6 ft (SLR) + 2 ft (ASCE 24-14 recommended freeboard)

Structural DFE = BFE + 1.8 ft (SLR) + 2 ft (ASCE 24-14 recommended freeboard)

### 6.2.1 Bay Street

#### Existing Conditions

The Bay Street Pump Station is an ejector pump station, which was constructed in 1989 (Figure 6).


Figure 6 Bay Street Pump Station

The station has an underground concrete substructure, which is accessed through a manhole with a watertight cover. Ejector pumps are an antiquated technology and spare parts for the station need to be special ordered and custom manufactured resulting in a very long lead time for replacement parts. All of the equipment in the station is well past its useful life and no longer considered dependable.

The effectiveness of the watertight cover is limited by whether it has been closed properly and whether the gasket is undamaged (Figure 7). If the cover is not closed properly during the flooding event, all the equipment in the station will be inundated and likely suffer severe electrical damage.

Figure 7 Bay Street Watertight Manhole Cover

Neither the age of the watertight cover, nor the flood water depth that the cover was originally designed for are known. Since the BFE has changed in the Town since the stations construction, the cover was likely not designed for the new BFE and should be replaced.

The pump stations electrical panel is below the BFE and will likely suffer severe electrical damage during the Base Flood event. The station does not have a standby generator.

### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B - Install a new watertight cover capable of withstanding the hydrostatic pressure of the Base Flood event
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure J - Install an immersible panel around the electric panel
- Mitigation Measure M - Install a portable generator hookup
- Mitigation Measure N – Replace past useful life equipment

Select recommended mitigation measures are shown in Figure 8.

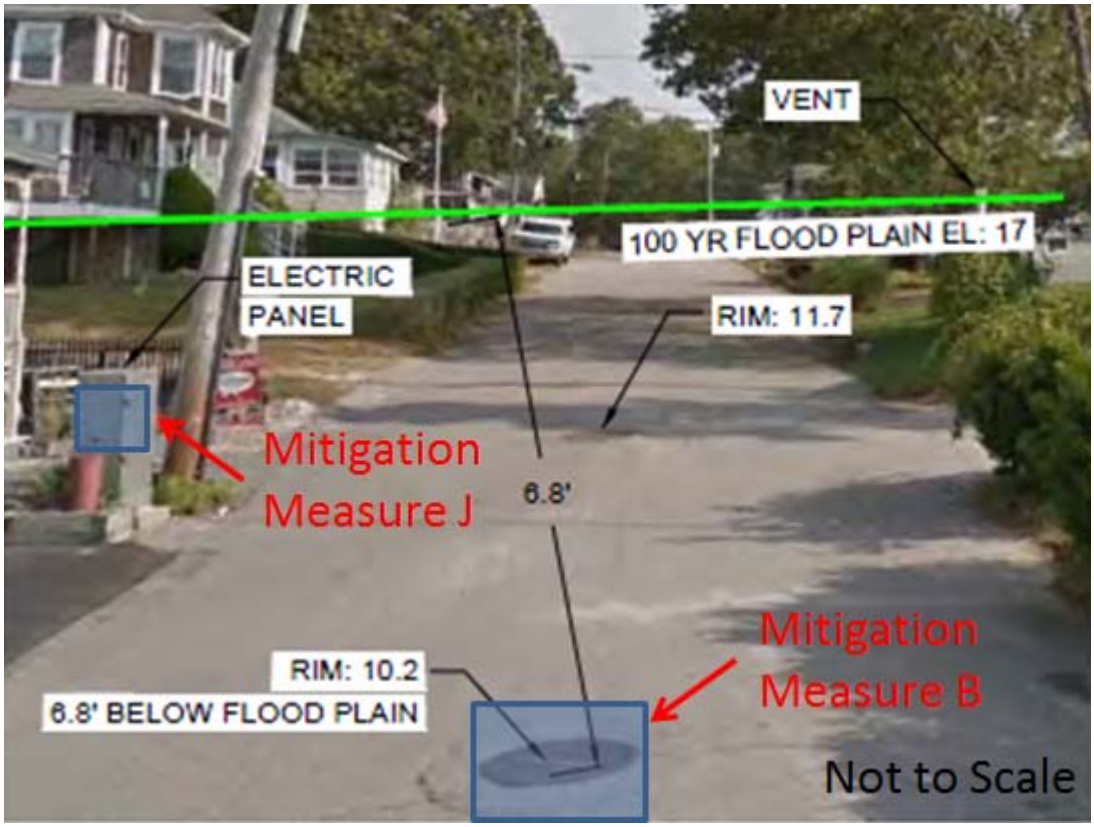



Figure 8 Bay Street Select Proposed Mitigation Measures

### 6.2.2 South Boulevard

#### Existing Conditions

The South Boulevard Pump Station, shown in Figure 9, is a submersible ejector station, which was constructed in 1972. All of the station's equipment is well past its useful life and no longer considered dependable.


Figure 9 South Boulevard Pump Station

The station is accessed through a hatch which is not watertight and is below the DFE. During the Base Flood all of the equipment in the station would be inundated and would likely suffer sever electrical damage.

The station has a metal substructure, shown in Figure 10. Metal substructures are typically installed with a sacrificial anode pack which provides cathodic protection for the station. The anode packs are designed to last approximately 20 years. Since it is unknown whether the anode pack has been changed out at this station, the structural integrity of the substructure is unknown and cannot be relied on to be watertight. It is assumed that during the Base Flood event the substructure will allow water into the pump station.

Figure 10 South Boulevard Substructure

### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight exterior hatch
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure J – Install immersible panel on the control panel
- Mitigation Measure M – Install portable generator hookup
- Mitigation Measure N – Replace past useful life equipment
- Mitigation Measure P – Structurally reinforce walls (replace past design life substructure in its entirety)

The location of select mitigation measures is shown in Figure 11.

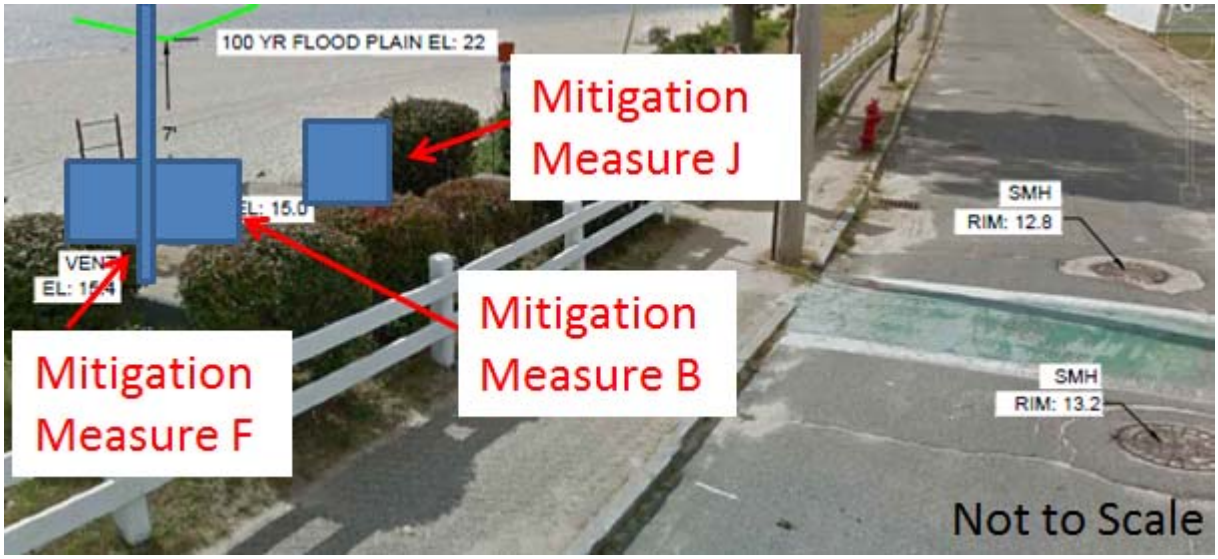



Figure 11 South Boulevard Select Proposed Mitigation Measures

### 6.2.3 Hill Street Jefferson Shores

#### Existing Conditions

Hill Street Jefferson Shores Pump Station is a submersible pump station with an unreinforced masonry superstructure, which was constructed in 1990. All of the equipment at the station is past its useful life. As shown in Figure 12, the station would be inundated during a Base Flood event. The pump stations' electrical equipment and emergency backup generator would likely suffer sever electrical damage in this event. Since the depth of water outside the station is above 2.5-feet, it is expected that the superstructure would collapse. The vault hatch is not watertight.


Figure 12 Hill Street Jefferson Shores Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch
- Mitigation Measure G – Install a louver to allow water to enter the station and equalize hydrostatic pressure
- Mitigation Measure J – Install immersible panel on the existing control panel
- Mitigation Measure L – Relocate generator above the DFE
- Mitigation Measure N – Replace past useful life equipment

The proposed location of select mitigation options is shown in Figure 13.

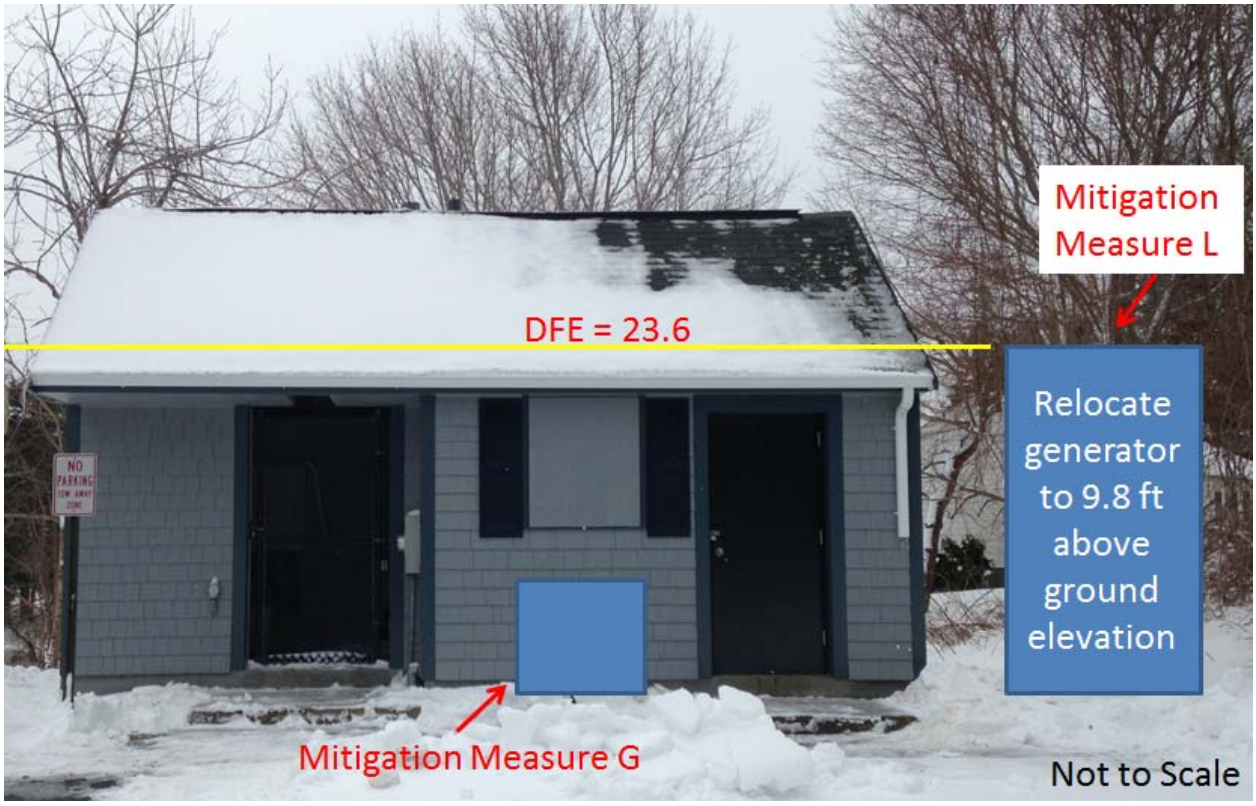



Figure 13 Hill Street Jefferson Shores Select Proposed Mitigation Measures

### 6.2.4 Saltworks Road

#### Existing Conditions

Saltworks Road Pump Station is a submersible pump station, which was constructed in 1990. All of the equipment at the station is past its useful life. As shown in Figure 14 the station would be inundated during the 100-year flooding event. The pump stations' electrical equipment and emergency backup generator would likely suffer sever electrical damage in this event. Since the depth of water outside the structure is greater than 2.5-feet it is expected that the building would collapse. The vault hatch is not watertight.


Figure 14 Saltworks Road Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch
- Mitigation Measure F - Raise vent above DFE
- Mitigation Measure G- Install a louver to allow water to enter the station and equalize hydrostatic pressures
- Mitigation Measure J - Install immersible panel on the existing control panel
- Mitigation Measure L – Relocate generator above the DFE
- Mitigation Measure N – Replace past useful life equipment

Select mitigation measures are shown on Figure 15.


Figure 15 Saltworks Road Select Proposed Mitigation Measures

### 6.2.5 Smith

#### Existing Conditions

The Smith Pump Station is a wet well/dry well pump station which was constructed in 1978 (Figure 16). The lower water entry point (the door) is below the DFE.

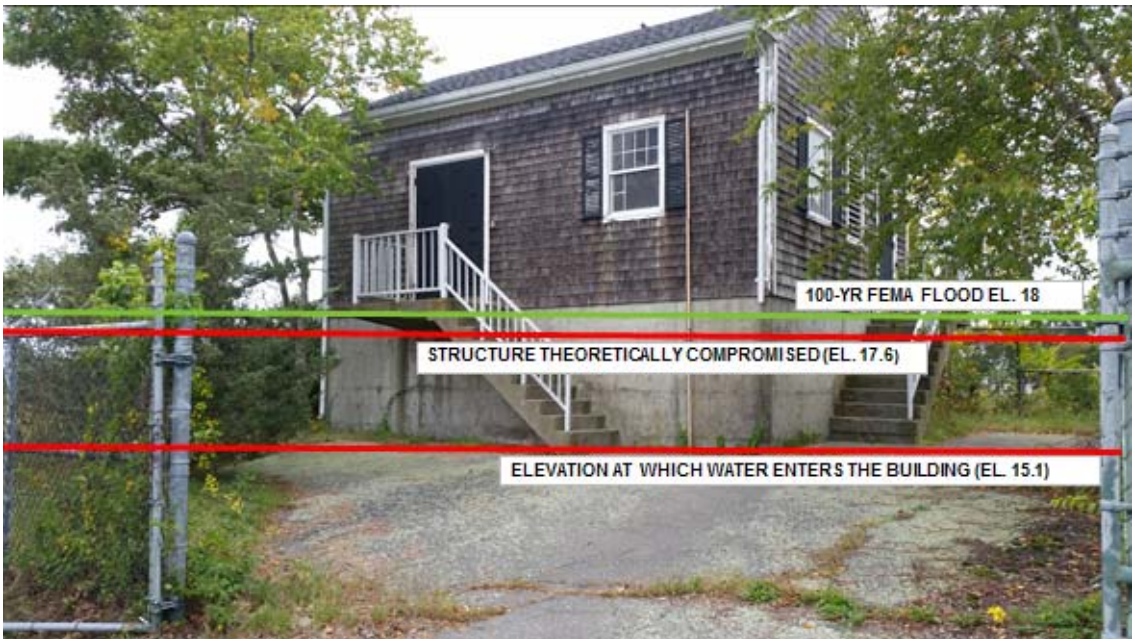



Figure 16 Smith Pump Station

The first floor elevation of the pump station is approximately 3-feet below the BFE. Once water enters the pump station, the electrical equipment (shown in

Figure 17), which is located approximately a foot above the first floor elevation of the pump station, would suffer severe electrical damage.


Figure 17 Smith Master Control Panel (MCC)

### Proposed Solutions

Since there is less than 2.5-feet of hydrostatic pressure on the unreinforced masonry wall at the anticipated 2065 BFE, it is recommended that the station is dry flood-proofed.

The following mitigation measures are recommended for this station:

- Mitigation Measure A - Install a 2-foot flood door at each door (2)
- Mitigation Measure C – Flood-proof paint the inside of the pump station
- Mitigation Measure N – Replace past useful life equipment

Select proposed mitigation measures are shown in Figure 18.


Figure 18 Smith Select Proposed Mitigation Measures

### 6.2.6 Cohasset Narrows

#### Existing Conditions

The Cohasset Narrows Pump Station is a dry pit/wet pit pump station, which was constructed in 1989. As shown in Figure 19, the station would be inundated during the 100-year flooding event. The pump stations' electrical equipment and emergency backup generator would likely suffer sever electrical damage in this event. The depth of water on the unreinforced concrete masonry wall is 2.1-feet. However, when expected sea level rise is taken into account, the depth of water will be over 2.5-feet.


Figure 19 Cohasset Narrows Pump Station

The pump station has several potential water entry points, including both doors and the louver, shown in Figure 20.

Figure 20 Louvered Opening for Equipment Removal

The station also has an MCC panel that cannot be raised above the DFE (Figure 21).

Figure 21 Cohasset Narrows MCC

### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install a flood door at each door (2)
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of louver to protect to the DFE
- Mitigation Measure N – Replace past useful life equipment
- Mitigation Measure P – Structurally reinforce masonry walls

Select Proposed Mitigation measures are shown in Figure 22.

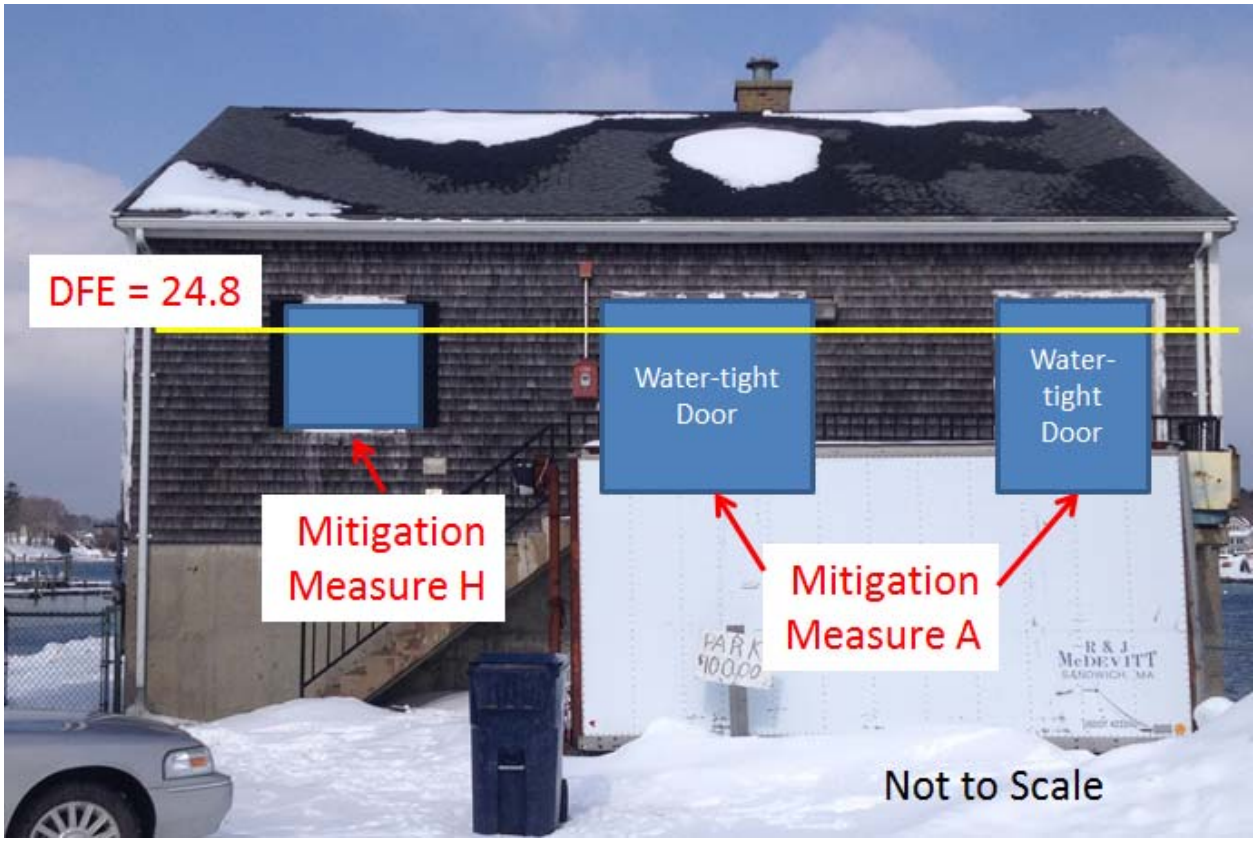



Figure 22 Cohasset Narrows Select Proposed Mitigation Measures

### 6.2.7 South Water Street

#### Existing Conditions

The South Water Street Pump Station is a dry pit/wet pit pump station, which was constructed in 1971. All of the equipment in the station is well past its useful life. As shown in Figure 23 the station would be inundated during the Base Flood event. The pump stations' electrical and mechanical equipment and emergency backup generator would likely suffer sever electrical damage in this event. The depth of water outside the station is over 2.5-feet so it is expected the structure would collapse. The station has an MCC panel which cannot be raised above the DFE.


Figure 23 South Water Street Pump Station

#### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install a watertight flood door
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure E – Raise generator above DFE
- Mitigation Measure N – Replace past useful life equipment
- Mitigation Measure P – Structurally reinforce masonry walls

Select proposed mitigation measures are shown in Figure 24.


Figure 24 South Water Street Select Proposed Mitigation Measures

### 6.2.8 Onset Pier

#### Existing Conditions

Onset Pier is a wet pit/dry pit pump station, which was constructed in 1971. All of the equipment in the station is past its useful life and no longer considered dependable. As shown in Figure 25 the station will be inundated during the Base Flood and all of the mechanical and electrical equipment in the station is expected to suffer severe electrical damage. The station has an MCC that cannot be relocated above the DFE.


Figure 25 Onset Pier Pump Station

#### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install flood-proof door
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure N - Replace past useful life equipment
- Mitigation Measure P – Structurally reinforce masonry wall to 2065 DFE

Select mitigation measures are shown in Figure 26.

