Town of Falmouth
Climate Change Vulnerability Assessment and Adaptation Planning

Public Presentation
October 29, 2019
Vulnerability Assessment and Adaptation Planning

Presentation Outline

- Project Background and Need
- Analysis Methods
- Vulnerability Assessment Results
  1. Municipal Asset Results
  2. Natural Resources Impacts
- Recommended Actions
Project Background and Need

*Climate Change – What’s happening and why?*

- Increasing concentrations of heat-trapping greenhouse gases, such as CO$_2$, are primarily responsible for the climate changes observed in the industrial era, especially over the last seven decades.

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**CO$_2$ concentration > 400ppm**
(9/23/19 from Mauna Loa Station)

**290 ppm CO$_2$**

**Industrial Revolution 1850**
Project Background and Need

*Climate Change – What’s happening and why?*

- Thousands of studies by researchers worldwide have documented temperature increases at the Earth’s surface and in the ocean.

- Seas are warming and rising, and flooding is becoming more frequent along the U.S. coastline.
Project Background and Need

Climate Change – What’s happening and why?

- Warmer oceans and melting ice caps will continue to contribute to sea-level rise in the future.

Statewide hydrodynamic modeling uses “High” Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Extremely unlikely to exceed (99.5%) under RCP8.5</th>
<th>Unlikely to exceed (83%) under RCP8.5 when accounting for possible ice sheet instabilities</th>
<th>Extremely unlikely to exceed (95%) under RCP4.5 when accounting for possible ice sheet instabilities</th>
</tr>
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<td>2.4</td>
<td>4.2</td>
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</table>
Climate Change Flood Vulnerability Assessment

Project Goals and Objectives

• Provide data on likely future flooding scenarios
• Identify potential flooding impacts to municipally-owned infrastructure
• Identify potential sea-level rise impacts to natural resources
• Identify and prioritize potential adaptation strategies to reduce risk
Climate Change Flood Vulnerability Assessment

Project Methods

• Assess risk for each asset
  ◦ Risk (R) = Probability of Flooding (P) x Consequence of Flooding (C)

• 5 step process:
  1. Determine critical assets
  2. Determine consequence of flooding score
  3. Determine critical elevations
  4. Obtain probability of exceedance data
  5. Calculate risk scores and rankings
Step 1: Determine critical assets

The following municipally owned assets **within the model grid** were included in the analysis:

- Buildings
- Above ground utilities (e.g., wastewater lift stations)
- Roads and bridges
- Parking lots
- Recreational facilities (e.g., baseballs fields, tennis courts, etc.)
- Shining Sea Bike Path
- Trunk River sewer main
- Boat ramps
- Coastal infrastructure (e.g., seawalls, jetties, groins, etc.)
## Step 2: Determine consequence of flooding

<table>
<thead>
<tr>
<th>Rating</th>
<th>Area of Service Loss</th>
<th>Duration of Service Loss</th>
<th>Cost of Damage</th>
<th>Impact on Public Safety &amp; Emergency Services</th>
<th>Impact on Important Economic Activities</th>
<th>Impact on Public Health &amp; Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Whole town/city</td>
<td>&gt; 30 days</td>
<td>&gt; $10m</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
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<tr>
<td>4</td>
<td>Multiple neighborhoods</td>
<td>14 - 30 days</td>
<td>$1m - $10m</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>3</td>
<td>Neighborhood</td>
<td>7 - 14 days</td>
<td>$100k - $1m</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
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<tr>
<td>2</td>
<td>Locality</td>
<td>1 - 7 days</td>
<td>$10k - $100k</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>1</td>
<td>Property</td>
<td>&lt; 1 day</td>
<td>&lt; $10k</td>
<td>None</td>
<td>None</td>
<td>None</td>
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</table>

Risk \( (R) = \text{Probability of Flooding (P)} \times \text{Consequence of Flooding (C)} \)
Step 2: Determine consequence of flooding

<table>
<thead>
<tr>
<th>Asset Name</th>
<th>Area of Service Loss</th>
<th>Duration of Service Loss</th>
<th>Cost of Damage</th>
<th>Impact on Public Safety &amp; Emergency Services</th>
<th>Impact on Important Economic Activities</th>
<th>Impact on Public Health &amp; Environment</th>
<th>Total Consequence Score</th>
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<tr>
<td>Town Hall - Main Building</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>77</td>
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<tr>
<td>Town Hall - Storage Shed</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Chamber of Commerce</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>53</td>
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<td>Department of Public Works - Fuel Tanks</td>
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<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>60</td>
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<td>Falmouth Police Department - Main Building</td>
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<td>3</td>
<td>4</td>
<td>5</td>
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<td>73</td>
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<tr>
<td>Falmouth Police Department - Shed</td>
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<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>27</td>
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<tr>
<td>Falmouth Library Main</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>57</td>
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<tr>
<td>East Falmouth Public Library</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
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<td>1</td>
<td>47</td>
</tr>
</tbody>
</table>

Risk (R) = Probability of Flooding (P) x **Consequence of Flooding (C)**
Step 3: Determine critical elevations

Threshold for significant damage?
- Indoor equipment
- Door threshold/ 1st Floor
- Outdoor equipment
- Opening to basement

Elevation above which asset would fail to function
Step 4: Obtain Probability of Exceedance Data
Step 4: Obtain Probability of Exceedance Data
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Step 4: Obtain Probability of Exceedance Data

Town Hall: Critical elevation = 6.7 feet (NAVD88)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<td>0.1</td>
<td>10.7</td>
<td>4.0</td>
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<td>10.0</td>
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<td>9.4</td>
<td>2.7</td>
<td>10.7</td>
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<td>8.5</td>
<td>1.9</td>
<td>9.9</td>
<td>3.2</td>
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<td>7.9</td>
<td>1.3</td>
<td>9.2</td>
<td>2.6</td>
<td>14.0</td>
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<td>7.3</td>
<td>0.6</td>
<td>8.6</td>
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<td>13.1</td>
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<td>10</td>
<td>6.4</td>
<td>dry</td>
<td>7.7</td>
<td>1.0</td>
<td>12.0</td>
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<tr>
<td>20</td>
<td>5.7</td>
<td>dry</td>
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<td>0.3</td>
<td>11.0</td>
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<tr>
<td>25</td>
<td>5.0</td>
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<td>10.0</td>
<td>3.4</td>
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<td>30</td>
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<td>dry</td>
<td>6.0</td>
<td>dry</td>
<td>9.7</td>
<td>3.0</td>
</tr>
<tr>
<td>50</td>
<td>4.5</td>
<td>dry</td>
<td>5.7</td>
<td>dry</td>
<td>9.4</td>
<td>2.7</td>
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<tr>
<td>100</td>
<td>3.7</td>
<td>dry</td>
<td>5.0</td>
<td>dry</td>
<td>8.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

![Water Surface Elevation Chart](chart.png)

Legend:
- **Present Day**
- **2030**
- **2070**
- **Critical Elevation**
Step 5: Calculate Risk Scores and Rankings

$$R_{\text{comp}} = (R_{\text{present}} \times W_{\text{present}}) + (R_{2030} \times W_{2030}) + (R_{2070} \times W_{2070})$$

<table>
<thead>
<tr>
<th>Time horizon</th>
<th>Probability of Exceedance</th>
<th>Consequence Score</th>
<th>Risk Score</th>
<th>Weight</th>
<th>Composite Risk Score</th>
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<tr>
<td>Present</td>
<td>5</td>
<td>77</td>
<td>383</td>
<td>0.5</td>
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<tr>
<td>2030</td>
<td>20</td>
<td>77</td>
<td>1533</td>
<td>0.3</td>
<td></td>
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<tr>
<td>2070</td>
<td>100</td>
<td>77</td>
<td>7667</td>
<td>0.2</td>
<td>2185</td>
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</table>
### Step 5: Calculate Risk Scores and Rankings