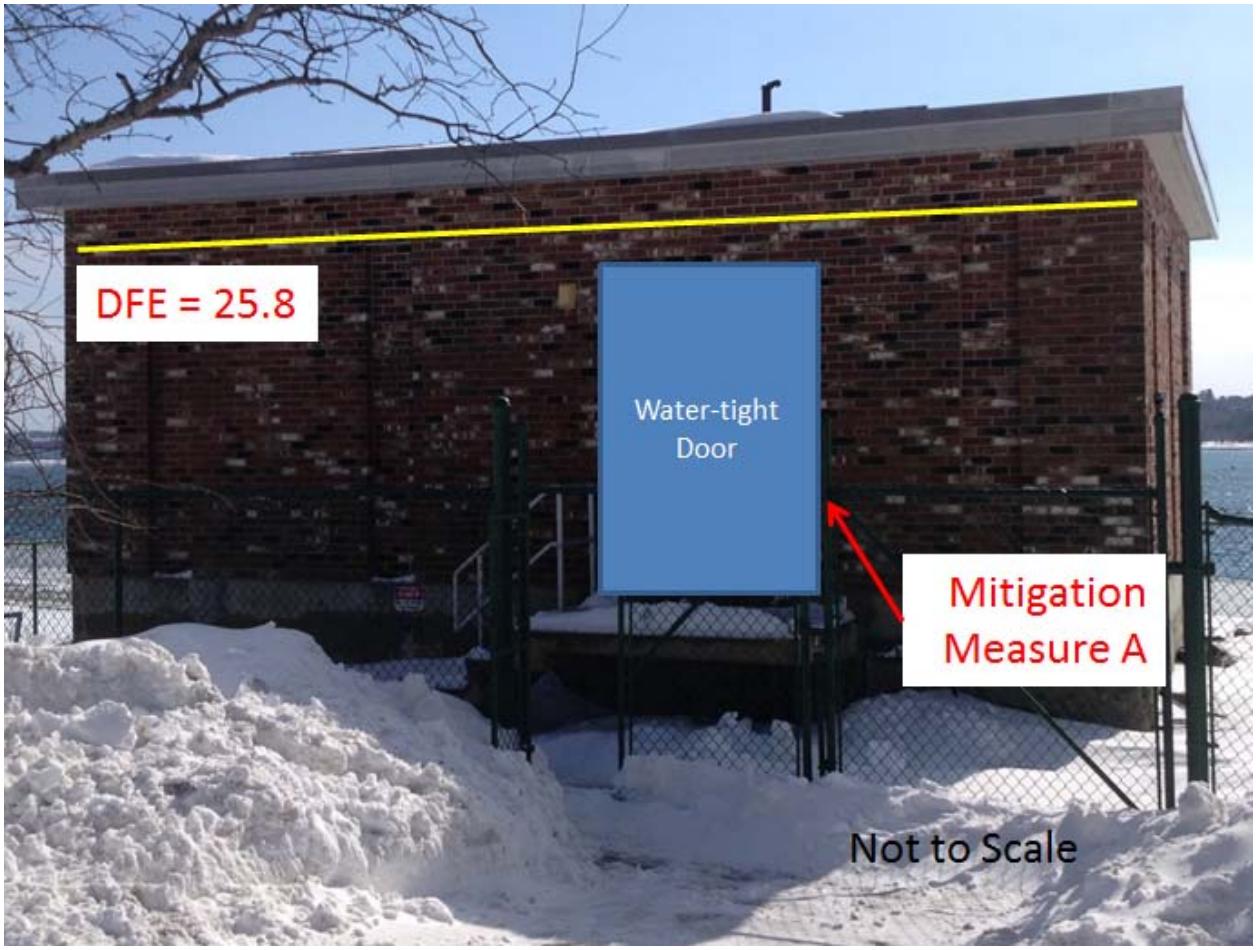



Figure 26 Onset Pier Select Proposed Mitigation Measures

### 6.2.9 Ruggles

#### Existing Conditions

Ruggles Pump Station is a wet pit/dry pit pump station, which was constructed in 2012 (Figure 27). During the Base Flood the hydrostatic pressure on the unreinforced masonry wall is greater than 2.5-feet and the structure may collapse. All of the equipment in the stations is expected to suffer severe electrical damage. The station has an MCC unit that cannot be relocated above the DFE.


Figure 27 Ruggles Pump Station

The pump station has several water entry points below the DFE, including both doors, windows, and the louvers shown in Figure 28.

Figure 28 Ruggles Potential Water Entry Points

### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install flood-proof door
- Mitigation Measure C- Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood-proof door in front of louver to protect to the DFE
- Mitigation Measure P – Structurally reinforce masonry wall to 2065 DFE

Select mitigation measures are shown in Figure 29.

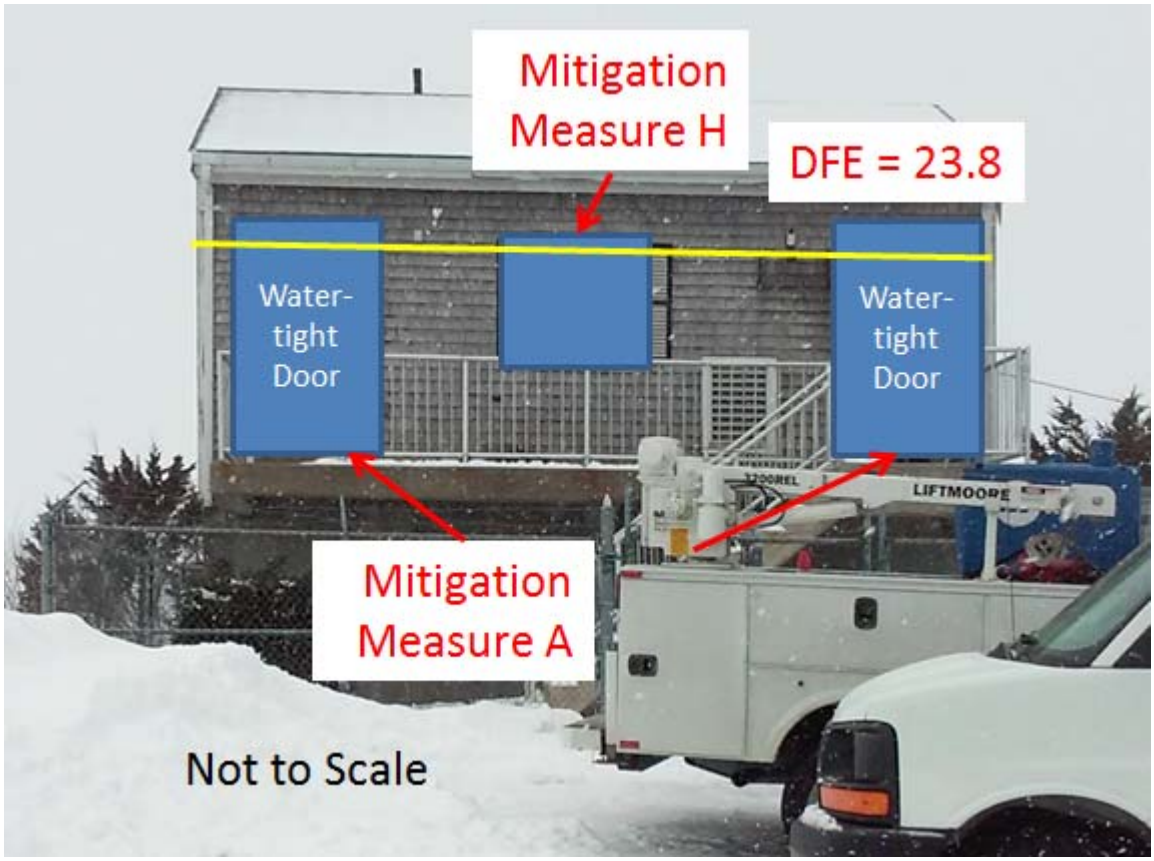



Figure 29 Ruggles Select Proposed Mitigation Measures

## 6.3 Pump Stations within the Coastal Zone AE

The Town has 14 pump stations within the Coastal Zone AE. The pump stations are located in areas subject to inundation by the Base Flood with potential for breaking waves and erosion. These areas are expected to experience wave action between 1.5- and 3-feet.

The following design elevations are recommended for mechanical and structural components, respectively:

Mechanical equipment DFE = BFE + 0.6 ft (SLR) + 2 ft (ASCE 24-14 recommended freeboard)

Structural DFE = BFE + 1.8 ft (SLR) + 2 ft (ASCE 24-14 recommended freeboard)

### 6.3.1 Cromessett Road

#### Existing Conditions

Cromessett Road Pump Station is a submersible pump station, which was constructed in 2012 (Figure 30). The generator, control panel, and pump station hatch are all below the DFE.


Figure 30 Cromessett Road Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above the DFE
- Mitigation Measure Q – Install flood wall around vulnerable equipment

Select mitigation measures are shown in Figure 31.

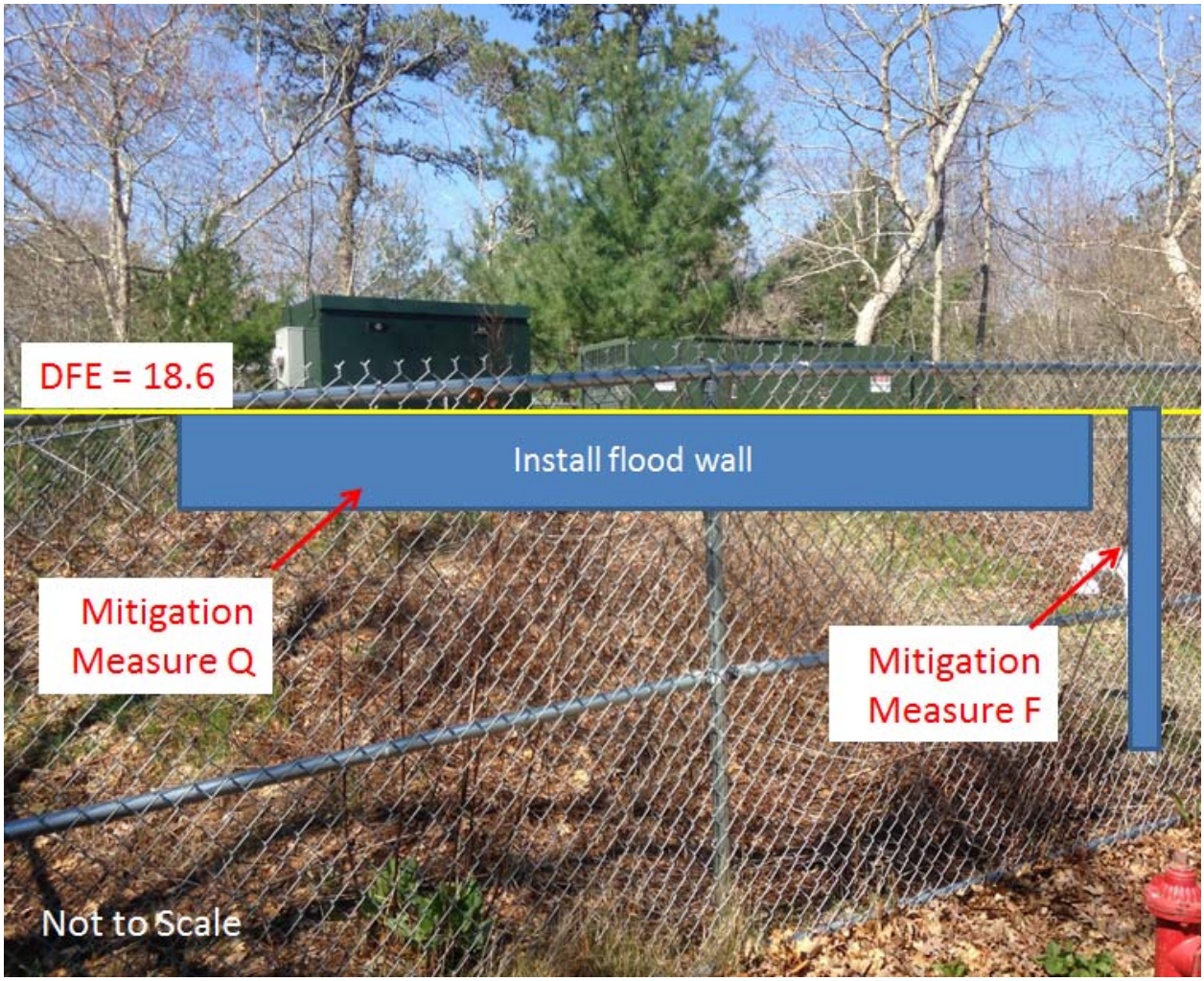



Figure 31 Cromessett Road Select Proposed Mitigation Measures

### 6.3.2 Leonard Street

#### Existing Conditions

Leonard Street Pump Station is a submersible pump station, which was constructed in 2006 (Figure 32). The station has a portable generator hookup. The control panel, vent, and pump station hatch are all below the DFE. The vault hatch is not watertight.

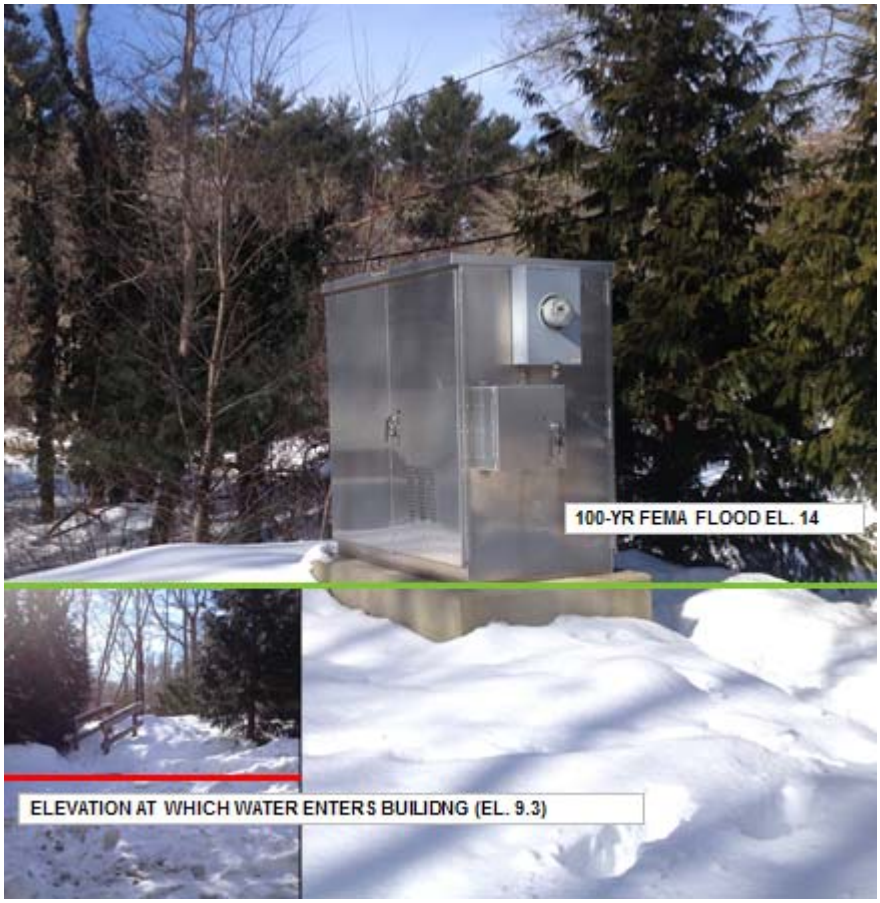



Figure 32 Leonard Street Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure Q – Install floodwall around vulnerable equipment

The proposed mitigation measures are shown on Figure 33.


Figure 33 Leonard Street Select Proposed Mitigation Measures

### 6.3.3 Apple Street

#### Existing Conditions

Apple Street Pump Station is a submersible pump station, which was constructed in 2012 (Figure 34). The pump station hatch, generator, control panel, and vent are all below the DFE. The vault hatch is not watertight.


Figure 34 Apple Street Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure E – Raise generator above the DFE
- Mitigation Measure F – Raise vent above the DFE
- Mitigation Measure Q – Install flood wall around control panel

Select mitigation measures are shown in Figure 35.

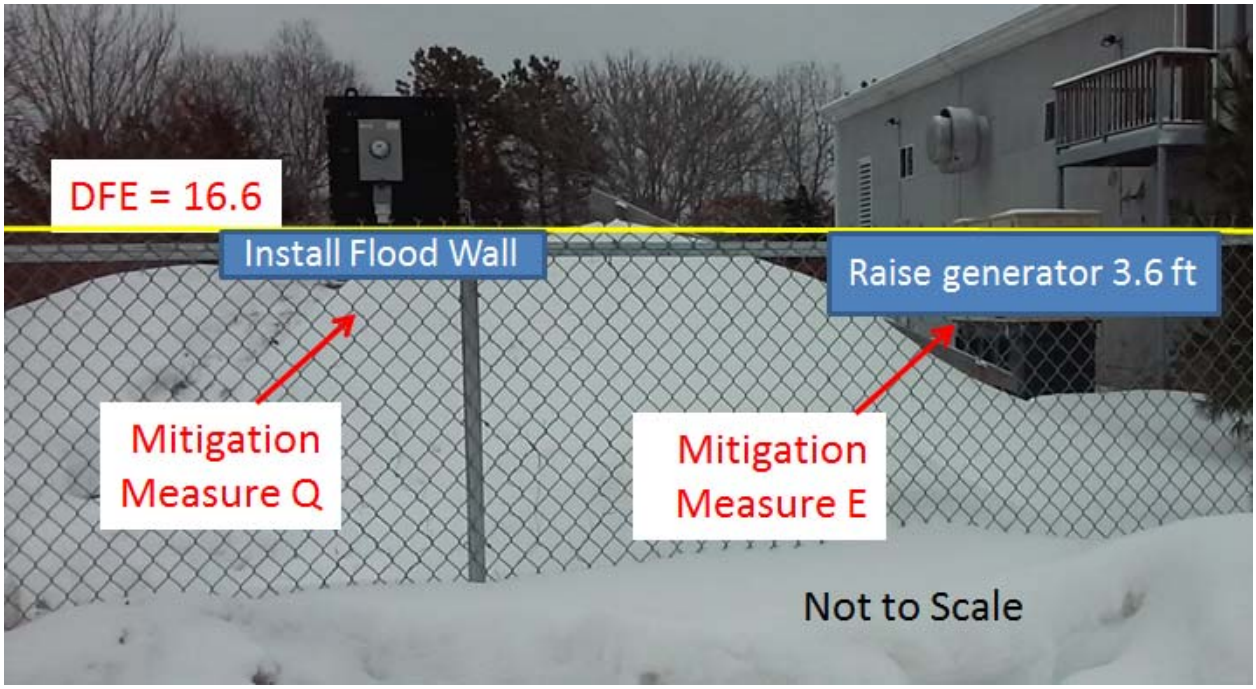



Figure 35 Apple Street Select Proposed Mitigation Measures

### 6.3.4 Onset Heights

#### Existing Conditions

Onset Heights Pump Station is a submersible pump station, which was constructed in 1996 (Figure 36). The vault hatch, control panel, vent, and generator are all below the DFE. The vault hatch is not watertight.

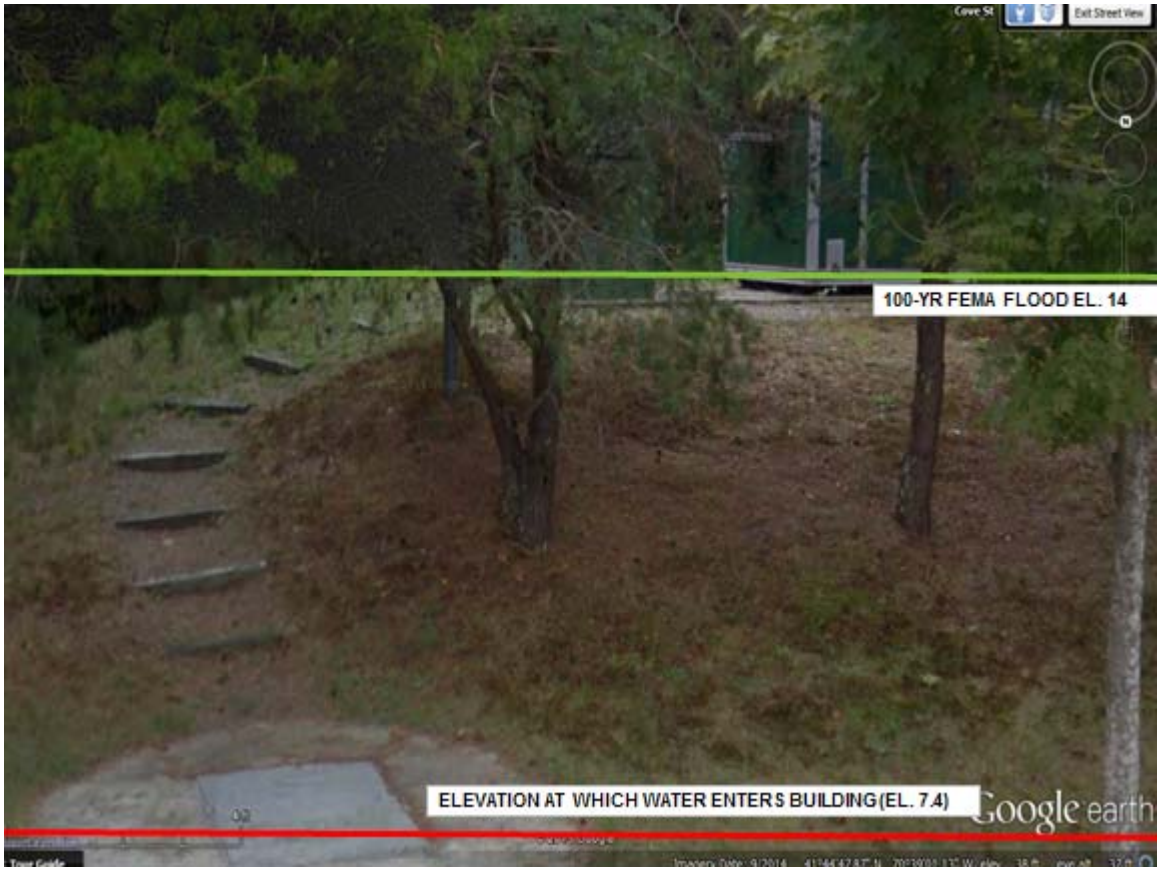



Figure 36 Onset Heights Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure F - Raise vent above the DFE
- Mitigation Measure Q – Install Flood Wall around vulnerable equipment

Select mitigation measures are shown on Figure 37.

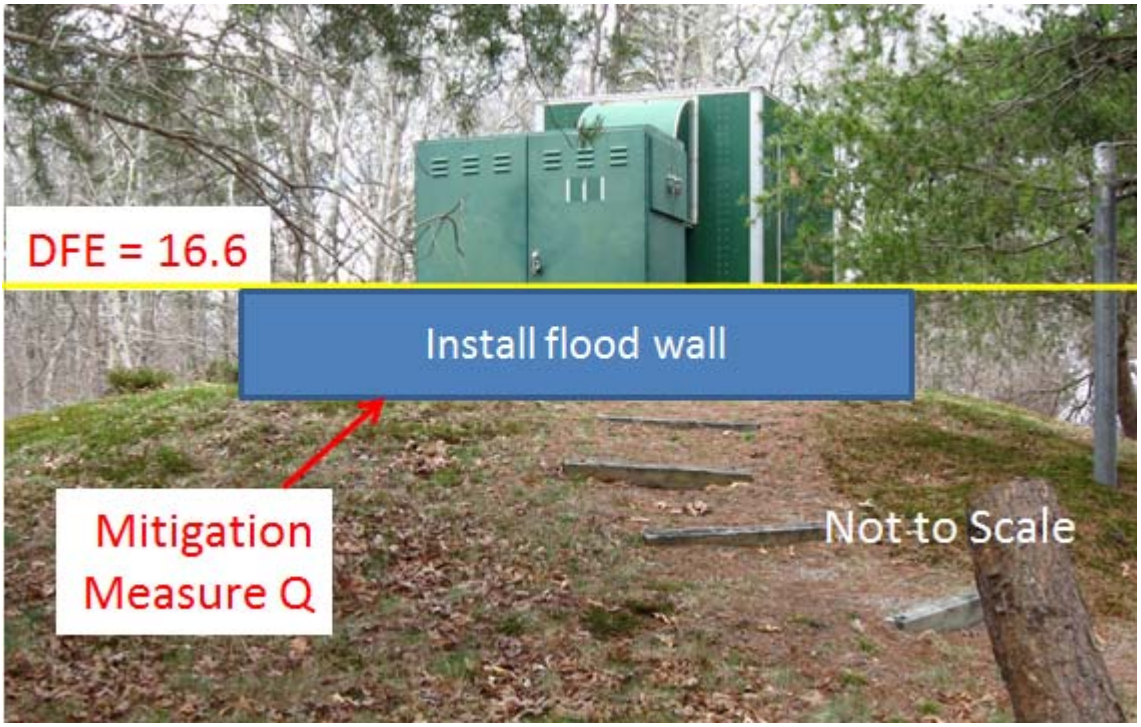



Figure 37 Onset Heights Select Proposed Mitigation Measures

### 6.3.5 Riverside

#### Existing Conditions

Riverside Pump Station is a submersible pump station, which was constructed in 1996 (Figure 38). All of the equipment at the station is past its useful life and is no longer considered reliable. The station has a control panel and generator, which are located at a higher elevation on Riverside Road, down the street from the station. The elevations of both pieces of equipment are below the DFE. The vault hatch is not watertight.