**Top 20 ranked buildings and structures**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Asset Name</th>
<th>Asset Type</th>
<th>Consequence Score</th>
<th>Present Probability (%)</th>
<th>2030 Probability (%)</th>
<th>2070 Probability (%)</th>
<th>Composite Risk Score</th>
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<tbody>
<tr>
<td>1</td>
<td>Park Road Sewer Lift Station</td>
<td>Sewer</td>
<td>37</td>
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<td>100</td>
<td>100</td>
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<td>2</td>
<td>Old Dock Road Pier Upwellers</td>
<td>Marine</td>
<td>40</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>3000</td>
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<tr>
<td>3</td>
<td>Woods Hole Draw Bridge Hut</td>
<td>Marine</td>
<td>57</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>2692</td>
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<td>4</td>
<td>Old Dock Road Pier Shed</td>
<td>Marine</td>
<td>33</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>2500</td>
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<tr>
<td>5</td>
<td>Old Silver Beach (South) Pedestrian Ramp</td>
<td>Rec</td>
<td>33</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>2500</td>
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<td>6</td>
<td>Town Hall - Main Building</td>
<td>Admin</td>
<td>77</td>
<td>5</td>
<td>20</td>
<td>100</td>
<td>2185</td>
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<tr>
<td>7</td>
<td>Mitchell Bathhouse</td>
<td>Rec</td>
<td>43</td>
<td>20</td>
<td>50</td>
<td>100</td>
<td>1950</td>
</tr>
<tr>
<td>8</td>
<td>Inner Harbor Upwellers</td>
<td>Marine</td>
<td>40</td>
<td>10</td>
<td>50</td>
<td>100</td>
<td>1600</td>
</tr>
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<td>9</td>
<td>Woods Hole Sewer Lift Station</td>
<td>Sewer</td>
<td>53</td>
<td>5</td>
<td>10</td>
<td>100</td>
<td>1360</td>
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<td>10</td>
<td>Surf Drive Sewer Lift Station</td>
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<td>43</td>
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<td>20</td>
<td>100</td>
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<td>11</td>
<td>Woods Hole Community Building</td>
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<td>20</td>
<td>100</td>
<td>1137</td>
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<td>5</td>
<td>100</td>
<td>1100</td>
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<td>13</td>
<td>Inner Harbor - Charter Boat Shed</td>
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<td>33</td>
<td>10</td>
<td>25</td>
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<td>1083</td>
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<td>14</td>
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<td>15</td>
<td>Town Hall - Storage Shed</td>
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<td>100</td>
<td>665</td>
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<td>16</td>
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<td>5</td>
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<td>560</td>
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<td>17</td>
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<td>19</td>
<td>Old Silver Beach (North) Bathhouse</td>
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<td>43</td>
<td>1</td>
<td>2</td>
<td>25</td>
<td>264</td>
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<tr>
<td>20</td>
<td>Mullen Hall School - Main Building</td>
<td>School</td>
<td>63</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>253</td>
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</table>
## Step 5: Calculate Risk Scores and Rankings