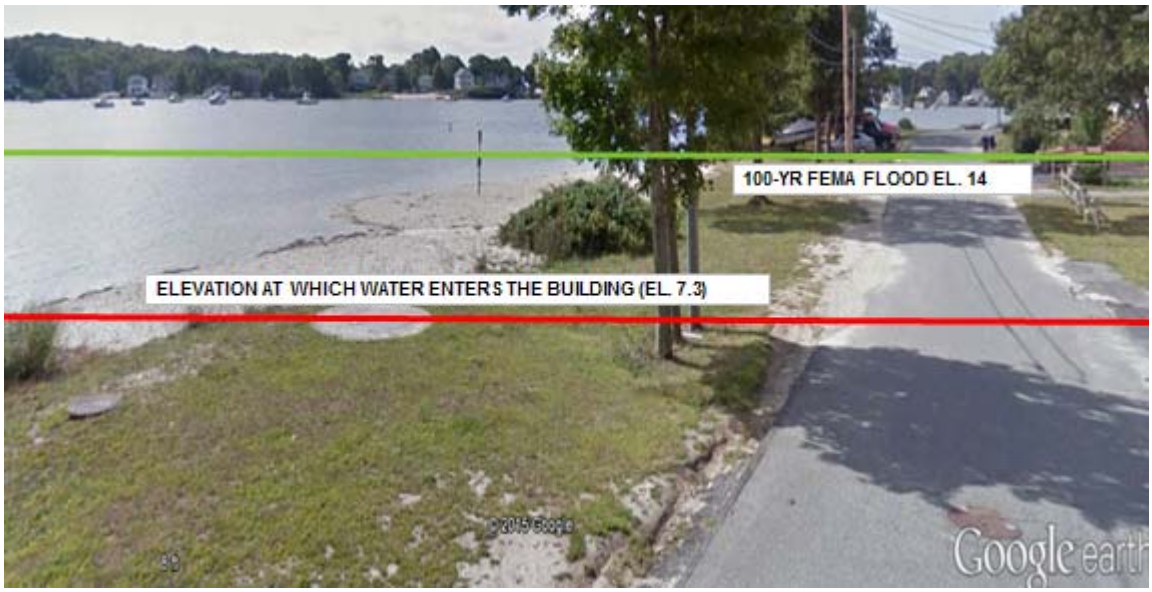



Figure 38 Riverside Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B - Install a watertight hatch on the submersible pump station
- Mitigation Measure D – Raise control panel above DFE
- Mitigation Measure E – Raise generator above DFE
- Mitigation Measure I - Replace all equipment, including control panel and generator

### 6.3.6 Avenue A

#### Existing Conditions

Avenue A Pump Station is a submersible pump station, which was constructed in 2011(Figure 39). The vault hatch, vent, control panel, and generator are all below the DFE. The vault hatch is not watertight and would allow water in during the Base Flood event.


Figure 39 Avenue A Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install a watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure Q – Install flood wall around vulnerable equipment

Select proposed mitigation measures are shown in Figure 40.


Figure 40 Avenue A Select Proposed Mitigation Measures

### 6.3.7 Briarwood

#### Existing Conditions

Briarwood Pump Station is a submersible pump station, which was constructed in 2006 (Figure 41). The vault hatch, vent, generator, and control panel are below the DFE. The vault hatch is not watertight.


Figure 41 Briarwood Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install a watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above the DFE
- Mitigation Measure Q – Install floodwall around vulnerable equipment

Select proposed mitigation measures are shown in Figure 42.

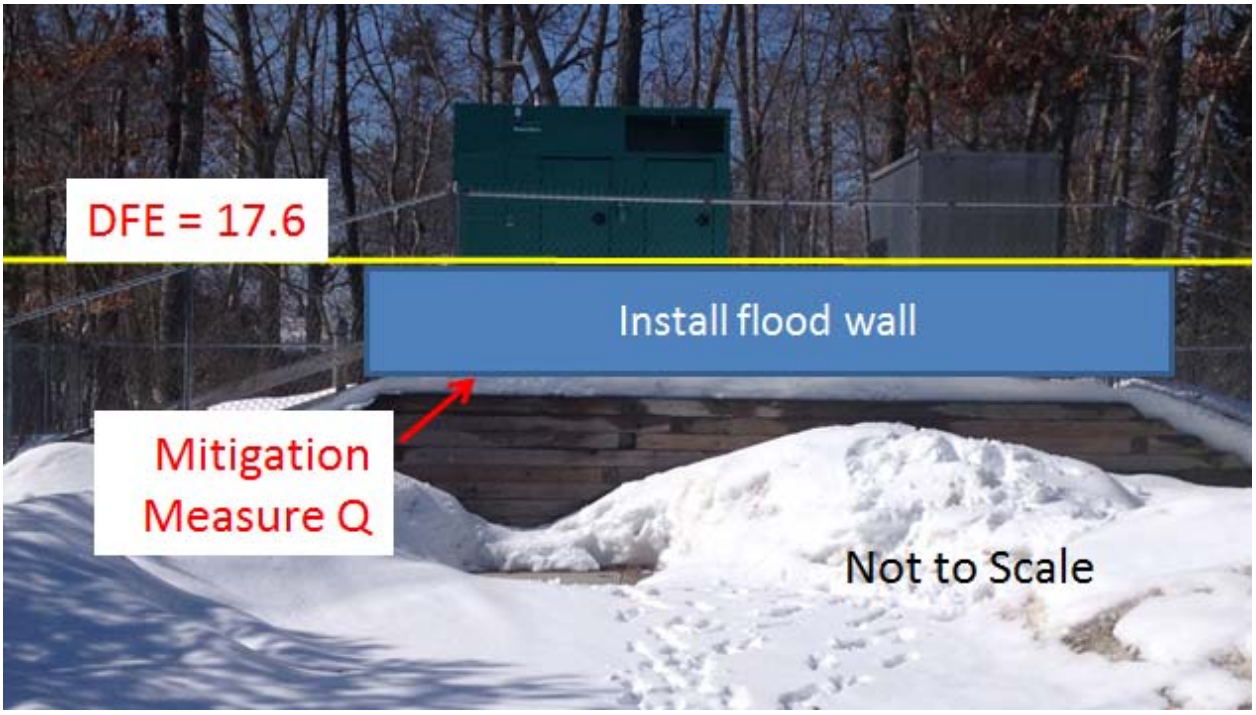



Figure 42 Briarwood Select Proposed Mitigation Measures

### 6.3.8 Arnold

#### Existing Conditions

Arnold Pump Station is a submersible pump station, which was constructed in 2006 (Figure 43). The vault hatch, control panel, generator, and lowest vent are below the DFE. The vault hatch is not watertight.


Figure 43 Arnold Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install a watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above the DFE
- Mitigation Measure Q – Install flood wall around vulnerable equipment

Select mitigation measures are shown in Figure 44.

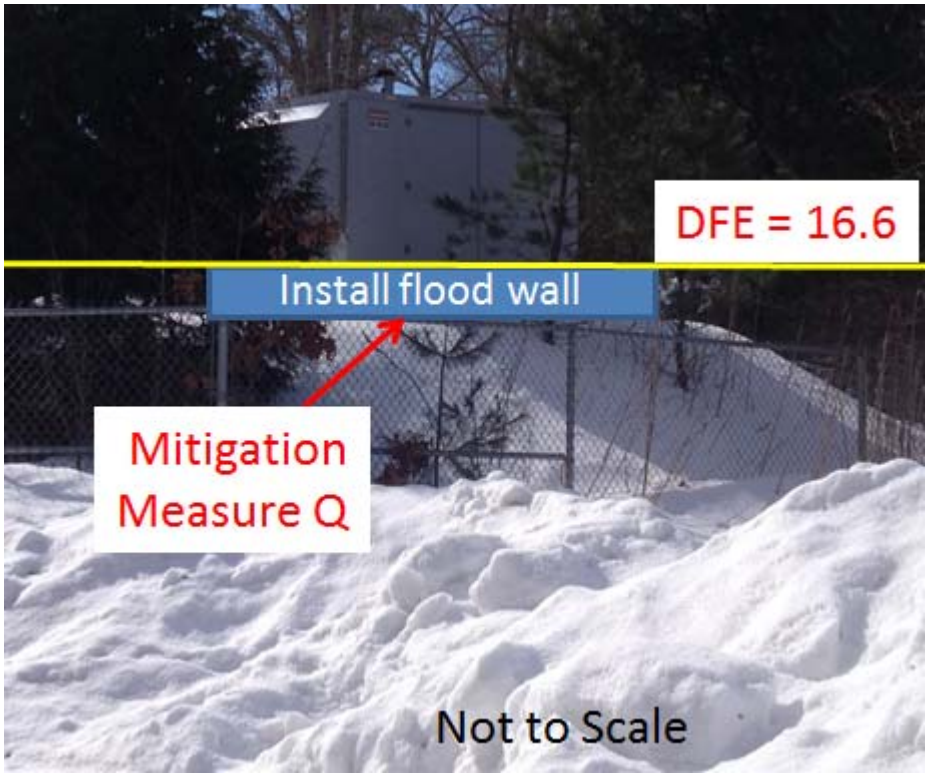



Figure 44 Arnold Select Proposed Mitigation Measures

### 6.3.9 Narrows

#### Existing Conditions

The Narrows Pump Station is a wet pit/dry pit pump station, which was constructed in 1970 (Figure 45). All of the equipment in the station dates to its original construction and is well past its useful life. The elevation at which the concrete foundation transitions to unreinforced masonry wall is estimated at elevation 10.75-feet. During the Base Flood the structure would have more than 2.5-feet of hydrostatic pressure on the building and is expected to collapse.


Figure 45 Narrows Pump Station

The station is also not watertight, with potential water entries through the door and through a louver at the back of the station (shown in Figure 46). None of the equipment within the station is water-resistant and is expected to suffer severe electrical damage during the BFE. The station has an MCC panel that cannot be relocated to above the DFE.

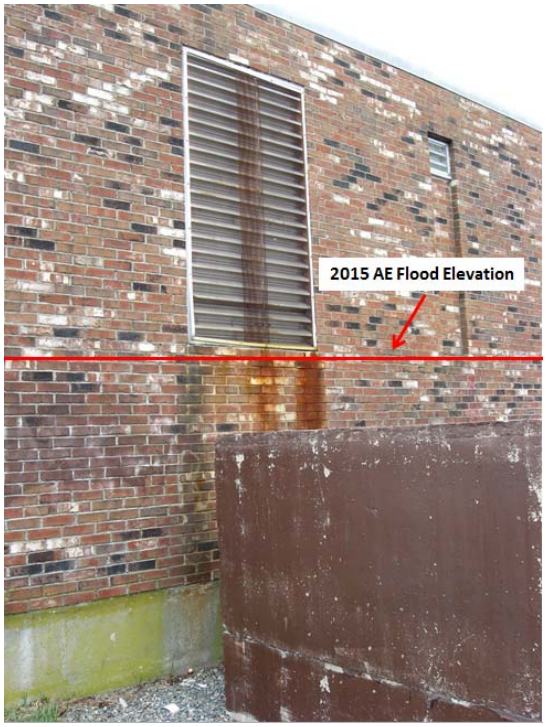



Figure 46 Narrows Pump Station Potential Water Entry Point

### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A - Install a watertight flood door
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of louver to protect to the DFE
- Mitigation Measure N – Replace past useful life equipment.
- Mitigation Measure P – Structurally reinforce masonry wall to 2065 DFE

Select mitigation measures are shown in Figure 47.

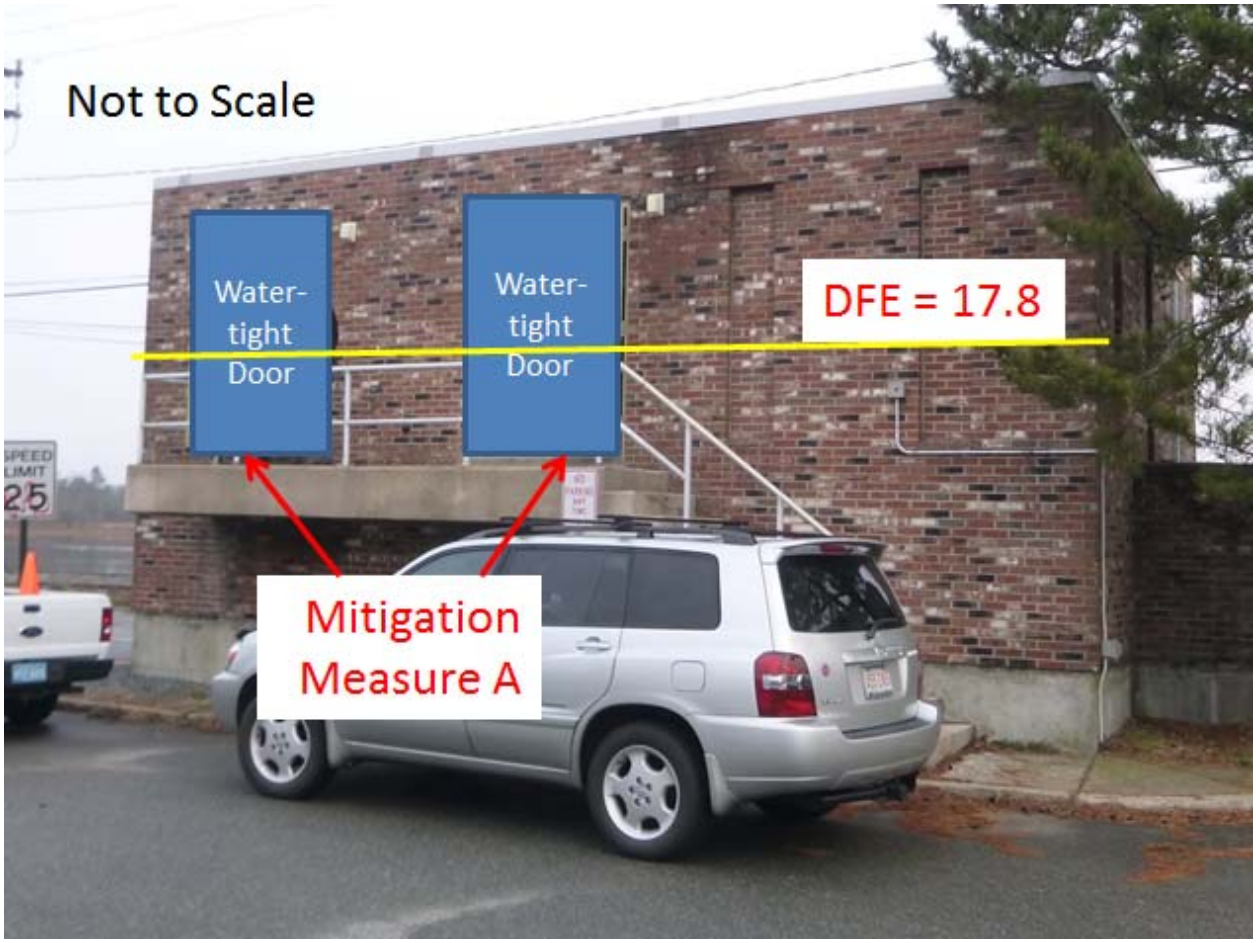



Figure 47 Narrows Select Proposed Mitigation Measures

### 6.3.10 Pinehurst

#### Existing Conditions

Pinehurst Pump Station is a wet pit/dry pit station, which was constructed in 1978. All of the equipment in the station is well past its useful life.


Figure 48 Pinehurst Pump Station

Both of the doors and the louver, shown in

Figure 49, are below the DFE.


Figure 49 Pinehurst Pump Station Water Entry Points Below DFE

### Proposed Solutions

Since there is less than 2.5-feet of hydrostatic pressure on the unreinforced masonry walls it is recommended that the station be dry flood-proofed.

The following mitigation measures are recommended for this station:

- Mitigation Measure A - Install a 2-foot flood door at each door (2)
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of louver to protect to the DFE
- Mitigation Measure N – Replace equipment past its useful life

Select mitigation options are shown in Figure 50.


Figure 50 Pinehurst Select Recommended Mitigation Measures

### 6.3.11 Dick's Pond

#### Existing Conditions

Dick's Pond Pump Station is a wet-pit/dry-pit pump station, which was constructed in 1989 (Figure 51). All of the equipment in the station is dated to the original construction and is well past its useful life.


Figure 51 Dick's Pond Pump Station

The station has several potential water entry points below the DFE as shown in Figure 52.

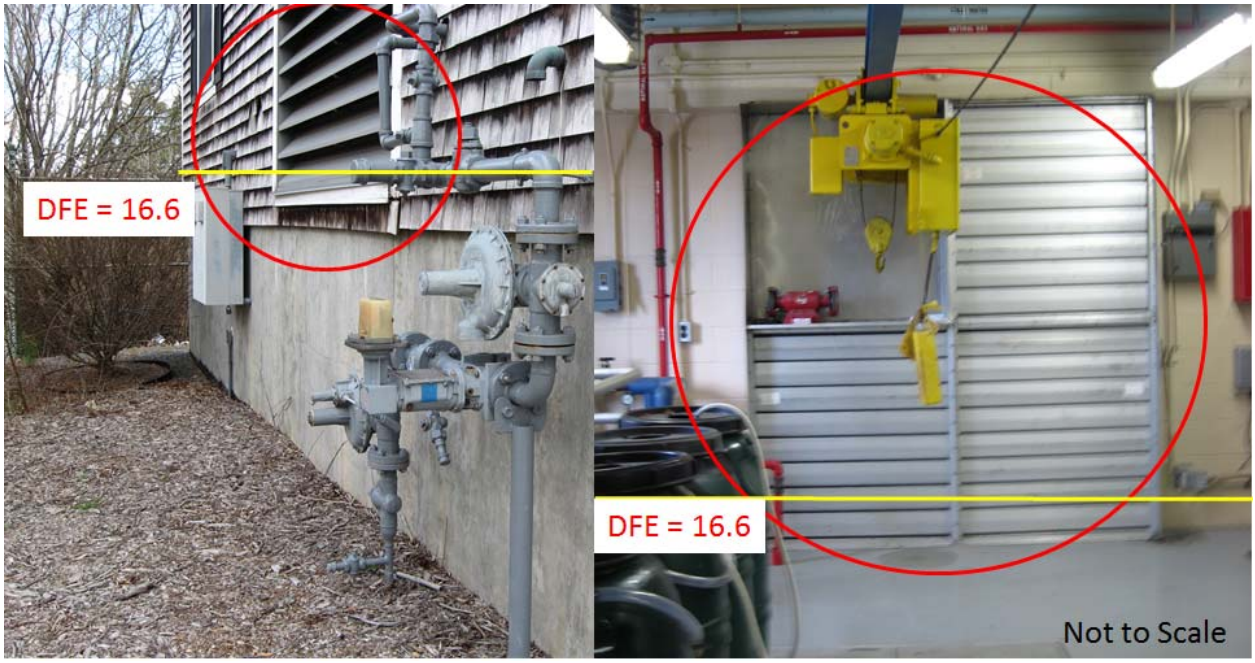



Figure 52 Dick's Pond Pump Station Potential Water Entry Points

### Proposed Solutions

Since there is less than 2.5-feet of hydrostatic pressure on the unreinforced masonry walls it is recommended that the station be dry flood-proofed.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install a 2-foot flood door at each door (2)
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of the louver to protect to the DFE.
- Mitigation Measure N – Replace past useful life equipment

Select proposed mitigation measures are shown in Figure 53.


Figure 53 Dick's Pond Select Proposed Mitigation Measures

### 6.3.12 North Boulevard

#### Existing Conditions

North Boulevard Pump Station is a dry pit/wet pit pump station, which was constructed in 1971. All of the equipment dates to the station's original construction and is well past its useful life. During a site visit the transition between the station's concrete foundation and the unreinforced masonry wall was estimated to be approximately at elevation 11.2 ft. During the Base Flood the hydrostatic pressure on the walls will be greater than 2.5-feet and the building may potentially collapse. The station has an MCC that cannot be relocated above the DFE.


Figure 54 North Boulevard Pump Station

As shown in Figure 55, the wet well entrance is accessed through a manhole outside the building.


Figure 55 North Boulevard Wet Well Manhole Cover

### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install a flood door
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of louver to protect the DFE
- Mitigation Measure L – Relocated generator above DFE
- Mitigation Measure O – Install watertight manhole cover
- Mitigation Measure P – Structurally reinforce masonry wall to 2065 DFE

Select mitigation measures are shown in Figure 56.


Figure 56 North Boulevard Select Proposed Mitigation Measures

### 6.3.13 Hynes Field

#### Existing Conditions

Hynes Field Pump Station is a wet pit/dry pit pump station, which was constructed in 1971. All of the equipment is from the station's original construction and well past its useful life.


Figure 57 Hynes Field Pump Station

The station is not sealed, with water entry possible through the two doors and the louver shown in Figure 58. None of the equipment within the station is water-resistant and the majority of the equipment is anticipated to experience severe electrical damage during the Base Flood. The station has an MCC that cannot be raised above the DFE.

Figure 58 Potential Water Entry Points: Doors and Louver

### Proposed Solutions

Since the pump station has a piece of critical equipment (MCC) that cannot be wet flood-proofed, it is recommended that the station be dry flood-proofed and that the unreinforced masonry walls be reinforced to withstand the hydrostatic pressure of the Base Flood in 2065.

- Mitigation Measure A - Install watertight flood door (2)
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure H – Raise louver above the DFE or install a flood door in front of louver to protect to the DFE
- Mitigation Measure N – Replace past useful life equipment
- Mitigation Measure P – Reinforce masonry wall to DFE 2065

Select mitigation options are shown in Figure 59.


Figure 59 Hynes Field Select Proposed Mitigation Measures

### 6.3.14 East Boulevard

#### Existing Conditions

East Boulevard Pump Station is an ejector pump station, which was constructed in 1971. Ejector pumps are an antiquated technology and spare parts for the station need to be special ordered and custom manufactured resulting in a very long lead time for replacement parts.


Figure 60 East Boulevard Pump Station

While the pump station has a watertight door (shown in Figure 61), water can enter through vents (Figure 62) that are below the BFE. Additionally, the BFE is above the skylight on the roof of the structure. If the skylight cannot support the weight of water above it, it will also become an entry for water. The equipment in this station would likely suffer severe electrical damage during the Base Flood. It is not known whether the station can withstand the buoyancy forces of the updated Base Flood elevations. It is recommended that an analysis of the buoyancy forces on the pump station be conducted. If the pump station can withstand the buoyancy forces of the Base Flood it may be more cost-effective to prevent water entry into the structure.

Figure 61 East Boulevard Watertight Door

Figure 62 Water Entry Point at Vents

### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure G – Install a louver to allow water to enter the station and equalize hydrostatic pressure
- Mitigation Measure I – Replace equipment with immersible equipment
- Mitigation Measure J – Install immersible panel on control panel
- Mitigation Measure M – Install a portable generator hook-up

## 6.4 Pump Stations Within the Zone AE

The Town has six pump stations within the Zone AE. The pump stations are located in areas subject to inundation by the base flood with shallow flooding and low potential for breaking waves and erosions. Waves in this area are expected to be less than 1.5-feet in height.

The following design elevations are recommended for mechanical and structural components, respectively:

Mechanical equipment DFE = BFE + 0.6 ft (SLR) + 1 ft (ASCE 24-14 recommended freeboard)

Structural DFE = BFE + 1.8 ft (SLR) + 1 ft (ASCE 24-14 recommended freeboard)

### 6.4.1 Parkwood

#### Existing Conditions

Parkwood Pump Station is a submersible pump station, which was constructed in 2010. As shown in Figure 63, both the control panel and standby generator are expected to be inundated and suffer severe electrical damage during the Base Flood. The pump stations hatch is not watertight and will allow flood waters into the wet well.


Figure 63 Parkwood Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure Q – Construct flood wall around vulnerable equipment

Select recommended mitigation measures are shown on Figure 64 .

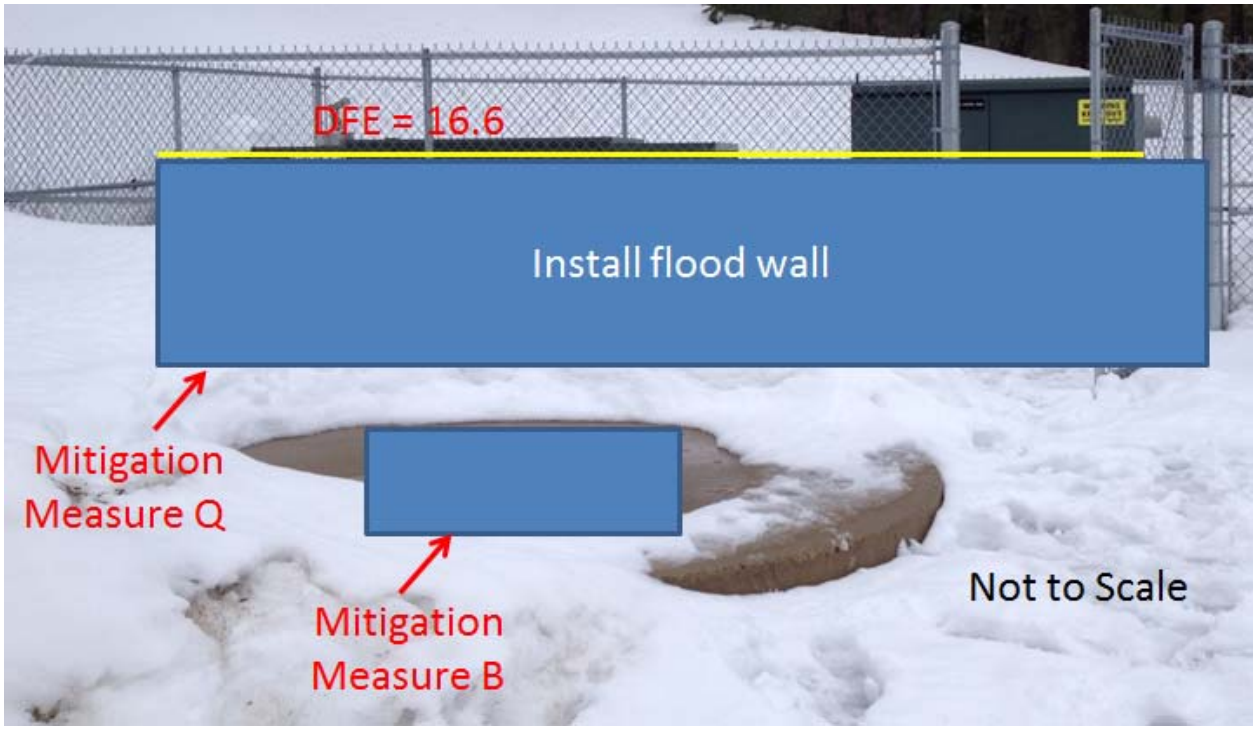



Figure 64 Parkwood Select Proposed Mitigation Measures

### 6.4.2 Indian Neck

#### Existing Conditions

Indian Neck Pump Station is a submersible pump station, which was constructed in 2010 and is shown in Figure 65. The generator and control panel are both below the DFE. The pump stations hatch is not watertight and will allow flood waters into the wet well.


Figure 65 Indian Neck Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure F – Raise vent above the DFE
- Mitigation Measure Q – Construct floodwall around vulnerable equipment

Select mitigation measures are shown in Figure 66.


Figure 66 Indian Neck Select Proposed Mitigation Measures

### 6.4.3 Linwood

#### Existing Conditions

Linwood Pump Station is a submersible pump station, which was constructed in 2005. The station has a portable generator hookup (Figure 67). The control panel is below the DFE. The pump station hatch is not watertight and will allow flood waters into the wet well.


Figure 67 Linwood Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch
- Mitigation Measure Q – Install flood wall around vulnerable equipment

Select mitigation measures are shown in Figure 68.


Figure 68 Linwood Select Proposed Mitigation Measures

### 6.4.4 Hathaway

#### Existing Conditions

Hathaway Pump Station, shown in Figure 69, is a submersible pump station, which was constructed in 2006. Both the control panel and the pump station hatch are below the DFE. The vault hatch is not watertight.


Figure 69 Hathaway Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure B – Install watertight hatch on a submersible station
- Mitigation Measure Q – Install flood wall around vulnerable equipment

Proposed mitigation measures are shown in Figure 70 .


Figure 70 Hathaway Select Proposed Mitigation Measures

### 6.4.5 Terry Lane/Pine Tree Estates (Terry Lane)

#### Existing Conditions

Terry Lane/Pine Tree Estates (Terry Lane) Pump Station is a submersible pump station with an unreinforced masonry superstructure, which was constructed in 1992. All of the equipment at the station is well past its useful life. The first entry to water (the door) is below the DFE. The vault hatch is not watertight.


Figure 71 Terry Lane/Pine Tree Estates (Terry Lane) Pump Station

#### Proposed Solutions

Since there is less than 2.5-feet of hydrostatic pressure on the unreinforced masonry walls during the Base Flood, it is recommended that the station be dry-proofed.

The following mitigation measures are recommended for this station:

- Mitigation Measure A – Install a 2-foot flood door at every door (2)
- Mitigation Measure B – Install a watertight hatch
- Mitigation Measure C – Flood-proof painting
- Mitigation Measure F – Raise vent above DFE
- Mitigation Measure H – Raise Louver above the DFE
- Mitigation Measure N – Replace past useful life equipment

Proposed mitigation measures are shown in Figure 72.


Figure 72 Terry Lane Select Proposed Mitigation Measures

### 6.4.6 Green Street

#### Existing Conditions

Green Street Pump Station is an ejector pump station, which was constructed in 1989. Ejector pumps are an antiquated technology and spare parts for the station need to be special ordered and custom manufactured resulting in a very long lead time for replacement parts. All of the stations' equipment is well past its useful life. The elevation at which water enters the building is below the DFE of 17.6. If water enters the structure the equipment in the station is expected to suffer severe electrical damage.


Figure 73 Green Street Pump Station

#### Proposed Solutions

The following mitigation measures are recommended for this station:

- Mitigation Measure A - Install a 2-foot flood door
- Mitigation Measure C – Flood-proof painting

- Mitigation Measure M – Install a portable generator hookup
- Mitigation Measure N – Replace past useful life equipment

Proposed mitigation measures are shown in Figure 74.

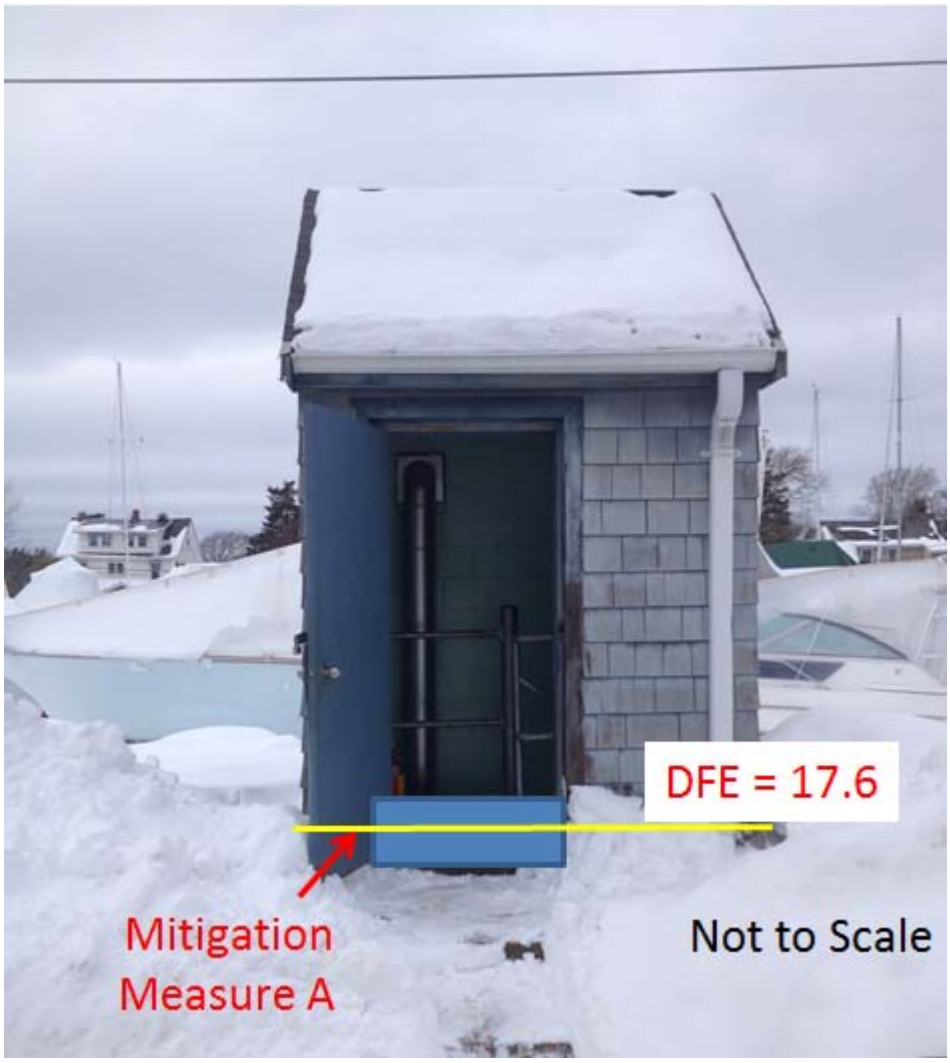



Figure 74 Green Street Select Proposed Mitigation Measures

## 6.5 Mitigation Budgetary Costs

Budgetary costs were developed for the recommended mitigation measures described in this section and are summarized in Table 6. The budgetary costs represent the sum of the mitigation measure allowances for each pump station, based on the allowances outlined in Section 5, Table 5.

Table 6 Recommended Mitigation Measures Budgetary Costs

| Street | Cost |
|---|---|
| Apple Street | $190,000 |
| Arnold | $80,000 |
| Avenue A | $80,000 |
| Bay Street | $1,720,000 |
| Briarwood | $40,000 |
| Cohasset Narrows | $2,670,000 |
| Cromessett Road | $80,000 |
| Dick's Pond | $2,510,000 |
| East Boulevard | $2,030,000 |
| Green Street | $1,860,000 |
| Hathaway | $30,000 |
| Hill Street Jefferson Shores | $2,130,000 |
| Hynes Field | $2,670,000 |
| Indian Neck | $70,000 |
| Leonard Street | $80,000 |
| Linwood | $60,000 |
| Narrows | $2,630,000 |
| North Boulevard | $2,920,000 |
| Onset Heights | $80,000 |
| Onset Pier | $2,460,000 |
| Parkwood | $80,000 |
| Pinehurst | $2,510,000 |
| Riverside | $1,630,000 |
| Ruggles | $870,000 |
| Saltworks Road | $2,640,000 |
| Smith | $2,830,000 |
| South Boulevard | $1,920,000 |
| South Water Street | $2,760,000 |
| Terry Lane/Pine Tree Estates | $2,550,000 |
| **TOTAL** | **$42,180,000** |

# 7. Flood Risk

A flood risk was calculated for the pump stations in SFHA using the methodology described in Chapter 4. The flood risk is the summation of the costs borne by the Town and its citizens. Costs to the Town include replacement of damaged or destroyed equipment and loss of essential services – such as the services of a hospital, police station, or fire department. Costs to citizens include relocation costs during the period that their house has no sewer service and volunteer costs for clean-up efforts. The risk for each station is shown in Table 6.

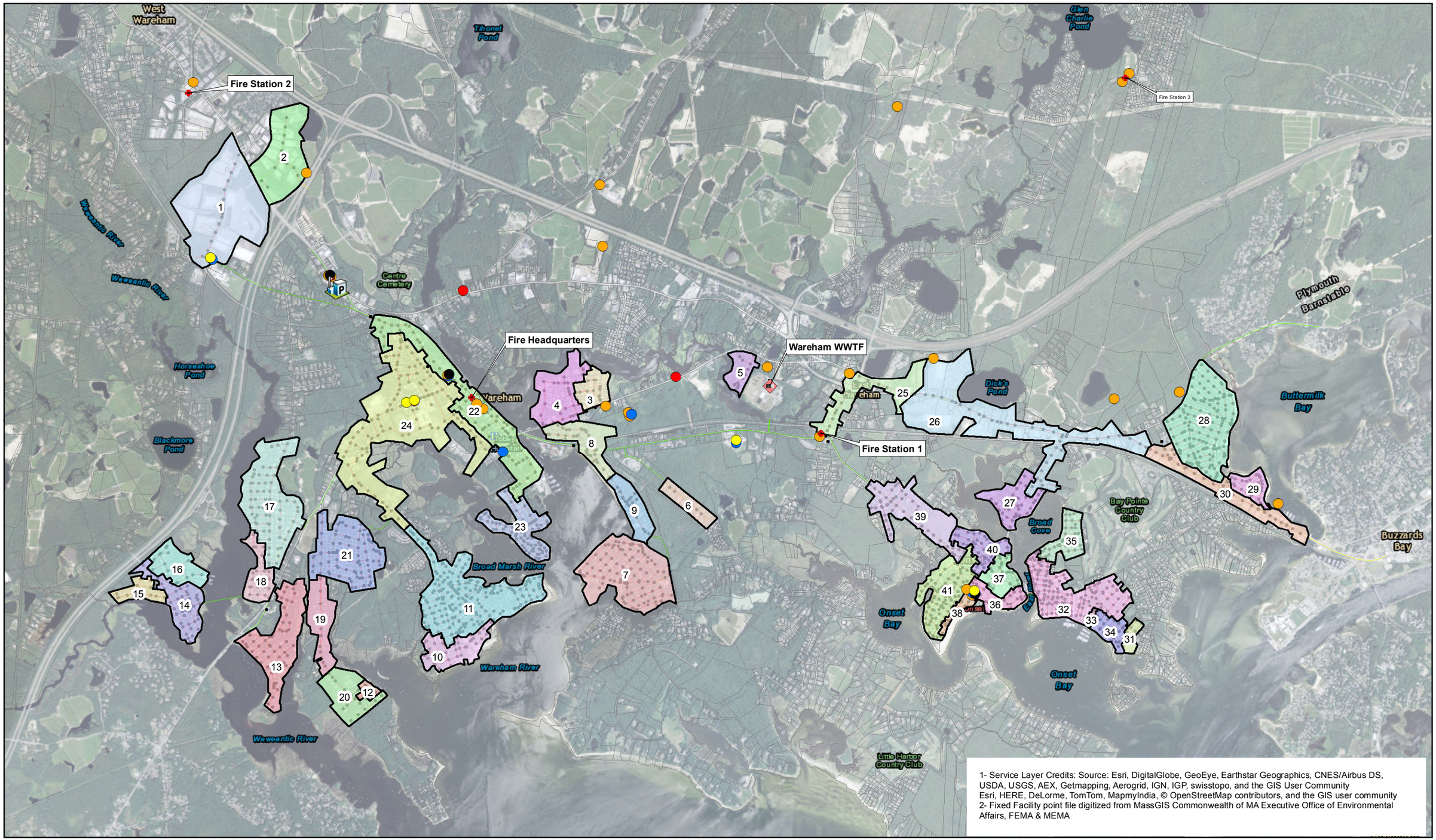
It is recommended that the Town prioritize projects with the highest annual flood risk.

Table 7 Flood Risk for Pump Stations Within SFHA

| Pumping Station | Threat Likelihood | Total Loss | Annual Flood Risk |
|---|---|---|---|
| Narrows | 0.01 | $99,800,000 | $998,000 |
| Hynes Field | 0.01 | $65,600,000 | $656,000 |
| Smith | 0.01 | $56,900,000 | $569,000 |
| Dick's Pond | 0.01 | $46,000,000 | $460,000 |
| Onset Pier | 0.01 | $45,200,000 | $452,000 |
| Hathaway | 0.01 | $44,100,000 | $441,000 |
| South Water Street | 0.01 | $43,000,000 | $430,000 |
| Cohasset Narrows | 0.01 | $42,800,000 | $428,000 |
| Saltworks Road | 0.01 | $39,800,000 | $398,000 |
| Indian Neck | 0.01 | $37,700,000 | $377,000 |
| Pine Tree Estates (Terry Lane) | 0.01 | $35,400,000 | $354,000 |
| Parkwood | 0.01 | $34,800,000 | $348,000 |
| Pinehurst | 0.01 | $33,800,000 | $338,000 |
| East Boulevard | 0.01 | $33,400,000 | $334,000 |
| Arnold | 0.01 | $31,700,000 | $317,000 |
| Ruggles | 0.01 | $31,500,000 | $315,000 |
| Briarwood | 0.01 | $31,100,000 | $311,000 |
| North Boulevard | 0.01 | $31,000,000 | $310,000 |
| Cromessett | 0.01 | $29,700,000 | $297,000 |
| Onset Heights | 0.01 | $29,600,000 | $296,000 |
| Avenue A | 0.01 | $29,500,000 | $295,000 |
| Riverside | 0.01 | $29,100,000 | $291,000 |
| Bay Street | 0.01 | $28,400,000 | $284,000 |
| Hill Street Jefferson Shores | 0.01 | $27,600,000 | $276,000 |
| South Boulevard | 0.01 | $27,400,000 | $274,000 |
| Leonard Street | 0.01 | $27,300,000 | $273,000 |
| Apple Street | 0.01 | $27,300,000 | $273,000 |
| Linwood | 0.01 | $27,200,000 | $272,000 |
| Green Street | 0.01 | $26,500,000 | $265,000 |

# Appendices

# Appendix A – Additional Figures




Paper Size ARCH D

0 1,250 2,500 5,000 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

LEGEND

Sewershed (TYP) (with ID Number)

**Facility**

- Critical Infrastructure
- Health & Medical Facility
- Fixed Hazard Facilities
- Emergency Operations Center
- Mass Care Shelters

Town of Wareham, Ma
Capital Improvement Plan

# CRITICAL INFRASTRUCTURE FACILITIES

| | |
|---|---|
| Job Number | 86-18489 |
| Revision | A |
| Date | 29 Oct 2015 |

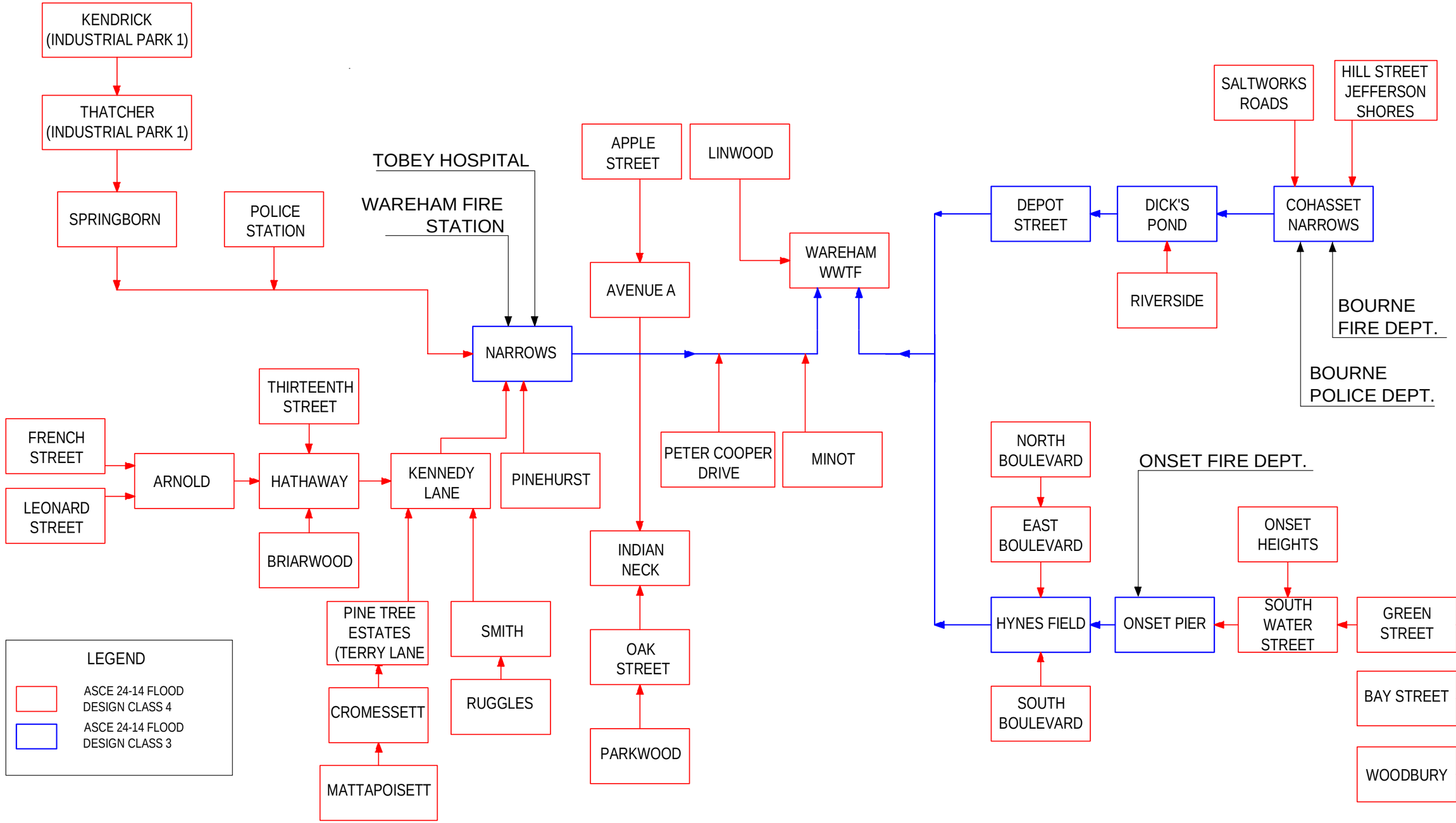
Figure 1

N:\US\Hyannis\Projects\86\18712\GIS\Maps\MXD_Deliverables\Fixed Hazardous Facilities F1.mxd



Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:jjobrien

180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com




TOWN OF WAREHAM, MASSACHUSETTS
VULNERABILITY ASSESSMENT

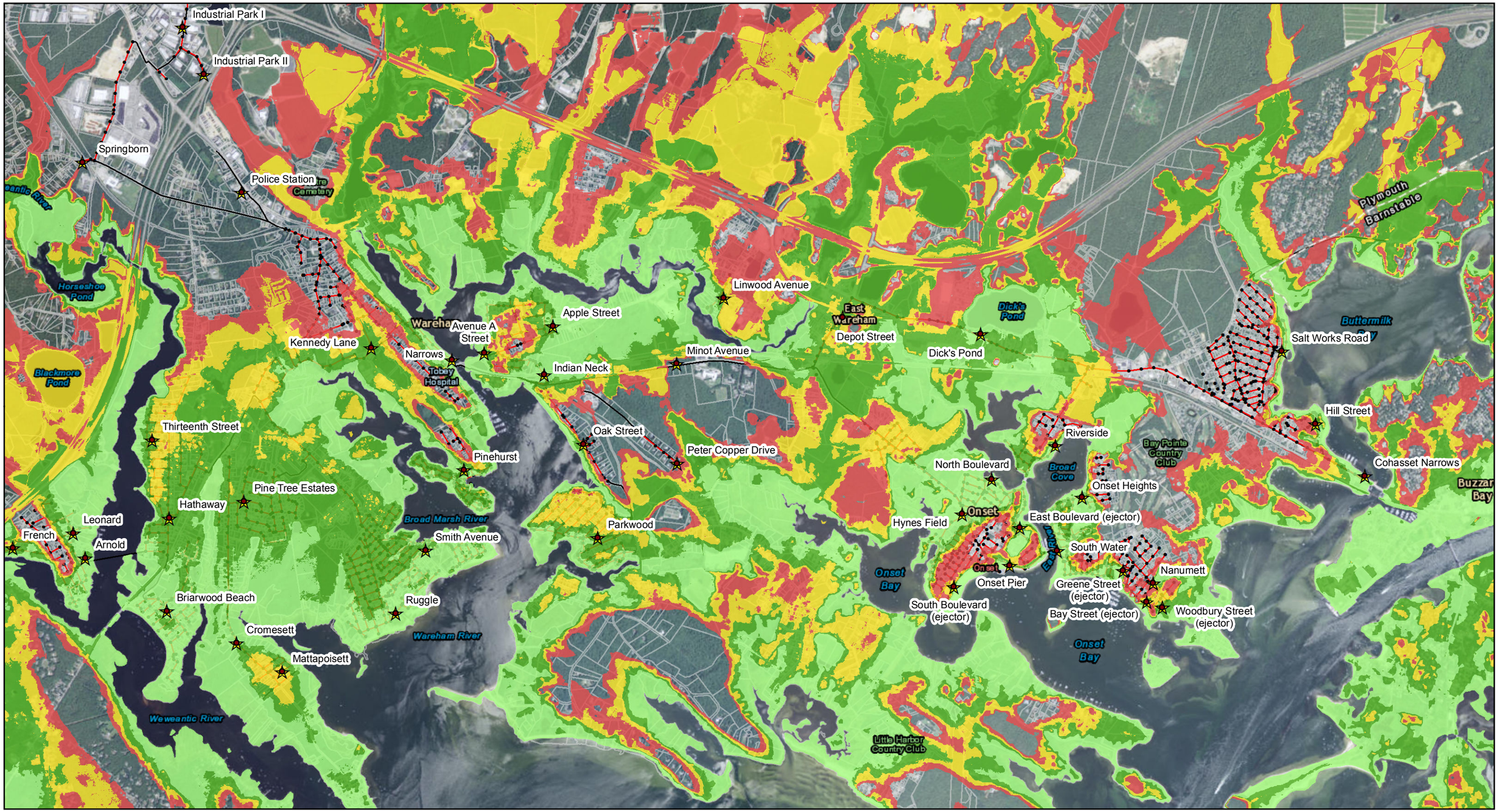
ASCE 24-14 WAREHAM PUMP STATIONS
FLOOD DESIGN CLASSES

Job Number 86-18712
Revision
Date NOV 2015

Figure 3-1

1545 Iyannough Road, Hyannis Massachusetts 02601 USA **T** 1 774 470 1630 **F** 1 774 470 1631 **E** hyamail@ghd.com **W** www.ghd.com

Plot Date: 19 November 2015 - 9:44 AM Cad File No: G:\86\18712\CADD\Drawings\Figures\8618489F3-1.dwg




PS_Category

Paper Size ANSI B

0 1,250 2,500 5,000 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

**Worst-case Hurricane Surge Inundation Zones**

**Hurricane Category**

- Category 1
- Category 2
- Category 3
- Category 4

PS_Category
Pump Station
Manhole
Gravity Sewer
Force Main

Town of Wareham, MA

HURRICANE INUNDATION ZONES

| | |
|---|---|
| Job Number | 86-18712 |
| Revision | A |
| Date | 12 Jan 2016 |

Figure 4

G:\86\18712\GIS\Maps\MXD_Deliverables\8618712F04_Cat1-4.mxd



Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:jjobrien

1545 Iyannough Road, Hyannis Massachusetts 02601 USA **T** 1 508 362 5680 **F** 1 508 362 5684 **E** hyamail@ghd.com **W** www.ghd.com

# Appendix B – BCA Output Report

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Project Summary:**

Project Number: Disaster #:

Program: Agency: Town of Wareham

Analyst:

Point of Contact: Phone Number:

Address: Massachusetts

Email:

Comments:

**Structure Summary For:**

Bay Street, 7 1/2 Terry Lane, Wareham, Massachusetts, 02571

Structure Type: Building Historic Building: No Contact:

Benefits: $0 Costs: $0 BCR: 0.00

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 0.00 | $0 | $0 |

Briarwood Drive, 15 Briarwood Drive, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $0 Costs: $0 BCR: 0.00

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Elevation | Flood | 0.00 | $0 | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Cohasset Narrows, 3254 Cranberry Highway, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $42,838,093 Costs: $2,670,000 BCR: 16.04

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 16.04 | $42,838,093 | $2,670,000 |

Dick's Pond, 3018 Cranberry Highway, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $46,046,466 Costs: $2,510,000 BCR: 18.35

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 18.35 | $46,046,466 | $2,510,000 |

East Blvd, 37 East Blvd, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $33,436,554 Costs: $2,030,000 BCR: 16.47

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Other flood proofing measures | Flood | 16.47 | $33,436,554 | $2,030,000 |

Green Street, 1 1/2 Green Street, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $26,505,574 Costs: $1,860,000 BCR: 14.25

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 14.25 | $26,505,574 | $1,860,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Hill Street Jefferson Shores, 9 1/2 Hill Street, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $27,556,400 Costs: $2,130,000 BCR: 12.94

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Other flood proofing measures | Flood | 12.94 | $27,556,400 | $2,130,000 |

Hynes Field, 248 Onset Ave., Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $65,587,358 Costs: $2,670,000 BCR: 24.56

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 24.56 | $65,587,358 | $2,670,000 |

Narrows, 1 Merchants Way, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $99,761,561 Costs: $2,630,000 BCR: 37.93

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 37.93 | $99,761,561 | $2,630,000 |

North Blvd, 17 North Blvd, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $31,033,069 Costs: $2,920,000 BCR: 10.63

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 10.63 | $31,033,069 | $2,920,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Onset Pier, 178 Onset Ave., Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $45,152,146 Costs: $2,460,000 BCR: 18.35

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 18.35 | $45,152,146 | $2,460,000 |

Parkwood Drive, 89 Parkwood Drive, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $0 Costs: $0 BCR: 0.00

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Elevation | Flood | 0.00 | $0 | $0 |

Pinehurst, 23 Franconia Ave., Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $33,838,998 Costs: $2,510,000 BCR: 13.48

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 13.48 | $33,838,998 | $2,510,000 |

Ruggles, 7 Ruggles Street, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $31,491,408 Costs: $870,000 BCR: 36.20

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 36.20 | $31,491,408 | $870,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Saltworks, 1 Wychunas Ave, Wareham MA, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $39,786,226 Costs: $2,640,000 BCR: 15.07

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Other flood proofing measures | Flood | 15.07 | $39,786,226 | $2,640,000 |

Smith Avenue, 5 Smith Avenue, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $56,943,111 Costs: $2,830,000 BCR: 20.12

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 20.12 | $56,943,111 | $2,830,000 |

South Blvd, 42 South Blvd, Wareham, Massachusetts, 01570, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $0 Costs: $0 BCR: 0.00

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Other flood proofing measures | Flood | 0.00 | $0 | $0 |

South Water Street, 1 South Water Street, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $43,016,957 Costs: $2,760,000 BCR: 15.59

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 15.59 | $43,016,957 | $2,760,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Terry Lane / Pine Tree Estates, 7 1/2 Terry Lane, Wareham, Massachusetts, 02571, Plymouth

Structure Type: Building Historic Building: No Contact:

Benefits: $35,381,700 Costs: $2,550,000 BCR: 13.88

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Dry Flood Proofing | Flood | 13.88 | $35,381,700 | $2,550,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Bay Street, 7 1/2 Terry Lane, Wareham, Massachusetts, 02571

Benefits: $ Costs: $ BCR: .00

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.738433000000 | Longitude: | -70.644386000000 | | |
| Size of Building: | | BRV ($/sf): | $0.00 | Total BRV: | $0 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 0.00 | First Floor Being Raised: | | Demolition Threshold: | 0.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 0 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | | | |
| Building Contents: | $1,600,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 0.00 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 0.00 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 0.00 | | | One Time Displacement Costs: | $4,650 |
| NFIP: | No | | | Displacement Costs: | $837,000 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 0 | Number of Hours Volunteered/Person: | 0 |
| Cost of Volunteers Time ($/Hour/Person): | $0.00 | Number of Days Lodging/Volunteer: | 0 |
| Per-Person Cost of Lodging for a Volunteer: | $0.00 | Cost of Volunteers: | $0.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 0 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $0.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 0 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $0.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 0.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 0.0000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: 0

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.00

Base Flood Elevation With Sea Level Rise: 17.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $0 | 9.2% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $0 | 14.5% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $0 | 17.7% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $0 | 22.6% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $0 | 27.9% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $0 | 29.7% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $0 | 32.9% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $0 | 36.8% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $0 | 38.4% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 12.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 13.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 14.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 15.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 16.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 14.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $400,000 | 25.0% | 0.0% | $400,000 |
| 3.0 | 37.0% | 0.0% | $592,000 | 37.0% | 0.0% | $592,000 |
| 4.0 | 47.0% | 0.0% | $752,000 | 47.0% | 0.0% | $752,000 |
| 5.0 | 55.0% | 0.0% | $880,000 | 55.0% | 0.0% | $880,000 |
| 6.0 | 63.0% | 0.0% | $1,008,000 | 63.0% | 0.0% | $1,008,000 |
| 7.0 | 74.0% | 0.0% | $1,184,000 | 74.0% | 0.0% | $1,184,000 |
| 8.0 | 83.0% | 0.0% | $1,328,000 | 83.0% | 0.0% | $1,328,000 |
| 9.0 | 84.0% | 0.0% | $1,344,000 | 84.0% | 0.0% | $1,344,000 |
| 10.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 11.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 12.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 13.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 14.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 15.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 16.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Displacement** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 45.0 | | |
| 2.0 | 90.0 | | $2,476,603 | 90.0 | | $2,476,603 |
| 3.0 | 135.0 | | $3,714,904 | 135.0 | | $3,714,904 |
| 4.0 | 180.0 | | $4,953,205 | 180.0 | | $4,953,205 |
| 5.0 | 225.0 | | $6,191,507 | 225.0 | | $6,191,507 |
| 6.0 | 270.0 | | $7,429,808 | 270.0 | | $7,429,808 |
| 7.0 | 315.0 | | $8,668,110 | 315.0 | | $8,668,110 |
| 8.0 | 360.0 | | $9,906,411 | 360.0 | | $9,906,411 |
| 9.0 | 405.0 | | $11,144,712 | 405.0 | | $11,144,712 |
| 10.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 11.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 12.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 13.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 14.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 15.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |
| 16.0 | 450.0 | | $12,383,014 | 450.0 | | $12,383,014 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 45.0 | | |
| 2.0 | 90.0 | | $0 | 90.0 | | $0 |
| 3.0 | 135.0 | | $0 | 135.0 | | $0 |
| 4.0 | 180.0 | | $0 | 180.0 | | $0 |
| 5.0 | 225.0 | | $0 | 225.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $0 | Annual: | $0 | Annual: | $0 |
| Present Value: | $0 | Present Value: | $0 | Present Value: | $0 |

Mitigation Benefits: $0 Mitigation Costs: $0

Benefits Minus Costs: $0 Benefit-Cost Ratio: NaN

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | | Construction Type: | |
| Mitigation Project Cost: | | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $0 | Years of Maintenance: | 0 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Annual Project Maintenance Cost | No anticipated increase in pump station O&M | |
| First Floor Elevation | Approximate elevation of electrical panel | |
| Mitigation Type - Other | Scope of Work:<br>1. Install watertight exterior hatch<br>2. Replace past useful life equipment with immersible equipment<br>3. Install immersible panel on control panel<br>4. Install portable generator hookup | |
| Number of Persons: | Number of people in the sewershed who will not have sewer service while pumping station is inoperable. | |
| Number of Workers: | Number of people in sewershed that will not have sewer service while pumping station is inoperable | |
| Project useful life | Useful life equals the projected useful life of the equipment installed. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Briarwood Drive, 15 Briarwood Drive, Wareham, Massachusetts, 02571, Plymouth

Benefits: $ Costs: $ BCR: .00

Hazard: **Flood**

Mitigation Option: Elevation

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.738666000000 | Longitude: | -70.741474000000 | | |
| Size of Building: | | BRV ($/sf): | $0.00 | Total BRV: | $0 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |

| | | | | | |
|---|---|---|---|---|---|
| Structure Elevation: | 0.00 | First Floor Being Raised: | 0.00 | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 0 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | 0 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $210,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 0.00 | | | Flood Zone Determination: | Outside Coastal A |
| Breaking Wave Height: | 0.00 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 0.00 | | | One Time Displacement Costs: | $10,625 |
| NFIP: | No | | | Displacement Costs: | $1,912,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Volunteer Costs

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 0 | Number of Hours Volunteered/Person: | 0 |
| Cost of Volunteers Time ($/Hour/Person): | $0.00 | Number of Days Lodging/Volunteer: | 0 |
| Per-Person Cost of Lodging for a Volunteer: | $0.00 | Cost of Volunteers: | $0.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 0 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $0.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 0 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $0.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 0.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: 0

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.00

Base Flood Elevation With Sea Level Rise: 15.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $0 | 9.2% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $0 | 14.5% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $0 | 17.7% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $0 | 22.6% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $0 | 27.9% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $0 | 29.7% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $0 | 32.9% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $0 | 36.8% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $0 | 38.4% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 12.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 13.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 14.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 15.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |
| 16.0 | 40.5% | 0.0% | $0 | 40.5% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Contents** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 14.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $52,500 | 25.0% | 0.0% | $52,500 |
| 3.0 | 37.0% | 0.0% | $77,700 | 37.0% | 0.0% | $77,700 |
| 4.0 | 47.0% | 0.0% | $98,700 | 47.0% | 0.0% | $98,700 |
| 5.0 | 55.0% | 0.0% | $115,500 | 55.0% | 0.0% | $115,500 |
| 6.0 | 63.0% | 0.0% | $132,300 | 63.0% | 0.0% | $132,300 |
| 7.0 | 74.0% | 0.0% | $155,400 | 74.0% | 0.0% | $155,400 |
| 8.0 | 83.0% | 0.0% | $174,300 | 83.0% | 0.0% | $174,300 |
| 9.0 | 84.0% | 0.0% | $176,400 | 84.0% | 0.0% | $176,400 |
| 10.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 11.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 12.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 13.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 14.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 15.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |
| 16.0 | 86.0% | 0.0% | $180,600 | 86.0% | 0.0% | $180,600 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 45.0 | | |
| 2.0 | 90.0 | | $5,658,904 | 90.0 | | $5,658,904 |
| 3.0 | 135.0 | | $8,488,356 | 135.0 | | $8,488,356 |
| 4.0 | 180.0 | | $11,317,808 | 180.0 | | $11,317,808 |
| 5.0 | 225.0 | | $14,147,260 | 225.0 | | $14,147,260 |
| 6.0 | 270.0 | | $16,976,712 | 270.0 | | $16,976,712 |
| 7.0 | 315.0 | | $19,806,164 | 315.0 | | $19,806,164 |
| 8.0 | 360.0 | | $22,635,616 | 360.0 | | $22,635,616 |
| 9.0 | 405.0 | | $25,465,068 | 405.0 | | $25,465,068 |
| 10.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 11.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 12.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 13.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 14.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 15.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |
| 16.0 | 450.0 | | $28,294,521 | 450.0 | | $28,294,521 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 45.0 | | |
| 2.0 | 90.0 | | $0 | 90.0 | | $0 |
| 3.0 | 135.0 | | $0 | 135.0 | | $0 |
| 4.0 | 180.0 | | $0 | 180.0 | | $0 |
| 5.0 | 225.0 | | $0 | 225.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $0 | Annual: | $0 | Annual: | $0 |
| Present Value: | $0 | Present Value: | $0 | Present Value: | $0 |

Mitigation Benefits: $0 Mitigation Costs: $0

Benefits Minus Costs: $0 Benefit-Cost Ratio: NaN

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 0 | Construction Type: | |
| Mitigation Project Cost: | $0 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $0 | Years of Maintenance: | 0 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Cohasset Narrows, 3254 Cranberry Highway, Wareham, Massachusetts, 02571, Plymouth

Benefits: $42,838,093 Costs: $2,670,000 BCR: 16.04

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.747840000000 | Longitude: | -70.622400000000 | | |
| Size of Building: | 1,200 | BRV ($/sf): | $250.00 | Total BRV: | $300,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 18.90 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 25023C0601J | FIRM Effective Date: | 07/17/2012 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 11.60 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 29.78 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 7.30 | | | One Time Displacement Costs: | $36,950 |
| NFIP: | No | | | Displacement Costs: | $6,651,000 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 1,478 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $3,610,754.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 1,478 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $12,911,808.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 21.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 24.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 21.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Building** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $27,600 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $43,500 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $53,100 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $67,800 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $83,700 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $89,100 | 29.7% | 0.0% | $89,100 |
| 7.0 | 32.9% | 0.0% | $98,700 | 32.9% | 0.0% | $98,700 |
| 8.0 | 36.8% | 0.0% | $110,400 | 36.8% | 0.0% | $110,400 |
| 9.0 | 38.4% | 0.0% | $115,200 | 38.4% | 0.0% | $115,200 |
| 10.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 11.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 12.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 13.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 14.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 15.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |
| 16.0 | 40.5% | 0.0% | $121,500 | 40.5% | 0.0% | $121,500 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 63.0% | 0.0% | $1,323,000 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $19,679,671 | 0.0 | | $0 |
| 3.0 | 135.0 | | $29,519,507 | 0.0 | | $0 |
| 4.0 | 180.0 | | $39,359,342 | 0.0 | | $0 |
| 5.0 | 225.0 | | $49,199,178 | 0.0 | | $0 |
| 6.0 | 270.0 | | $59,039,014 | 270.0 | | $59,039,014 |
| 7.0 | 315.0 | | $68,878,849 | 315.0 | | $68,878,849 |
| 8.0 | 360.0 | | $78,718,685 | 360.0 | | $78,718,685 |
| 9.0 | 405.0 | | $88,558,521 | 405.0 | | $88,558,521 |
| 10.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 11.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 12.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 13.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 14.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 15.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |
| 16.0 | 450.0 | | $98,398,356 | 450.0 | | $98,398,356 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | ($1,488,049) | 0.0 | | $0 |
| 3.0 | 135.0 | | ($2,232,074) | 0.0 | | $0 |
| 4.0 | 180.0 | | ($2,976,098) | 0.0 | | $0 |
| 5.0 | 225.0 | | ($3,720,123) | 0.0 | | $0 |
| 6.0 | 270.0 | | ($4,464,148) | 270.0 | | ($4,464,148) |
| 7.0 | 315.0 | | ($5,208,172) | 315.0 | | ($5,208,172) |
| 8.0 | 360.0 | | ($5,952,197) | 360.0 | | ($5,952,197) |
| 9.0 | 405.0 | | ($6,696,221) | 405.0 | | ($6,696,221) |
| 10.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 11.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 12.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 13.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 14.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 15.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 16.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Police Station:**

| | |
|---|---|
| Type of Area Served by this Police Station: | City |
| Number of people Served by this Police Station: | 19,754 |
| Number of Police Officers Working at this Police Station: | 45 |
| Number of Police Officers That Would Serve the Same Area If The Station Were Shut Down Due to a Disaster: | 74 |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $19,006,562 | Annual: | $0 | Annual: | $19,006,562 |
| Present Value: | $42,838,093 | Present Value: | $0 | Present Value: | $42,838,093 |

| | | | |
|---|---|---|---|
| Mitigation Benefits: | $42,838,093 | Mitigation Costs: | $2,670,000 |
| Benefits Minus Costs: | $40,168,093 | Benefit-Cost Ratio: | 16.04 |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,670,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,670,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | No |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Dick's Pond, 3018 Cranberry Highway, Wareham, Massachusetts, 02571, Plymouth

Benefits: $46,046,466 Costs: $2,510,000 BCR: 18.35

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.758680000000 | Longitude: | -70.660318000000 | | |
| Size of Building: | 710 | BRV ($/sf): | $250.00 | Total BRV: | $177,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 10.90 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 493J | FIRM Effective Date: | 07/17/2012 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 9.80 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 1.10 | | | One Time Displacement Costs: | $44,125 |
| NFIP: | No | | | Displacement Costs: | $4,972,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 1,765 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $4,311,895.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 1,765 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $15,419,040.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 17.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $16,330 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $25,738 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $31,418 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $40,115 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $49,523 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $52,718 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $58,398 | 32.9% | 0.0% | $58,398 |
| 8.0 | 36.8% | 0.0% | $65,320 | 36.8% | 0.0% | $65,320 |
| 9.0 | 38.4% | 0.0% | $68,160 | 38.4% | 0.0% | $68,160 |
| 10.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 11.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 12.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 13.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 14.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 15.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |
| 16.0 | 40.5% | 0.0% | $71,888 | 40.5% | 0.0% | $71,888 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $14,713,151 | 0.0 | | $0 |
| 3.0 | 135.0 | | $22,069,726 | 0.0 | | $0 |
| 4.0 | 180.0 | | $29,426,301 | 0.0 | | $0 |
| 5.0 | 225.0 | | $36,782,877 | 0.0 | | $0 |
| 6.0 | 270.0 | | $44,139,452 | 0.0 | | $0 |
| 7.0 | 315.0 | | $51,496,027 | 315.0 | | $51,496,027 |
| 8.0 | 360.0 | | $58,852,603 | 360.0 | | $58,852,603 |
| 9.0 | 405.0 | | $66,209,178 | 405.0 | | $66,209,178 |
| 10.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 11.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 12.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 13.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 14.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 15.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |
| 16.0 | 450.0 | | $73,565,753 | 450.0 | | $73,565,753 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | ($1,488,049) | 0.0 | | $0 |
| 3.0 | 135.0 | | ($2,232,074) | 0.0 | | $0 |
| 4.0 | 180.0 | | ($2,976,098) | 0.0 | | $0 |
| 5.0 | 225.0 | | ($3,720,123) | 0.0 | | $0 |
| 6.0 | 270.0 | | ($4,464,148) | 0.0 | | $0 |
| 7.0 | 315.0 | | ($5,208,172) | 315.0 | | ($5,208,172) |
| 8.0 | 360.0 | | ($5,952,197) | 360.0 | | ($5,952,197) |
| 9.0 | 405.0 | | ($6,696,221) | 405.0 | | ($6,696,221) |
| 10.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 11.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 12.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 13.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 14.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 15.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |
| 16.0 | 450.0 | | ($7,440,246) | 450.0 | | ($7,440,246) |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Police Station:**

| | |
|---|---|
| Type of Area Served by this Police Station: | City |
| Number of people Served by this Police Station: | 19,754 |
| Number of Police Officers Working at this Police Station: | 45 |
| Number of Police Officers That Would Serve the Same Area If The Station Were Shut Down Due to a Disaster: | 74 |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $22,214,935 | Annual: | $0 | Annual: | $22,214,935 |
| Present Value: | $46,046,466 | Present Value: | $0 | Present Value: | $46,046,466 |

| | | | |
|---|---|---|---|
| Mitigation Benefits: | $46,046,466 | Mitigation Costs: | $2,510,000 |
| Benefits Minus Costs: | $43,536,466 | Benefit-Cost Ratio: | 18.35 |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,510,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,510,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** East Blvd, 37 East Blvd, Wareham, Massachusetts, 02571, Plymouth