### Top 20 ranked roads

<table>
<thead>
<tr>
<th>Rank</th>
<th>Asset Name</th>
<th>Consequence Score</th>
<th>Present Probability (%)</th>
<th>2030 Probability (%)</th>
<th>2070 Probability (%)</th>
<th>Composite Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water St (Luscombe Ave to Drawbridge)</td>
<td>67</td>
<td>99</td>
<td>99</td>
<td>100</td>
<td>6635</td>
</tr>
<tr>
<td>2</td>
<td>Chapoquoit Rd (Little Neck Bar Rd to Bridge)</td>
<td>57</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>5546</td>
</tr>
<tr>
<td>3</td>
<td>Clinton Ave (Swing Lane to Scranton)</td>
<td>67</td>
<td>73</td>
<td>83</td>
<td>100</td>
<td>5464</td>
</tr>
<tr>
<td>4</td>
<td>Scranton Ave (Lowry Road to Clinton)</td>
<td>67</td>
<td>69</td>
<td>83</td>
<td>100</td>
<td>5312</td>
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<tr>
<td>5</td>
<td>Waquoit Hwy (Waquoit Landing Rd to Childs River)</td>
<td>53</td>
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<td>100</td>
<td>100</td>
<td>5300</td>
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<td>6</td>
<td>Menauhant Rd (Grand to Maravista)</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>5300</td>
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<tr>
<td>7</td>
<td>Surf Dr (Mill Rd to Bywater Ct)</td>
<td>53</td>
<td>95</td>
<td>97</td>
<td>100</td>
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<td>8</td>
<td>Clinton Ave (Swing Ln to Sheridan Ave)</td>
<td>63</td>
<td>68</td>
<td>77</td>
<td>100</td>
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<tr>
<td>9</td>
<td>Surf Dr (Elm Rd to Mill Rd)</td>
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<td>10</td>
<td>Menauhant Rd (Foster Rd to Central)</td>
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<td>73</td>
<td>91</td>
<td>100</td>
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</tr>
<tr>
<td>11</td>
<td>West Ave</td>
<td>53</td>
<td>86</td>
<td>90</td>
<td>100</td>
<td>4766</td>
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<tr>
<td>12</td>
<td>Nashawena St (Lummis Ln to Pine Island Cir)</td>
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<td>100</td>
<td>100</td>
<td>4700</td>
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<tr>
<td>13</td>
<td>Nashawena St (Cordwood Landing Rd to Swift St)</td>
<td>60</td>
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<td>78</td>
<td>99</td>
<td>4579</td>
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<tr>
<td>14</td>
<td>Old Dock Rd (Bowline Rd to Chapoquoit Rd)</td>
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<td>68</td>
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<td>Quissett Harbor Rd</td>
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<td>16</td>
<td>Mill Rd (Hedge Ln to Seagull Ln)</td>
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<td>66</td>
<td>78</td>
<td>100</td>
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<td>17</td>
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<td>64</td>
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<td>Menauhant Rd (Acapesket Rd to Green Harbor Rd)</td>
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<td>98</td>
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<td>19</td>
<td>Nashawena St (Pine Island Cir to Cordwood Landing Road)</td>
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<td>61</td>
<td>73</td>
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<td>Chapoquoit Rd (Little Neck Bar Rd to Chapoquoit Rd)</td>
<td>57</td>
<td>67</td>
<td>70</td>
<td>96</td>
<td>4189</td>
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### Step 5: Calculate Risk Scores and Rankings

**Top 20 ranked assets (overall)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Asset Name</th>
<th>Asset Type</th>
<th>Consequence Score</th>
<th>Present Probability (%)</th>
<th>2030 Probability (%)</th>
<th>2070 Probability (%)</th>
<th>Composite Risk Score</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Water St (Luscombe Ave to Drawbridge)</td>
<td>Road</td>
<td>67</td>
<td>99</td>
<td>99</td>
<td>100</td>
<td>6635</td>
</tr>
<tr>
<td>2</td>
<td>Chapoquoit Rd (Little Neck Bars Rd to Bridge)</td>
<td>Road</td>
<td>57</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>5546</td>
</tr>
<tr>
<td>3</td>
<td>Clinton Ave (Swing Ln to Scranton Ave)</td>
<td>Road</td>
<td>67</td>
<td>73</td>
<td>83</td>
<td>100</td>
<td>5464</td>
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<tr>
<td>4</td>
<td>Menauhant Road (At Bristol Beach/Little Pond)</td>
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Vulnerability Assessment – Other Deliverables

Asset Specific Visualizations

- Mitchell Bathhouse
- Green Pond Bridge
- Water Street
Mitchell Bathhouse

- 2070 100-year flood depth = 9.3 feet (elevation = 14.9 feet NAVD88)
- 2030 100-year flood depth = 4.3 feet (elevation = 9.9 feet NAVD88)
- Present day 100-year flood depth = 2.9 feet (elevation = 8.5 feet NAVD88)
2019 100-year event
2030 100-year event
2070 100-year event
Green Pond Bridge

2070 100-year flood depth* = 9.0 feet (elevation = 15.5 feet NAVD88)

2030 100-year flood depth* = 3.6 feet (elevation = 10.1 feet NAVD88)

Present day 100-year flood depth* = 2.1 feet (elevation = 8.6 feet NAVD88)

*Above low chord elevation of bridge
2019 100-year event
2030 100-year event
Vulnerability Assessment

Assessment of Impacts to Natural Resources: SLAMM Results
Vulnerability Assessment