Benefits: $33,436,554 Costs: $2,030,000 BCR: 16.47

Hazard: **Flood**

Mitigation Option: Other flood proofing measures

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.744290000000 | Longitude: | -70.656645000000 | | |
| Size of Building: | 200 | BRV ($/sf): | $250.00 | Total BRV: | $50,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 5.60 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 581K | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $1,600,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 4.71 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 0.89 | | | One Time Displacement Costs: | $15,925 |
| NFIP: | No | | | Displacement Costs: | $2,866,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 637 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $1,556,191.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 637 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $5,564,832.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 14.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $4,600 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $7,250 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $8,850 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $11,300 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $13,950 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $14,850 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $16,450 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $18,400 | 0.0% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $19,200 | 0.0% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 12.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 13.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 14.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 15.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |
| 16.0 | 40.5% | 0.0% | $20,250 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Contents** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $400,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $592,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $752,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $880,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,008,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,184,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $1,328,000 | 0.0% | 0.0% | $0 |
| 9.0 | 84.0% | 0.0% | $1,344,000 | 0.0% | 0.0% | $0 |
| 10.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 11.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 12.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 13.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 14.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 15.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 16.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Displacement** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $8,481,699 | | | $0 |
| 3.0 | 135.0 | | $12,722,548 | | | $0 |
| 4.0 | 180.0 | | $16,963,397 | | | $0 |
| 5.0 | 225.0 | | $21,204,247 | | | $0 |
| 6.0 | 270.0 | | $25,445,096 | | | $0 |
| 7.0 | 315.0 | | $29,685,945 | | | $0 |
| 8.0 | 360.0 | | $33,926,795 | | | $0 |
| 9.0 | 405.0 | | $38,167,644 | | | $0 |
| 10.0 | 450.0 | | $42,408,493 | | | $0 |
| 11.0 | 450.0 | | $42,408,493 | | | $0 |
| 12.0 | 450.0 | | $42,408,493 | | | $0 |
| 13.0 | 450.0 | | $42,408,493 | | | $0 |
| 14.0 | 450.0 | | $42,408,493 | | | $0 |
| 15.0 | 450.0 | | $42,408,493 | | | $0 |
| 16.0 | 450.0 | | $42,408,493 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Loss of Function** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $0 | | | $0 |
| 3.0 | 135.0 | | $0 | | | $0 |
| 4.0 | 180.0 | | $0 | | | $0 |
| 5.0 | 225.0 | | $0 | | | $0 |
| 6.0 | 270.0 | | $0 | | | $0 |
| 7.0 | 315.0 | | $0 | | | $0 |
| 8.0 | 360.0 | | $0 | | | $0 |
| 9.0 | 405.0 | | $0 | | | $0 |
| 10.0 | 450.0 | | $0 | | | $0 |
| 11.0 | 450.0 | | $0 | | | $0 |
| 12.0 | 450.0 | | $0 | | | $0 |
| 13.0 | 450.0 | | $0 | | | $0 |
| 14.0 | 450.0 | | $0 | | | $0 |
| 15.0 | 450.0 | | $0 | | | $0 |
| 16.0 | 450.0 | | $0 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $9,605,023 | Annual: | $0 | Annual: | $9,605,023 |
| Present Value: | $33,436,554 | Present Value: | $0 | Present Value: | $33,436,554 |

Mitigation Benefits: $33,436,554 Mitigation Costs: $2,030,000

Benefits Minus Costs: $31,406,554 Benefit-Cost Ratio: 16.47

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,030,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,030,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | No |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Green Street, 1 1/2 Green Street, Wareham, Massachusetts, 02571, Plymouth

Benefits: $26,505,574 Costs: $1,860,000 BCR: 14.25

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.741030000000 | Longitude: | -70.646409000000 | | |
| Size of Building: | 100 | BRV ($/sf): | $250.00 | Total BRV: | $25,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 17.10 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 482J | FIRM Effective Date: | 11/24/2015 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $1,600,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 16.50 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 22.69 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 0.60 | | | One Time Displacement Costs: | $425 |
| NFIP: | No | | | Displacement Costs: | $76,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 17 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $41,531.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 17 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $148,512.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 16.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 19.0000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Building** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $2,300 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $3,625 | 14.5% | 0.0% | $3,625 |
| 3.0 | 17.7% | 0.0% | $4,425 | 17.7% | 0.0% | $4,425 |
| 4.0 | 22.6% | 0.0% | $5,650 | 22.6% | 0.0% | $5,650 |
| 5.0 | 27.9% | 0.0% | $6,975 | 27.9% | 0.0% | $6,975 |
| 6.0 | 29.7% | 0.0% | $7,425 | 29.7% | 0.0% | $7,425 |
| 7.0 | 32.9% | 0.0% | $8,225 | 32.9% | 0.0% | $8,225 |
| 8.0 | 36.8% | 0.0% | $9,200 | 36.8% | 0.0% | $9,200 |
| 9.0 | 38.4% | 0.0% | $9,600 | 38.4% | 0.0% | $9,600 |
| 10.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 11.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 12.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 13.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 14.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 15.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |
| 16.0 | 40.5% | 0.0% | $10,125 | 40.5% | 0.0% | $10,125 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $400,000 | 25.0% | 0.0% | $400,000 |
| 3.0 | 37.0% | 0.0% | $592,000 | 37.0% | 0.0% | $592,000 |
| 4.0 | 47.0% | 0.0% | $752,000 | 47.0% | 0.0% | $752,000 |
| 5.0 | 55.0% | 0.0% | $880,000 | 55.0% | 0.0% | $880,000 |
| 6.0 | 63.0% | 0.0% | $1,008,000 | 63.0% | 0.0% | $1,008,000 |
| 7.0 | 74.0% | 0.0% | $1,184,000 | 74.0% | 0.0% | $1,184,000 |
| 8.0 | 83.0% | 0.0% | $1,328,000 | 83.0% | 0.0% | $1,328,000 |
| 9.0 | 84.0% | 0.0% | $1,344,000 | 84.0% | 0.0% | $1,344,000 |
| 10.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 11.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 12.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 13.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 14.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 15.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |
| 16.0 | 86.0% | 0.0% | $1,376,000 | 86.0% | 0.0% | $1,376,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $226,356 | 90.0 | | $226,356 |
| 3.0 | 135.0 | | $339,534 | 135.0 | | $339,534 |
| 4.0 | 180.0 | | $452,712 | 180.0 | | $452,712 |
| 5.0 | 225.0 | | $565,890 | 225.0 | | $565,890 |
| 6.0 | 270.0 | | $679,068 | 270.0 | | $679,068 |
| 7.0 | 315.0 | | $792,247 | 315.0 | | $792,247 |
| 8.0 | 360.0 | | $905,425 | 360.0 | | $905,425 |
| 9.0 | 405.0 | | $1,018,603 | 405.0 | | $1,018,603 |
| 10.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 11.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 12.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 13.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 14.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 15.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |
| 16.0 | 450.0 | | $1,131,781 | 450.0 | | $1,131,781 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 90.0 | | $0 |
| 3.0 | 135.0 | | $0 | 135.0 | | $0 |
| 4.0 | 180.0 | | $0 | 180.0 | | $0 |
| 5.0 | 225.0 | | $0 | 225.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $2,674,043 | Annual: | $0 | Annual: | $2,674,043 |
| Present Value: | $26,505,574 | Present Value: | $0 | Present Value: | $26,505,574 |

Mitigation Benefits: $26,505,574 Mitigation Costs: $1,860,000

Benefits Minus Costs: $24,645,574 Benefit-Cost Ratio: 14.25

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $1,860,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $1,860,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | No |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Hill Street Jefferson Shores, 9 1/2 Hill Street, Wareham, Massachusetts, 02571, Plymouth

Benefits: $27,556,400 Costs: $2,130,000 BCR: 12.94

---

Hazard: **Flood**

Mitigation Option: Other flood proofing measures

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | | Longitude: | | | |
| Size of Building: | 360 | BRV ($/sf): | $250.00 | Total BRV: | $90,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 15.00 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 249J | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | | | |
| Building Contents: | $1,600,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 13.80 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 29.78 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 1.20 | | | One Time Displacement Costs: | $2,775 |
| NFIP: | No | | | Displacement Costs: | $499,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 111 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $271,173.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 111 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $969,696.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 21.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 21.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $8,280 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $13,050 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $15,930 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $20,340 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $25,110 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $26,730 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $29,610 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $33,120 | 0.0% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $34,560 | 0.0% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 12.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 13.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 14.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 15.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |
| 16.0 | 40.5% | 0.0% | $36,450 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Contents** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $400,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $592,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $752,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $880,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,008,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,184,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $1,328,000 | 0.0% | 0.0% | $0 |
| 9.0 | 84.0% | 0.0% | $1,344,000 | 0.0% | 0.0% | $0 |
| 10.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 11.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 12.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 13.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 14.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 15.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |
| 16.0 | 86.0% | 0.0% | $1,376,000 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $1,477,973 | | | $0 |
| 3.0 | 135.0 | | $2,216,959 | | | $0 |
| 4.0 | 180.0 | | $2,955,945 | | | $0 |
| 5.0 | 225.0 | | $3,694,932 | | | $0 |
| 6.0 | 270.0 | | $4,433,918 | | | $0 |
| 7.0 | 315.0 | | $5,172,904 | | | $0 |
| 8.0 | 360.0 | | $5,911,890 | | | $0 |
| 9.0 | 405.0 | | $6,650,877 | | | $0 |
| 10.0 | 450.0 | | $7,389,863 | | | $0 |
| 11.0 | 450.0 | | $7,389,863 | | | $0 |
| 12.0 | 450.0 | | $7,389,863 | | | $0 |
| 13.0 | 450.0 | | $7,389,863 | | | $0 |
| 14.0 | 450.0 | | $7,389,863 | | | $0 |
| 15.0 | 450.0 | | $7,389,863 | | | $0 |
| 16.0 | 450.0 | | $7,389,863 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Loss of Function** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $0 | | | $0 |
| 3.0 | 135.0 | | $0 | | | $0 |
| 4.0 | 180.0 | | $0 | | | $0 |
| 5.0 | 225.0 | | $0 | | | $0 |
| 6.0 | 270.0 | | $0 | | | $0 |
| 7.0 | 315.0 | | $0 | | | $0 |
| 8.0 | 360.0 | | $0 | | | $0 |
| 9.0 | 405.0 | | $0 | | | $0 |
| 10.0 | 450.0 | | $0 | | | $0 |
| 11.0 | 450.0 | | $0 | | | $0 |
| 12.0 | 450.0 | | $0 | | | $0 |
| 13.0 | 450.0 | | $0 | | | $0 |
| 14.0 | 450.0 | | $0 | | | $0 |
| 15.0 | 450.0 | | $0 | | | $0 |
| 16.0 | 450.0 | | $0 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $3,724,869 | Annual: | $0 | Annual: | $3,724,869 |
| Present Value: | $27,556,400 | Present Value: | $0 | Present Value: | $27,556,400 |

Mitigation Benefits: $27,556,400 Mitigation Costs: $2,130,000

Benefits Minus Costs: $25,426,400 Benefit-Cost Ratio: 12.94

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,130,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,130,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Hynes Field, 248 Onset Ave., Wareham, Massachusetts, 02571, Plymouth

Benefits: $65,587,358 Costs: $2,670,000 BCR: 24.56

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.745332000000 | Longitude: | -70.662266000000 | | |
| Size of Building: | 630 | BRV ($/sf): | $250.00 | Total BRV: | $157,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 10.89 | First Floor Being Raised: | | Demolition Threshold: | 100.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 581K | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 6.40 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 4.49 | | | One Time Displacement Costs: | $87,825 |
| NFIP: | No | | | Displacement Costs: | $15,808,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 3,513 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $8,582,259.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 3,513 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $30,689,568.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 17.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 14.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $14,490 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $22,838 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $27,878 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $35,595 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $43,943 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $46,778 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $51,818 | 32.9% | 0.0% | $51,818 |
| 8.0 | 36.8% | 0.0% | $57,960 | 36.8% | 0.0% | $57,960 |
| 9.0 | 38.4% | 0.0% | $60,480 | 38.4% | 0.0% | $60,480 |
| 10.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 11.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 12.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 13.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 14.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 15.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 16.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $46,775,836 | 0.0 | | $0 |
| 3.0 | 135.0 | | $70,163,753 | 0.0 | | $0 |
| 4.0 | 180.0 | | $93,551,671 | 0.0 | | $0 |
| 5.0 | 225.0 | | $116,939,589 | 0.0 | | $0 |
| 6.0 | 270.0 | | $140,327,507 | 0.0 | | $0 |
| 7.0 | 315.0 | | $163,715,425 | 315.0 | | $163,715,425 |
| 8.0 | 360.0 | | $187,103,342 | 360.0 | | $187,103,342 |
| 9.0 | 405.0 | | $210,491,260 | 405.0 | | $210,491,260 |
| 10.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 11.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 12.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 13.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 14.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 15.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |
| 16.0 | 450.0 | | $233,879,178 | 450.0 | | $233,879,178 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $5,558 | 0.0 | | $0 |
| 3.0 | 135.0 | | $8,338 | 0.0 | | $0 |
| 4.0 | 180.0 | | $11,117 | 0.0 | | $0 |
| 5.0 | 225.0 | | $13,896 | 0.0 | | $0 |
| 6.0 | 270.0 | | $16,675 | 0.0 | | $0 |
| 7.0 | 315.0 | | $19,454 | 315.0 | | $19,454 |
| 8.0 | 360.0 | | $22,234 | 360.0 | | $22,234 |
| 9.0 | 405.0 | | $25,013 | 405.0 | | $25,013 |
| 10.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 11.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 12.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 13.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 14.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 15.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |
| 16.0 | 450.0 | | $27,792 | 450.0 | | $27,792 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Fire Station:**

| | |
|---|---|
| Number of People Served by this Fire Station: | 2,700 |
| Type of Area Served by this Fire Station: | Urban |
| Distance in miles between this fire station and the fire station that would provide fire protection for the geographical area normally served by this fire station: | 0.50 |
| Fire Station Provide Emergency Medical Services (EMS)? | No |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $41,755,827 | Annual: | $0 | Annual: | $41,755,827 |
| Present Value: | $65,587,358 | Present Value: | $0 | Present Value: | $65,587,358 |

Mitigation Benefits: $65,587,358 Mitigation Costs: $2,670,000

Benefits Minus Costs: $62,917,358 Benefit-Cost Ratio: 24.56

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,670,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,670,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Annual Project Maintenance Cost | No anticipated increase in O&M for the pump station | |
| Building contents - other | Estimated cost of equipment. | |
| Displacement costs | Housing @ $150/night for all the people dependent on PS for sewer service. | |
| Dry Flood Proofing/Flood Barrier | Scope of project - Install wateright doors, floodproof painting, raise louver above the DFE, replace past useful life equipment, structurally reinforce masonry wall | |
| Mitigation Project Cost | Allowance. | |
| Number of Hours Volunteered/Person | Working 16 hours a day for a month | |
| Number of Persons: | Number of people dependent on pump station. | |
| Number of Volunteers Required | Quarter of the fire department volunteering to help cleanup after station has flooded. | |
| Number of Workers: | Number of people dependent on pump station | |
| One-Time displacement costs | 1/2 tank of gas per person displaced to find alternative lodging. | |
| Project useful life | Industry standard for mechanic life. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Narrows, 1 Merchants Way, Wareham, Massachusetts, 02571, Plymouth

Benefits: $99,761,561 Costs: $2,630,000 BCR: 37.93

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | | Longitude: | | | |
| Size of Building: | 630 | BRV ($/sf): | $250.00 | Total BRV: | $157,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 10.75 | First Floor Being Raised: | | Demolition Threshold: | 100.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 489 | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,600,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 6.50 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 4.25 | | | One Time Displacement Costs: | $164,250 |
| NFIP: | No | | | Displacement Costs: | $29,565,000 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 6,570 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $16,050,510.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 6,570 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $57,395,520.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 17.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Building** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $14,490 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $22,838 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $27,878 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $35,595 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $43,943 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $46,778 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $51,818 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $57,960 | 36.8% | 0.0% | $57,960 |
| 9.0 | 38.4% | 0.0% | $60,480 | 38.4% | 0.0% | $60,480 |
| 10.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 11.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 12.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 13.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 14.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 15.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |
| 16.0 | 40.5% | 0.0% | $63,788 | 40.5% | 0.0% | $63,788 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Contents** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $650,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $962,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $1,222,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,430,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,638,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,924,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $2,158,000 | 83.0% | 0.0% | $2,158,000 |
| 9.0 | 84.0% | 0.0% | $2,184,000 | 84.0% | 0.0% | $2,184,000 |
| 10.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 11.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 12.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 13.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 14.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 15.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 16.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $87,480,000 | 0.0 | | $0 |
| 3.0 | 135.0 | | $131,220,000 | 0.0 | | $0 |
| 4.0 | 180.0 | | $174,960,000 | 0.0 | | $0 |
| 5.0 | 225.0 | | $218,700,000 | 0.0 | | $0 |
| 6.0 | 270.0 | | $262,440,000 | 0.0 | | $0 |
| 7.0 | 315.0 | | $306,180,000 | 0.0 | | $0 |
| 8.0 | 360.0 | | $349,920,000 | 360.0 | | $349,920,000 |
| 9.0 | 405.0 | | $393,660,000 | 405.0 | | $393,660,000 |
| 10.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 11.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 12.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 13.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 14.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 15.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |
| 16.0 | 450.0 | | $437,400,000 | 450.0 | | $437,400,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $264,762 | 0.0 | | $0 |
| 3.0 | 135.0 | | $397,143 | 0.0 | | $0 |
| 4.0 | 180.0 | | $529,524 | 0.0 | | $0 |
| 5.0 | 225.0 | | $661,905 | 0.0 | | $0 |
| 6.0 | 270.0 | | $794,286 | 0.0 | | $0 |
| 7.0 | 315.0 | | $926,667 | 0.0 | | $0 |
| 8.0 | 360.0 | | $1,059,048 | 360.0 | | $1,059,048 |
| 9.0 | 405.0 | | $1,191,429 | 405.0 | | $1,191,429 |
| 10.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 11.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 12.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 13.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 14.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 15.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 16.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Hospital:**

| | |
|---|---|
| Number of People Served by this Hospital: | 20,822 |
| Distance in miles between this hospital and the hospital that would treat these people in the event this hospital was inoperative: | 18.20 |
| Number of People Normally Served by the Alternate Hospital: | 56,468 |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $75,930,030 | Annual: | $0 | Annual: | $75,930,030 |
| Present Value: | $99,761,561 | Present Value: | $0 | Present Value: | $99,761,561 |

| | | | |
|---|---|---|---|
| Mitigation Benefits: | $99,761,561 | Mitigation Costs: | $2,630,000 |
| Benefits Minus Costs: | $97,131,561 | Benefit-Cost Ratio: | 37.93 |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,630,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,630,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Annual Project Maintenance Cost | No anticipated O&M increase at pump station. | |
| Displacement costs | Cost of housing displaced population at a hotel for $150/night | |
| Distance between hospitals | Distance between Tobey Hospital and New Bedford St. Luke's Hospital | |
| How many people are normally served by the alternate hospital | New Bedford's population | |
| How many people are served by this hospital | Population of Wareham | |
| Mitigation Project Cost | Scope of work - install watertight door, floodproof painting, raise louver above the DFE, replace all past useful life equipment, structurally reinforce masonry wall to withstand hydrostatic pressure of BFE | |
| One-Time displacement costs | cost of half a tank of gas for each person displaced to find alternative lodging. | |
| Per-Person Cost of Lodging for a Volunteer | Require quarter of fire department to clean up contamination after pump station flooding. Estimated month long clean-up time. | |
| Project useful life | Industry standard for equipment useful life. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** North Blvd, 17 North Blvd, Wareham, Massachusetts, 02571, Plymouth

Benefits: $31,033,069 Costs: $2,920,000 BCR: 10.63

| | | | | | |
|---|---|---|---|---|---|
| Hazard: | **Flood** | | | | |
| Mitigation Option: | Dry Flood Proofing | | | | |
| Latitude: | 41.747852000000 | Longitude: | -70.659357000000 | | |
| Size of Building: | 270 | BRV ($/sf): | $250.00 | Total BRV: | $67,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 11.14 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 581K | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 6.90 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 4.24 | | | One Time Displacement Costs: | $10,550 |
| NFIP: | No | | | Displacement Costs: | $1,899,000 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 422 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $1,030,946.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 422 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $3,686,592.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 17.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 14.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $6,210 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $9,788 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $11,948 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $15,255 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $18,833 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $20,048 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $22,208 | 32.9% | 0.0% | $22,208 |
| 8.0 | 36.8% | 0.0% | $24,840 | 36.8% | 0.0% | $24,840 |
| 9.0 | 38.4% | 0.0% | $25,920 | 38.4% | 0.0% | $25,920 |
| 10.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 11.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 12.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 13.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 14.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 15.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 16.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Displacement** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $5,618,959 | 0.0 | | $0 |
| 3.0 | 135.0 | | $8,428,438 | 0.0 | | $0 |
| 4.0 | 180.0 | | $11,237,918 | 0.0 | | $0 |
| 5.0 | 225.0 | | $14,047,397 | 0.0 | | $0 |
| 6.0 | 270.0 | | $16,856,877 | 0.0 | | $0 |
| 7.0 | 315.0 | | $19,666,356 | 315.0 | | $19,666,356 |
| 8.0 | 360.0 | | $22,475,836 | 360.0 | | $22,475,836 |
| 9.0 | 405.0 | | $25,285,315 | 405.0 | | $25,285,315 |
| 10.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 11.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 12.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 13.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 14.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 15.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |
| 16.0 | 450.0 | | $28,094,795 | 450.0 | | $28,094,795 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 0.0 | | $0 |
| 4.0 | 180.0 | | $0 | 0.0 | | $0 |
| 5.0 | 225.0 | | $0 | 0.0 | | $0 |
| 6.0 | 270.0 | | $0 | 0.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $7,201,538 | Annual: | $0 | Annual: | $7,201,538 |
| Present Value: | $31,033,069 | Present Value: | $0 | Present Value: | $31,033,069 |

Mitigation Benefits: $31,033,069 Mitigation Costs: $2,920,000

Benefits Minus Costs: $28,113,069 Benefit-Cost Ratio: 10.63

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,920,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,920,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | No |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Barrier Elevation | DFE for 2065 (estimated structural life) | |
| Building contents - other | Estimated equipment replacement cost. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Onset Pier, 178 Onset Ave., Wareham, Massachusetts, 02571, Plymouth

Benefits: $45,152,146 Costs: $2,460,000 BCR: 18.35

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.741487000000 | Longitude: | -70.657673000000 | | |
| Size of Building: | 270 | BRV ($/sf): | $250.00 | Total BRV: | $67,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |

| | | | | | |
|---|---|---|---|---|---|
| Structure Elevation: | 15.00 | First Floor Being Raised: | | Demolition Threshold: | 100.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 581K | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 11.70 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 31.20 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 3.30 | | | One Time Displacement Costs: | $42,125 |
| NFIP: | No | | | Displacement Costs: | $7,582,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 1,685 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $4,116,455.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 1,685 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $14,720,160.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 22.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 25.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $6,210 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $9,788 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $11,948 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $15,255 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $18,833 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $20,048 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $22,208 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $24,840 | 0.0% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $25,920 | 0.0% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $27,338 | 0.0% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 12.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 13.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 14.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 15.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 16.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 0.0% | 0.0% | $0 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 0.0% | 0.0% | $0 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $22,435,890 | 0.0 | | $0 |
| 3.0 | 135.0 | | $33,653,836 | 0.0 | | $0 |
| 4.0 | 180.0 | | $44,871,781 | 0.0 | | $0 |
| 5.0 | 225.0 | | $56,089,726 | 0.0 | | $0 |
| 6.0 | 270.0 | | $67,307,671 | 0.0 | | $0 |
| 7.0 | 315.0 | | $78,525,616 | 0.0 | | $0 |
| 8.0 | 360.0 | | $89,743,562 | 0.0 | | $0 |
| 9.0 | 405.0 | | $100,961,507 | 0.0 | | $0 |
| 10.0 | 450.0 | | $112,179,452 | 0.0 | | $0 |
| 11.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |
| 12.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |
| 13.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |
| 14.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |
| 15.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |
| 16.0 | 450.0 | | $112,179,452 | 450.0 | | $112,179,452 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 0.0 | | $0 |
| 4.0 | 180.0 | | $0 | 0.0 | | $0 |
| 5.0 | 225.0 | | $0 | 0.0 | | $0 |
| 6.0 | 270.0 | | $0 | 0.0 | | $0 |
| 7.0 | 315.0 | | $0 | 0.0 | | $0 |
| 8.0 | 360.0 | | $0 | 0.0 | | $0 |
| 9.0 | 405.0 | | $0 | 0.0 | | $0 |
| 10.0 | 450.0 | | $0 | 0.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Fire Station:**

| | |
|---|---|
| Number of People Served by this Fire Station: | 2,700 |
| Type of Area Served by this Fire Station: | Urban |
| Distance in miles between this fire station and the fire station that would provide fire protection for the geographical area normally served by this fire station: | 0.50 |
| Fire Station Provide Emergency Medical Services (EMS)? | No |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $21,320,615 | Annual: | $0 | Annual: | $21,320,615 |
| Present Value: | $45,152,146 | Present Value: | $0 | Present Value: | $45,152,146 |

Mitigation Benefits: $45,152,146 Mitigation Costs: $2,460,000

Benefits Minus Costs: $42,692,146 Benefit-Cost Ratio: 18.35

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,460,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,460,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Displacement costs | Estimated equipment cost | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Parkwood Drive, 89 Parkwood Drive, Wareham, Massachusetts, 02571, Plymouth

Benefits: $ Costs: $ BCR: .00

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**Structure and Mitigation Details For:** Pinehurst, 23 Franconia Ave., Wareham, Massachusetts, 02571, Plymouth

Benefits: $33,838,998 Costs: $2,510,000 BCR: 13.48

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | | Longitude: | | | |
| Size of Building: | 270 | BRV ($/sf): | $250.00 | Total BRV: | $67,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 14.60 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 11.20 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 3.40 | | | One Time Displacement Costs: | $16,825 |
| NFIP: | No | | | Displacement Costs: | $3,028,500 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

ICC: No

## Street Maintenance Details

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

## Volunteer Costs

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 673 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $1,644,139.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 673 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $5,879,328.00 |

## Coastal Flood Elevations

| | | | |
|---|---|---|---|
| Flood Source Name: | | | |
| Base Flood Elevation: | 14.00 | Flood Profile Number: | |
| Elevation At Which Barrier Will Be Overtopped: | 16.6000 | | |
| FEMA Elevation Certificate Diagram Description: | Other | Other Elevation Source: | Survey |
| Has Sea Level Rise Been Included? | Yes | Sea Level Rise Increase: | 0.60 |
| Base Flood Elevation With Sea Level Rise: | 14.60 | | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| Flood Depth (ft) | Before Mitigation (pct) | Before Mitigation User Entered (pct) | Before Mitigation ($) | After Mitigation (pct) | After Mitigation User Entered (pct) | After Mitigation ($) |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $6,210 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $9,788 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $11,948 | 17.7% | 0.0% | $11,948 |
| 4.0 | 22.6% | 0.0% | $15,255 | 22.6% | 0.0% | $15,255 |
| 5.0 | 27.9% | 0.0% | $18,833 | 27.9% | 0.0% | $18,833 |
| 6.0 | 29.7% | 0.0% | $20,048 | 29.7% | 0.0% | $20,048 |
| 7.0 | 32.9% | 0.0% | $22,208 | 32.9% | 0.0% | $22,208 |
| 8.0 | 36.8% | 0.0% | $24,840 | 36.8% | 0.0% | $24,840 |
| 9.0 | 38.4% | 0.0% | $25,920 | 38.4% | 0.0% | $25,920 |
| 10.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 11.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 12.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 13.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 14.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 15.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |
| 16.0 | 40.5% | 0.0% | $27,338 | 40.5% | 0.0% | $27,338 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Contents** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 37.0% | 0.0% | $777,000 |
| 4.0 | 47.0% | 0.0% | $987,000 | 47.0% | 0.0% | $987,000 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 55.0% | 0.0% | $1,155,000 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 63.0% | 0.0% | $1,323,000 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $8,961,041 | 0.0 | | $0 |
| 3.0 | 135.0 | | $13,441,562 | 135.0 | | $13,441,562 |
| 4.0 | 180.0 | | $17,922,082 | 180.0 | | $17,922,082 |
| 5.0 | 225.0 | | $22,402,603 | 225.0 | | $22,402,603 |
| 6.0 | 270.0 | | $26,883,123 | 270.0 | | $26,883,123 |
| 7.0 | 315.0 | | $31,363,644 | 315.0 | | $31,363,644 |
| 8.0 | 360.0 | | $35,844,164 | 360.0 | | $35,844,164 |
| 9.0 | 405.0 | | $40,324,685 | 405.0 | | $40,324,685 |
| 10.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 11.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 12.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 13.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 14.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 15.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |
| 16.0 | 450.0 | | $44,805,205 | 450.0 | | $44,805,205 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 135.0 | | $0 |
| 4.0 | 180.0 | | $0 | 180.0 | | $0 |
| 5.0 | 225.0 | | $0 | 225.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $10,007,467 | Annual: | $0 | Annual: | $10,007,467 |
| Present Value: | $33,838,998 | Present Value: | $0 | Present Value: | $33,838,998 |

Mitigation Benefits: $33,838,998 Mitigation Costs: $2,510,000

Benefits Minus Costs: $31,328,998 Benefit-Cost Ratio: 13.48

| | | | | | |
|---|---|---|---|---|---|
| Total Benefits: | **$658,375,621** | Total Costs: | **$36,040,000** | BCR: | **18.27** |
| Project Number: | | Disaster #: | | Program: | |
| Agency: | **Town of Wareham** | | | | |
| State: | **Massachusetts** | Point of Contact: | | Analyst: | |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,510,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,510,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Displacement costs | Estimated equipment replacement cost. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Ruggles, 7 Ruggles Street, Wareham, Massachusetts, 02571, Plymouth

Benefits: $31,491,408 Costs: $870,000 BCR: 36.20

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | | Longitude: | | | |
| Size of Building: | 320 | BRV ($/sf): | $250.00 | Total BRV: | $80,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 14.60 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | $0 | | |
| Building Contents: | $2,600,000 (Other) | | | Value of Crawlspace Contents: | $0 |
| Ground Surface Elevation: | 5.90 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 0.00 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 8.70 | | | One Time Displacement Costs: | $11,575 |
| NFIP: | No | | | Displacement Costs: | $2,083,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 463 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $1,131,109.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 463 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $4,044,768.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 20.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 23.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 20.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $7,360 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $11,600 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $14,160 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $18,080 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $22,320 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $23,760 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $26,320 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $29,440 | 0.0% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $30,720 | 0.0% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 11.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 12.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 13.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 14.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 15.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |
| 16.0 | 40.5% | 0.0% | $32,400 | 40.5% | 0.0% | $32,400 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $650,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $962,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $1,222,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,430,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,638,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,924,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $2,158,000 | 0.0% | 0.0% | $0 |
| 9.0 | 84.0% | 0.0% | $2,184,000 | 0.0% | 0.0% | $0 |
| 10.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 11.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 12.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 13.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 14.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 15.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |
| 16.0 | 86.0% | 0.0% | $2,236,000 | 86.0% | 0.0% | $2,236,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Displacement** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $6,164,877 | 0.0 | | $0 |
| 3.0 | 135.0 | | $9,247,315 | 0.0 | | $0 |
| 4.0 | 180.0 | | $12,329,753 | 0.0 | | $0 |
| 5.0 | 225.0 | | $15,412,192 | 0.0 | | $0 |
| 6.0 | 270.0 | | $18,494,630 | 0.0 | | $0 |
| 7.0 | 315.0 | | $21,577,068 | 0.0 | | $0 |
| 8.0 | 360.0 | | $24,659,507 | 0.0 | | $0 |
| 9.0 | 405.0 | | $27,741,945 | 0.0 | | $0 |
| 10.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 11.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 12.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 13.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 14.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 15.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |
| 16.0 | 450.0 | | $30,824,384 | 450.0 | | $30,824,384 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 0.0 | | $0 |
| 4.0 | 180.0 | | $0 | 0.0 | | $0 |
| 5.0 | 225.0 | | $0 | 0.0 | | $0 |
| 6.0 | 270.0 | | $0 | 0.0 | | $0 |
| 7.0 | 315.0 | | $0 | 0.0 | | $0 |
| 8.0 | 360.0 | | $0 | 0.0 | | $0 |
| 9.0 | 405.0 | | $0 | 0.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $7,659,877 | Annual: | $0 | Annual: | $7,659,877 |
| Present Value: | $31,491,408 | Present Value: | $0 | Present Value: | $31,491,408 |

Mitigation Benefits: $31,491,408 Mitigation Costs: $870,000

Benefits Minus Costs: $30,621,408 Benefit-Cost Ratio: 36.20

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $870,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $870,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Saltworks, 1 Wychunas Ave, Wareham MA, Massachusetts, 02571, Plymouth

Benefits: $39,786,226 Costs: $2,640,000 BCR: 15.07

Hazard: **Flood**

Mitigation Option: Other flood proofing measures

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.757227000000 | Longitude: | -70.630452000000 | | |
| Size of Building: | 299 | BRV ($/sf): | $250.00 | Total BRV: | $74,750 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 14.80 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 249J | FIRM Effective Date: | 01/01/1900 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 12.10 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 29.78 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 2.70 | | | One Time Displacement Costs: | $30,125 |
| NFIP: | No | | | Displacement Costs: | $5,422,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 1,205 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $2,943,815.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 1,205 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $10,526,880.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 21.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $6,877 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $10,839 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $13,231 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $16,894 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $20,855 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $22,201 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $24,593 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $27,508 | 0.0% | 0.0% | $0 |
| 9.0 | 38.4% | 0.0% | $28,704 | 0.0% | 0.0% | $0 |
| 10.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 11.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 12.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 13.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 14.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 15.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |
| 16.0 | 40.5% | 0.0% | $30,274 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 0.0% | 0.0% | $0 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 0.0% | 0.0% | $0 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 0.0% | 0.0% | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $16,044,658 | | | $0 |
| 3.0 | 135.0 | | $24,066,986 | | | $0 |
| 4.0 | 180.0 | | $32,089,315 | | | $0 |
| 5.0 | 225.0 | | $40,111,644 | | | $0 |
| 6.0 | 270.0 | | $48,133,973 | | | $0 |
| 7.0 | 315.0 | | $56,156,301 | | | $0 |
| 8.0 | 360.0 | | $64,178,630 | | | $0 |
| 9.0 | 405.0 | | $72,200,959 | | | $0 |
| 10.0 | 450.0 | | $80,223,288 | | | $0 |
| 11.0 | 450.0 | | $80,223,288 | | | $0 |
| 12.0 | 450.0 | | $80,223,288 | | | $0 |
| 13.0 | 450.0 | | $80,223,288 | | | $0 |
| 14.0 | 450.0 | | $80,223,288 | | | $0 |
| 15.0 | 450.0 | | $80,223,288 | | | $0 |
| 16.0 | 450.0 | | $80,223,288 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Loss of Function** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | | | |
| -1.0 | 0.0 | | | | | |
| 0.0 | 0.0 | | | | | |
| 1.0 | 45.0 | | | | | |
| 2.0 | 90.0 | | $0 | | | $0 |
| 3.0 | 135.0 | | $0 | | | $0 |
| 4.0 | 180.0 | | $0 | | | $0 |
| 5.0 | 225.0 | | $0 | | | $0 |
| 6.0 | 270.0 | | $0 | | | $0 |
| 7.0 | 315.0 | | $0 | | | $0 |
| 8.0 | 360.0 | | $0 | | | $0 |
| 9.0 | 405.0 | | $0 | | | $0 |
| 10.0 | 450.0 | | $0 | | | $0 |
| 11.0 | 450.0 | | $0 | | | $0 |
| 12.0 | 450.0 | | $0 | | | $0 |
| 13.0 | 450.0 | | $0 | | | $0 |
| 14.0 | 450.0 | | $0 | | | $0 |
| 15.0 | 450.0 | | $0 | | | $0 |
| 16.0 | 450.0 | | $0 | | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $15,954,695 | Annual: | $0 | Annual: | $15,954,695 |
| Present Value: | $39,786,226 | Present Value: | $0 | Present Value: | $39,786,226 |

Mitigation Benefits: $39,786,226 Mitigation Costs: $2,640,000

Benefits Minus Costs: $37,146,226 Benefit-Cost Ratio: 15.07

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,640,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,640,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Smith Avenue, 5 Smith Avenue, Wareham, Massachusetts, 02571, Plymouth

Benefits: $56,943,111 Costs: $2,830,000 BCR: 20.12

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.743024000000 | Longitude: | -70.715688000000 | | |
| Size of Building: | 570 | BRV ($/sf): | $250.00 | Total BRV: | $142,500 |
| Residential: | No | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 15.10 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 25023C0577J | FIRM Effective Date: | 07/17/2012 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | $0 | | |
| Building Contents: | $98,325 (Default) | | | Value of Crawlspace Contents: | $0 |
| Ground Surface Elevation: | 8.80 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 25.53 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 6.30 | | | One Time Displacement Costs: | $0 |
| NFIP: | No | | | Displacement Costs: | $0 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $150.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $120.00 | Cost of Volunteers: | $3,024,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 2,228 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $5,443,004.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 2,228 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $19,463,808.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 18.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 20.6000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 18.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 50 | 2.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 100 | 1.00% | 0.0 | 0.6 | 0.0 | 0.6 |
| 500 | 0.20% | 0.0 | 0.6 | 0.0 | 0.6 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Building** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $13,110 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $20,663 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $25,223 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $32,205 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $39,758 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $42,323 | 29.7% | 0.0% | $42,323 |
| 7.0 | 32.9% | 0.0% | $46,883 | 32.9% | 0.0% | $46,883 |
| 8.0 | 36.8% | 0.0% | $52,440 | 36.8% | 0.0% | $52,440 |
| 9.0 | 38.4% | 0.0% | $54,720 | 38.4% | 0.0% | $54,720 |
| 10.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 11.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 12.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 13.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 14.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 15.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |
| 16.0 | 40.5% | 0.0% | $57,713 | 40.5% | 0.0% | $57,713 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $24,581 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $36,380 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $46,213 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $54,079 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $61,945 | 63.0% | 0.0% | $61,945 |
| 7.0 | 74.0% | 0.0% | $72,761 | 74.0% | 0.0% | $72,761 |
| 8.0 | 83.0% | 0.0% | $81,610 | 83.0% | 0.0% | $81,610 |
| 9.0 | 84.0% | 0.0% | $82,593 | 84.0% | 0.0% | $82,593 |
| 10.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 11.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 12.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 13.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 14.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 15.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |
| 16.0 | 86.0% | 0.0% | $84,560 | 86.0% | 0.0% | $84,560 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Displacement** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 0.0 | | $0 |
| 4.0 | 180.0 | | $0 | 0.0 | | $0 |
| 5.0 | 225.0 | | $0 | 0.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $264,762 | 0.0 | | $0 |
| 3.0 | 135.0 | | $397,143 | 0.0 | | $0 |
| 4.0 | 180.0 | | $529,524 | 0.0 | | $0 |
| 5.0 | 225.0 | | $661,905 | 0.0 | | $0 |
| 6.0 | 270.0 | | $794,286 | 270.0 | | $794,286 |
| 7.0 | 315.0 | | $926,667 | 315.0 | | $926,667 |
| 8.0 | 360.0 | | $1,059,048 | 360.0 | | $1,059,048 |
| 9.0 | 405.0 | | $1,191,429 | 405.0 | | $1,191,429 |
| 10.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 11.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 12.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 13.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 14.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 15.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |
| 16.0 | 450.0 | | $1,323,810 | 450.0 | | $1,323,810 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Loss of Services

**Fire Station:**

| | |
|---|---|
| Number of People Served by this Fire Station: | 20,335 |
| Type of Area Served by this Fire Station: | Urban |
| Distance in miles between this fire station and the fire station that would provide fire protection for the geographical area normally served by this fire station: | 2.10 |
| Fire Station Provide Emergency Medical Services (EMS)? | No |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $27,930,812 | Annual: | $0 | Annual: | $27,930,812 |
| Present Value: | $56,943,111 | Present Value: | $0 | Present Value: | $56,943,111 |

| | | | |
|---|---|---|---|
| Mitigation Benefits: | $56,943,111 | Mitigation Costs: | $2,830,000 |
| Benefits Minus Costs: | $54,113,111 | Benefit-Cost Ratio: | 20.12 |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,830,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,830,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Annual Project Maintenance Cost | Annual pump station maintenance not expected to increase as a result of this project. | |
| Dry Flood Proofing/Flood Barrier | Scope of project: Installation of a 2' tall flood barrier at each of the pump stations doors, applying flood proof paint to the inside of the station and replacing equipment which is past its useful life. | |
| First Floor Elevation | First floor elevation | |
| Mitigation Project Cost | Estimated cost to install 2' flood doors at each door in the pumping station, apply flood proof paint to the interior of the station and replace all mechanical equipment which is past its useful life. | |
| Number of Persons: | Number of people dependent on Smith Pump Station (people within Smith Pump Station sewershed and all upstream pump stations that would not be able to function if Smith Pump Station was down). | |
| Number of Workers: | Number of people that would not have sewer service - both in Smith Pump Station sewershed and sewersheds upstream of the station that would also be affected if it were down. | |
| Other Elevation Source | Survey data from Greenseal Environmental, Inc. | |
| Project useful life | Industry specified useful life for mechanical equipment. | |
| Total size of building | Estimated square footage for building footprint. | |
| Value of building (BRV) ($/sf) | Estimated based on experience from similar projects. | |
| Value of Projected SLR Increase | USACE Sea Level Calculator estimation of SLR for 2035 (end of equipment useful life) | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** South Blvd, 42 South Blvd, Wareham, Massachusetts, 01570, Plymouth

Benefits: $ Costs: $ BCR: .00

---

Hazard: **Flood**

Mitigation Option: Other flood proofing measures

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.739953000000 | Longitude: | -70.663207000000 | | |
| Size of Building: | | BRV ($/sf): | | Total BRV: | |
| Residential: | Yes | Building Type: | | | |
| Obstruction: | No | Foundation Type: | | Basement: | No |
| Building Primary Use: | | Structure Type: | | Historic Building: | No |
| Structure Elevation: | 0.00 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 0 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 0 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal V | Loss of Rent: | $0 | | |
| Building Contents: | $0 (Default) | | | Value of Crawlspace Contents: | $0 |
| Ground Surface Elevation: | 0.00 | | | Flood Zone Determination: | Coastal V |
| Breaking Wave Height: | 0.00 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 0.00 | | | One Time Displacement Costs: | $0 |
| NFIP: | No | | | Displacement Costs: | $0 (Default) |
| ICC: | No | | | Current federal lodging per diem: | $77 |
| | | | | Population affected : | 0 |
| | | | | Current federal meals per diem: | $46 |
| | | | | Cost per person to eat meals at home: | $7 |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Volunteer Costs

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 0 | Number of Hours Volunteered/Person: | 0 |
| Cost of Volunteers Time ($/Hour/Person): | $0.00 | Number of Days Lodging/Volunteer: | 0 |
| Per-Person Cost of Lodging for a Volunteer: | $0.00 | Cost of Volunteers: | $0.00 |

## Social Benefits

**Mental Stress and Anxiety**

| | |
|---|---|
| Number of Person: | 0 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $0.00 |

**Lost Productivity**

| | |
|---|---|
| Number of Worker: | 0 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $0.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 0.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description: Diagram 9 Other Elevation Source:

Has Sea Level Rise Been Included? No Sea Level Rise Increase: 0.00

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $0 | Annual: | $0 | Annual: | $0 |
| Present Value: | $0 | Present Value: | $0 | Present Value: | $0 |

Mitigation Benefits: $0 Mitigation Costs: $0

Benefits Minus Costs: $0 Benefit-Cost Ratio: NaN

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 0 | Construction Type: | |
| Mitigation Project Cost: | $0 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $0 | Years of Maintenance: | 0 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | No |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Annual Project Maintenance Cost | Scope of project - raise vent above FED, replace well past useful life equipment with immersion equipment, enclose electrical panel with immersible enclosure, install portable generator hookup | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** South Water Street, 1 South Water Street, Wareham, Massachusetts, 02571, Plymouth

Benefits: $43,016,957 Costs: $2,760,000 BCR: 15.59

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | | Longitude: | | | |
| Size of Building: | 620 | BRV ($/sf): | $250.00 | Total BRV: | $155,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |
| Structure Elevation: | 14.80 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 0 | FIRM Effective Date: | 11/13/2015 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 9.50 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 26.95 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 5.30 | | | One Time Displacement Costs: | $37,350 |
| NFIP: | No | | | Displacement Costs: | $6,723,000 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 1,494 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $3,649,842.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 1,494 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $13,051,584.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 19.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 22.8000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: Survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 0.00

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Building | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| Flood Depth (ft) | Before Mitigation (pct) | Before Mitigation User Entered (pct) | Before Mitigation ($) | After Mitigation (pct) | After Mitigation User Entered (pct) | After Mitigation ($) |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $14,260 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $22,475 | 0.0% | 0.0% | $0 |
| 3.0 | 17.7% | 0.0% | $27,435 | 0.0% | 0.0% | $0 |
| 4.0 | 22.6% | 0.0% | $35,030 | 0.0% | 0.0% | $0 |
| 5.0 | 27.9% | 0.0% | $43,245 | 0.0% | 0.0% | $0 |
| 6.0 | 29.7% | 0.0% | $46,035 | 0.0% | 0.0% | $0 |
| 7.0 | 32.9% | 0.0% | $50,995 | 0.0% | 0.0% | $0 |
| 8.0 | 36.8% | 0.0% | $57,040 | 36.8% | 0.0% | $57,040 |
| 9.0 | 38.4% | 0.0% | $59,520 | 38.4% | 0.0% | $59,520 |
| 10.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 11.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 12.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 13.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 14.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 15.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |
| 16.0 | 40.5% | 0.0% | $62,775 | 40.5% | 0.0% | $62,775 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 0.0% | 0.0% | $0 |
| 3.0 | 37.0% | 0.0% | $777,000 | 0.0% | 0.0% | $0 |
| 4.0 | 47.0% | 0.0% | $987,000 | 0.0% | 0.0% | $0 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 0.0% | 0.0% | $0 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 0.0% | 0.0% | $0 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 0.0% | 0.0% | $0 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $19,892,712 | 0.0 | | $0 |
| 3.0 | 135.0 | | $29,839,068 | 0.0 | | $0 |
| 4.0 | 180.0 | | $39,785,425 | 0.0 | | $0 |
| 5.0 | 225.0 | | $49,731,781 | 0.0 | | $0 |
| 6.0 | 270.0 | | $59,678,137 | 0.0 | | $0 |
| 7.0 | 315.0 | | $69,624,493 | 0.0 | | $0 |
| 8.0 | 360.0 | | $79,570,849 | 360.0 | | $79,570,849 |
| 9.0 | 405.0 | | $89,517,205 | 405.0 | | $89,517,205 |
| 10.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 11.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 12.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 13.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 14.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 15.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |
| 16.0 | 450.0 | | $99,463,562 | 450.0 | | $99,463,562 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 0.0 | | $0 |
| 3.0 | 135.0 | | $0 | 0.0 | | $0 |
| 4.0 | 180.0 | | $0 | 0.0 | | $0 |
| 5.0 | 225.0 | | $0 | 0.0 | | $0 |
| 6.0 | 270.0 | | $0 | 0.0 | | $0 |
| 7.0 | 315.0 | | $0 | 0.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $19,185,426 | Annual: | $0 | Annual: | $19,185,426 |
| Present Value: | $43,016,957 | Present Value: | $0 | Present Value: | $43,016,957 |

Mitigation Benefits: $43,016,957 Mitigation Costs: $2,760,000

Benefits Minus Costs: $40,256,957 Benefit-Cost Ratio: 15.59

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,760,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,760,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Building contents - other | Estimated equipment replacement cost. | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Structure and Mitigation Details For:** Terry Lane / Pine Tree Estates, 7 1/2 Terry Lane, Wareham, Massachusetts, 02571, Plymouth

Benefits: $35,381,700 Costs: $2,550,000 BCR: 13.88

---

Hazard: **Flood**

Mitigation Option: Dry Flood Proofing

| | | | | | |
|---|---|---|---|---|---|
| Latitude: | 41.746777000000 | Longitude: | -70.733731000000 | | |
| Size of Building: | 300 | BRV ($/sf): | $250.00 | Total BRV: | $75,000 |
| Residential: | No | Building Type: | | | |
| Obstruction: | N/A | Foundation Type: | | Basement: | |
| Building Primary Use: | Protective Services | Structure Type: | Engineered | Historic Building: | No |

| | | | | | |
|---|---|---|---|---|---|
| Structure Elevation: | 14.70 | First Floor Being Raised: | | Demolition Threshold: | 50.00% |
| Source of Flood Data: | FIS | Project in SFHA: | Yes | Community ID Number: | 255223 |
| Effective FIS Date: | 07/17/2012 | FIRM Panel Number: | 576K | FIRM Effective Date: | 02/05/2014 |
| Project Useful Life: | 20 | H&H Study Title: | | H&H Effective Date: | |
| Flood Zone: | Coastal A | Loss of Rent: | | | |
| Building Contents: | $2,100,000 (Other) | | | Value of Crawlspace Contents: | |
| Ground Surface Elevation: | 12.50 | | | Flood Zone Determination: | Coastal A |
| Breaking Wave Height: | 19.85 | | | Utilities that are not elevated: | No |
| Height FFE Above Grade: | 2.20 | | | One Time Displacement Costs: | $20,275 |
| NFIP: | No | | | Displacement Costs: | $3,649,500 |
| ICC: | No | | | | |

**Street Maintenance Details**

| | |
|---|---|
| Street maintenance budget ($) | |
| Miles of street (miles) | |
| Length of road (miles) | |
| Total Reduced Street Maintenance Costs | $0.00 |

**Volunteer Costs**

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

| | | | |
|---|---|---|---|
| Number of Volunteers Required: | 40 | Number of Hours Volunteered/Person: | 480 |
| Cost of Volunteers Time ($/Hour/Person): | $120.00 | Number of Days Lodging/Volunteer: | 30 |
| Per-Person Cost of Lodging for a Volunteer: | $150.00 | Cost of Volunteers: | $2,484,000.00 |

## Social Benefits

### Mental Stress and Anxiety

| | |
|---|---|
| Number of Person: | 811 |
| Treatment Costs per person: | $2,443.00 |
| Total Mental Stress and Anxiety Cost: | $1,981,273.00 |

### Lost Productivity

| | |
|---|---|
| Number of Worker: | 811 |
| Productivity Loss per person: | $8,736.00 |
| Total Lost Productivity Cost: | $7,084,896.00 |

## Coastal Flood Elevations

Flood Source Name:

Base Flood Elevation: 14.00 Flood Profile Number:

Elevation At Which Barrier Will Be Overtopped: 16.7000

FEMA Elevation Certificate Diagram Description: Other Other Elevation Source: survey

Has Sea Level Rise Been Included? Yes Sea Level Rise Increase: 0.60

Base Flood Elevation With Sea Level Rise: 14.60

| Recurrence Interval (yr) | Percent Annual Chance (%) | Stillwater Elevation Before Mitigation | Stillwater Elevation Before Mitigation With SLR | Stillwater Elevation After Mitigation | Stillwater Elevation After Mitigation With SLR |
|---|---|---|---|---|---|
| 10 | 10.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 50 | 2.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 100 | 1.00% | 0.0 | 0.0 | 0.0 | 0.0 |
| 500 | 0.20% | 0.0 | 0.0 | 0.0 | 0.0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| **Building** | **Before Mitigation Values:** | | | **After Mitigation Values:** | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| -1.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 0.0 | 0.0% | 0.0% | $0 | 0.0% | 0.0% | $0 |
| 1.0 | 9.2% | 0.0% | $6,900 | 0.0% | 0.0% | $0 |
| 2.0 | 14.5% | 0.0% | $10,875 | 14.5% | 0.0% | $10,875 |
| 3.0 | 17.7% | 0.0% | $13,275 | 17.7% | 0.0% | $13,275 |
| 4.0 | 22.6% | 0.0% | $16,950 | 22.6% | 0.0% | $16,950 |
| 5.0 | 27.9% | 0.0% | $20,925 | 27.9% | 0.0% | $20,925 |
| 6.0 | 29.7% | 0.0% | $22,275 | 29.7% | 0.0% | $22,275 |
| 7.0 | 32.9% | 0.0% | $24,675 | 32.9% | 0.0% | $24,675 |
| 8.0 | 36.8% | 0.0% | $27,600 | 36.8% | 0.0% | $27,600 |
| 9.0 | 38.4% | 0.0% | $28,800 | 38.4% | 0.0% | $28,800 |
| 10.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 11.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 12.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 13.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 14.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 15.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |
| 16.0 | 40.5% | 0.0% | $30,375 | 40.5% | 0.0% | $30,375 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Contents | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (pct)** | **Before Mitigation User Entered (pct)** | **Before Mitigation ($)** | **After Mitigation (pct)** | **After Mitigation User Entered (pct)** | **After Mitigation ($)** |
| -2.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| -1.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 0.0 | 0.0% | 0.0% | | 0.0% | 0.0% | |
| 1.0 | 14.0% | 0.0% | | 0.0% | 0.0% | |
| 2.0 | 25.0% | 0.0% | $525,000 | 25.0% | 0.0% | $525,000 |
| 3.0 | 37.0% | 0.0% | $777,000 | 37.0% | 0.0% | $777,000 |
| 4.0 | 47.0% | 0.0% | $987,000 | 47.0% | 0.0% | $987,000 |
| 5.0 | 55.0% | 0.0% | $1,155,000 | 55.0% | 0.0% | $1,155,000 |
| 6.0 | 63.0% | 0.0% | $1,323,000 | 63.0% | 0.0% | $1,323,000 |
| 7.0 | 74.0% | 0.0% | $1,554,000 | 74.0% | 0.0% | $1,554,000 |
| 8.0 | 83.0% | 0.0% | $1,743,000 | 83.0% | 0.0% | $1,743,000 |
| 9.0 | 84.0% | 0.0% | $1,764,000 | 84.0% | 0.0% | $1,764,000 |
| 10.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 11.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 12.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 13.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 14.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 15.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |
| 16.0 | 86.0% | 0.0% | $1,806,000 | 86.0% | 0.0% | $1,806,000 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Displacement | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $10,798,521 | 90.0 | | $10,798,521 |
| 3.0 | 135.0 | | $16,197,781 | 135.0 | | $16,197,781 |
| 4.0 | 180.0 | | $21,597,041 | 180.0 | | $21,597,041 |
| 5.0 | 225.0 | | $26,996,301 | 225.0 | | $26,996,301 |
| 6.0 | 270.0 | | $32,395,562 | 270.0 | | $32,395,562 |
| 7.0 | 315.0 | | $37,794,822 | 315.0 | | $37,794,822 |
| 8.0 | 360.0 | | $43,194,082 | 360.0 | | $43,194,082 |
| 9.0 | 405.0 | | $48,593,342 | 405.0 | | $48,593,342 |
| 10.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 11.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 12.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 13.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 14.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 15.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |
| 16.0 | 450.0 | | $53,992,603 | 450.0 | | $53,992,603 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Depth-Damage Functions Using Protective Services (Default)**

| Loss of Function | Before Mitigation Values: | | | After Mitigation Values: | | |
|---|---|---|---|---|---|---|
| **Flood Depth (ft)** | **Before Mitigation (Days)** | **Before Mitigation User Entered (Days)** | **Before Mitigation ($)** | **After Mitigation (Days)** | **After Mitigation User Entered (Days)** | **After Mitigation ($)** |
| -2.0 | 0.0 | | | 0.0 | | |
| -1.0 | 0.0 | | | 0.0 | | |
| 0.0 | 0.0 | | | 0.0 | | |
| 1.0 | 45.0 | | | 0.0 | | |
| 2.0 | 90.0 | | $0 | 90.0 | | $0 |
| 3.0 | 135.0 | | $0 | 135.0 | | $0 |
| 4.0 | 180.0 | | $0 | 180.0 | | $0 |
| 5.0 | 225.0 | | $0 | 225.0 | | $0 |
| 6.0 | 270.0 | | $0 | 270.0 | | $0 |
| 7.0 | 315.0 | | $0 | 315.0 | | $0 |
| 8.0 | 360.0 | | $0 | 360.0 | | $0 |
| 9.0 | 405.0 | | $0 | 405.0 | | $0 |
| 10.0 | 450.0 | | $0 | 450.0 | | $0 |
| 11.0 | 450.0 | | $0 | 450.0 | | $0 |
| 12.0 | 450.0 | | $0 | 450.0 | | $0 |
| 13.0 | 450.0 | | $0 | 450.0 | | $0 |
| 14.0 | 450.0 | | $0 | 450.0 | | $0 |
| 15.0 | 450.0 | | $0 | 450.0 | | $0 |
| 16.0 | 450.0 | | $0 | 450.0 | | $0 |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Other Benefits

### Other Benefits Before Mitigation

No Data

### Other Benefits After Mitigation

No Data

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $11,550,169 | Annual: | $0 | Annual: | $11,550,169 |
| Present Value: | $35,381,700 | Present Value: | $0 | Present Value: | $35,381,700 |

Mitigation Benefits: $35,381,700 Mitigation Costs: $2,550,000

Benefits Minus Costs: $32,831,700 Benefit-Cost Ratio: 13.88

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 20 | Construction Type: | |
| Mitigation Project Cost: | $2,550,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $0 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $2,550,000 | Years of Maintenance: | 20 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $0 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$658,375,621** Total Costs: **$36,040,000** BCR: **18.27**

Project Number: Disaster #: Program: Agency: **Town of Wareham**

State: **Massachusetts** Point of Contact: Analyst:

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|

| Pump Station | Flood Zone | Project Useful Life (yrs) | Mitigation Project Cost | Annual O&M Cost | # of Volunteers Required | # of Hours Volunteered/Person | Cost of Volunteers Time ($/Hr/Person) | Number of Days Lodging/Volunteer | Per Person Cost of Lodging for a Volunteer | Volunteers Cost | Number of Persons - Mental Stress and Anxiety | Lost Productivity - Number of Workers | Total Social Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Narrows | Coastal AE | 50 | $ 2,630,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 6570 | 6570 | $ 73,446,030 |
| Hynes Field | Coastal AE | 50 | $ 2,670,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 3513 | 3513 | $ 39,271,827 |
| Smith | VE | 20 | $ 2,830,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 2228 | 2228 | $ 24,906,812 |
| Dick's Pond | Coastal AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1765 | 1765 | $ 19,730,935 |
| Onset Pier | VE | 50 | $ 2,460,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1685 | 1685 | $ 18,836,615 |
| Hathaway | AE | 20 | $ 30,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1591 | 1591 | $ 17,785,789 |
| South Water Street | VE | 50 | $ 2,760,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1494 | 1494 | $ 16,701,426 |
| Cohasset Narrows | VE | 50 | $ 2,670,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1478 | 1478 | $ 16,522,562 |
| Saltworks Road | VE | 20 | $ 2,640,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1205 | 1205 | $ 13,470,695 |
| Indian Neck | AE | 20 | $ 70,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1014 | 1014 | $ 11,335,506 |
| Pine Tree Estates (Terry Lane) | NA | 20 | $ 2,550,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 0 | 0 | $ - |
| Parkwood | AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 755 | 755 | $ 8,440,145 |
| Pinehurst | Coastal AE | 20 | $ 2,510,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 673 | 673 | $ 7,523,467 |
| East Boulevard | Coastal AE | 20 | $ 2,670,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 637 | 637 | $ 7,121,023 |
| Arnold | Coastal AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 480 | 480 | $ 5,365,920 |
| Ruggles | VE | 50 | $ 870,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 463 | 463 | $ 5,175,877 |
| Briarwood | Coastal AE | 20 | $ 40,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 425 | 425 | $ 4,751,075 |
| North Boulevard | Coastal AE | 50 | $ 2,920,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 422 | 422 | $ 4,717,538 |
| Cromessett | VE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 1478 | 1478 | $ 16,522,562 |
| Onset Heights | Coastal AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 290 | 290 | $ 3,241,910 |
| Avenue A | Coastal AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 286 | 286 | $ 3,197,194 |
| Riverside | Coastal AE | 20 | $ 1,630,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 246 | 246 | $ 2,750,034 |
| Bay Street | VE | 20 | $ 1,720,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 186 | 186 | $ 2,079,294 |
| Hill Street Jefferson Shores | VE | 20 | $ 2,130,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 111 | 111 | $ 1,240,869 |
| South Boulevard | VE | 20 | $ 1,920,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 99 | 99 | $ 1,106,721 |
| Leonard Street | Coastal AE | 20 | $ 80,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 87 | 87 | $ 972,573 |
| Apple Street | Coastal AE | 20 | $ 190,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 85 | 85 | $ 950,215 |
| Linwood | Coastal AE | 20 | $ 60,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 87 | 87 | $ 972,573 |
| Green Street | AE | 20 | $ 1,860,000 | 0 | 40 | 480 | 120 | 30 | 150 | $ 2,484,000 | 17 | 17 | $ 190,043 |

| Pump Station | FIRM Panel Number | Sea Level Rise | Elevation of Lowest Floor Member | Ground Surface Elevation | First Floor Elevation Above Grade (ft) | BFE | BFE + SLR | Building Size (SF) | Value of Building ($/sf) | Demolition Damage Threshold | Type of Structure | Primary Use of Building | Building Contents | Displacement Costs ($/month) | One Time Displacement Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Narrows | 489K | 1.8 | 10.75 | 6.5 | | 14 | 15.8 | 630 | 250 | 50% | Engineered | Protective Serv | $ 2,600,000 | $ 29,565,000 | $ 164,250 |
| Hynes Field | 581K | 1.8 | 10.9 | 6.4 | | 14 | 15.8 | 630 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 15,808,500 | $ 87,825 |
| Smith | 577J | 0.6 | 18 | 8.8 | | 18 | 18.6 | 570 | 250 | 50% | Engineered | Protective Serv | $ 2,600,000 | $ 10,026,000 | $ 55,700 |
| Dick's Pond | 493J | 0.6 | 14.7 | 9.8 | | 14 | 14.6 | 710 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 7,942,500 | $ 44,125 |
| Onset Pier | 581K | 1.8 | 15 | 11.7 | | 22 | 23.8 | 270 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 7,582,500 | $ 42,125 |
| Hathaway | 576K | 0.6 | | 15.2 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 7,159,500 | $ 39,775 |
| South Water Street | 582K | 1.8 | 14.8 | 9.5 | | 19 | | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 6,723,000 | $ 37,350 |
| Cohasset Narrows | 501J | 1.8 | | 11.6 | | 21 | 22.8 | 1200 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 6,651,000 | $ 36,950 |
| Saltworks Road | 249J | 0.6 | 14.8 | 12.1 | | 21 | 21.6 | 300 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 5,422,500 | $ 30,125 |
| Indian Neck | 489K | 0.6 | | 14.6 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,600,000 | $ 4,563,000 | $ 25,350 |
| Pine Tree Estates (Terry Lane) | 576K | 0.6 | 14.7 | 12.5 | | 14 | 14.6 | 300 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ - | $ - |
| Parkwood | 577J | 0.6 | | 12.7 | | 15 | 15.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 3,397,500 | $ 18,875 |
| Pinehurst | 577J | 0.6 | 14.6 | 11.2 | | 14 | 14.6 | 430 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 3,028,500 | $ 16,825 |
| East Boulevard | 581K | 0.6 | | 4.71 | | 14 | 14.6 | 200 | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 2,866,500 | $ 15,925 |
| Arnold | 576K | 0.6 | | 6.8 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 2,160,000 | $ 12,000 |
| Ruggles | 577J | 1.8 | 14.6 | 5.9 | | 20 | 21.8 | 620 | 250 | 50% | Engineered | Protective Serv | $ 2,600,000 | $ 2,083,500 | $ 11,575 |
| Briarwood | 576K | 0.6 | 18.9 | 9.3 | | 15 | 15.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 1,912,500 | $ 10,625 |
| North Boulevard | 581K | 1.8 | 11.15 | 6.9 | | 14 | 15.8 | 270 | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 1,899,000 | $ 10,550 |
| Cromessett | 576K | 0.6 | | 11.5 | | 16 | 16.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 6,651,000 | $ 36,950 |
| Onset Heights | 582K | 0.6 | | 7.4 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 1,305,000 | $ 7,250 |
| Avenue A | 489K | 0.6 | | 7.1 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 1,287,000 | $ 7,150 |
| Riverside | 294J | 0.6 | | 7.3 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 1,107,000 | $ 6,150 |
| Bay Street | 482J | 0.6 | | 10.2 | | 17 | 17.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 837,000 | $ 4,650 |
| Hill Street Jefferson Shores | 249J | 0.6 | 15 | 13.8 | | 21 | 21.6 | 360 | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 499,500 | $ 2,775 |
| South Boulevard | 581K | 0.6 | | 13.2 | | 22 | 22.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 445,500 | $ 2,475 |
| Leonard Street | 557K | 0.6 | | 9.3 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 391,500 | $ 2,175 |
| Apple Street | 489K | 0.6 | | 8.5 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 2,100,000 | $ 382,500 | $ 2,125 |
| Linwood | 493J | 0.6 | | 14.1 | | 14 | 14.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 391,500 | $ 2,175 |
| Green Street | 482J | 0.6 | | 17 | | 16 | 16.6 | | 250 | 50% | Engineered | Protective Serv | $ 1,600,000 | $ 76,500 | $ 425 |

| Pump Station | Displacem | Total Displacement Cost | Annual Benefit | Present Value | Annual Flood R |
|---|---|---|---|---|---|
| Narrows | 18 | $ 532,334,250 | $ 75,930,030 | $ 99,800,000 | $ 998,000 |
| Hynes Field | 18 | $ 284,640,825 | $ 41,755,827 | $ 65,600,000 | $ 656,000 |
| Smith | 18 | $ 180,523,700 | $ 27,390,812 | $ 56,900,000 | $ 569,000 |
| Dick's Pond | 12 | $ 95,354,125 | $ 22,214,935 | $ 46,000,000 | $ 460,000 |
| Onset Pier | 18 | $ 136,527,125 | $ 21,320,615 | $ 45,200,000 | $ 452,000 |
| Hathaway | 9 | $ 64,475,275 | $ 20,269,789 | $ 44,100,000 | $ 441,000 |
| South Water Street | 18 | $ 121,051,350 | $ 19,185,426 | $ 43,000,000 | $ 430,000 |
| Cohasset Narrows | 12 | $ 79,848,950 | $ 19,006,562 | $ 42,800,000 | $ 428,000 |
| Saltworks Road | 18 | $ 97,635,125 | $ 15,954,695 | $ 39,800,000 | $ 398,000 |
| Indian Neck | 9 | $ 41,092,350 | $ 13,819,506 | $ 37,700,000 | $ 377,000 |
| Pine Tree Estates (Terry Lane) | 9 | $ - | $ 2,484,000 | $ 35,400,000 | $ 354,000 |
| Parkwood | 9 | $ 30,596,375 | $ 10,924,145 | $ 34,800,000 | $ 348,000 |
| Pinehurst | 9 | $ 27,273,325 | $ 10,007,467 | $ 33,800,000 | $ 338,000 |
| East Boulevard | 12 | $ 34,413,925 | $ 9,605,023 | $ 33,400,000 | $ 334,000 |
| Arnold | 12 | $ 25,932,000 | $ 7,849,920 | $ 31,700,000 | $ 317,000 |
| Ruggles | 18 | $ 37,514,575 | $ 7,659,877 | $ 31,500,000 | $ 315,000 |
| Briarwood | 12 | $ 22,960,625 | $ 7,235,075 | $ 31,100,000 | $ 311,000 |
| North Boulevard | 12 | $ 22,798,550 | $ 7,201,538 | $ 31,000,000 | $ 310,000 |
| Cromessett | 12 | $ 79,848,950 | $ 19,006,562 | $ 29,700,000 | $ 297,000 |
| Onset Heights | 12 | $ 15,667,250 | $ 5,725,910 | $ 29,600,000 | $ 296,000 |
| Avenue A | 12 | $ 15,451,150 | $ 5,681,194 | $ 29,500,000 | $ 295,000 |
| Riverside | 12 | $ 13,290,150 | $ 5,234,034 | $ 29,100,000 | $ 291,000 |
| Bay Street | 12 | $ 10,048,650 | $ 4,563,294 | $ 28,400,000 | $ 284,000 |
| Hill Street Jefferson Shores | 12 | $ 5,996,775 | $ 3,724,869 | $ 27,600,000 | $ 276,000 |
| South Boulevard | 18 | $ 8,021,475 | $ 3,590,721 | $ 27,400,000 | $ 274,000 |
| Leonard Street | 12 | $ 4,700,175 | $ 3,456,573 | $ 27,300,000 | $ 273,000 |
| Apple Street | 12 | $ 4,592,125 | $ 3,434,215 | $ 27,300,000 | $ 273,000 |
| Linwood | 9 | $ 3,525,675 | $ 3,456,573 | $ 27,200,000 | $ 272,000 |
| Green Street | 9 | $ 688,925 | $ 2,674,043 | $ 26,500,000 | $ 265,000 |
| | | | | **$ 1,093,200,000** | **$ 10,932,000** |

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