SLAMM Results – Present Day
Vulnerability Assessment

SLAMM Results – 2030
Vulnerability Assessment

SLAMM Results – 2070
# Vulnerability Assessment

## SLAMM Results – Townwide Changes

<table>
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<tr>
<th>Area Type</th>
<th>Present Day</th>
<th>2030</th>
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![Graph showing area changes](image)

1. **Area (Acres)**
2. **Present Day**
3. **2030**
4. **2070**

**Legend:**
- Irregularly Flooded Marsh
- Regularly Flooded Marsh

**Graph注释:**
- **Total Open Water**
- **Total Wetland**
Vulnerability Assessment

SLAMM Results – Site-specific Changes

All public beaches:
- Bristol Beach
- Chapoquoit Beach
- Falmouth Heights Beach
- Megansett Beach
- Menauhant Beach
- Old Silver Beach
- Stoney Beach
- Surf Drive Beach
- Wood Neck Beach

Other major coastal wetlands:
- The marsh system behind Old Silver Beach
- Great Sippewissett Marsh
- Little Sippewissett Marsh
- Little Pond
- Great Pond
- Green Pond
- Bournes Pond
- Eel Pond
- Waquoit Bay
Vulnerability Assessment

SLAMM Results – Site-specific Changes
Vulnerability Assessment

SLAMM Results – Site-specific Changes

Old Silver Beach Area

SLAMM Wetland Categories
- Upland
- Nontidal Swamp
- Inland Fresh Marsh
- Transitional Marsh/Scrub-Shrub
- Regularly Flooded Marsh
- Estuarine Beach/Tidal Flat
- Ocean Beach
- Ocean Flat
- Estuarine Open Water
- Open Ocean
- Irregularly Flooded Marsh
- Tidal Swamp

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Great Sippewissett Marsh

SLAMM Wetland Categories
- Upland
- Nontidal Swamp
- Inland Fresh Marsh
- Inland Open Water
- Tidal Fresh Marsh
- Estuarine Open Water
- Transitional Marsh/Scrub-Shrub
- Open Ocean
- Regularly Flooded Marsh
- Estuarine Beach/Tidal Flat
- Irregularly Flooded Marsh
- Total Swamp

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Develop Adaptation Strategies

Recommendations for site specific, asset-based adaptations:

1. Park Road Sewer Lift Station
2. Old Dock Road Dock, Upwellers and Shed
3. Woods Hole Drawbridge Hut
4. Town Hall
5. Old Silver Beach Parking Lot
6. Falmouth Harbor Docks (1-12)
7. Green Pond Dock (2)
8. Taft Park – Baseball Field, Tennis Courts, and Playground
9. Shining Sea Bike Path (Chapoquoit Road → Bumblebee Hill Road)
10. Chapoquoit Road
11. Corner of Clinton Ave and Scranton Ave
12. Waquoit Highway/Rt 28 Bridge (@ Childs River)
13. Menauhant Road Bridge (at Bristol Beach/Little Pond)
Develop Adaptation Strategies

Old Dock Road Pier Assets

**Recommendations:**

**Present** - Wet floodproof the shed; ensuring that nothing inside is damaged during a flood event.

**Present** - Properly secure upwellers so they cannot be dislodged.

**Present** - Assess the pier to ensure it is structurally robust enough to withstand storm conditions.

**2050/2070** - By 2050, daily MHW will overtop the pier, as well as impact Old Dock Road. In the long-term, this area will have to be redesigned.

- Raising the structure in its current location would require raising Old Dock Road and the water main.
- A portion of Old Dock Road could be abandoned, creating a dead end road that terminates at the relocated pier and associated boat ramp.
Develop Adaptation Strategies

Woods Hole Drawbridge Hut

Recommendations:

Present - Dry floodproof the bulkhead to protect the interior mechanics of the drawbridge hut.

Present - Determine whether the submersible pump in the metal box to the right of the bulkhead is still necessary. If so, raise this component.

2030 - Dry floodproof the upper room of the drawbridge hut to protect the vital electrical equipment that’s inside.

2030/2050 - Evaluate the viability and necessity of the Woods Hole Drawbridge and Drawbridge Hut in the long-term. (See the regional adaptation discussion for the Woods Hole area.)
Develop Adaptation Strategies

**Town Hall**

**Recommendations:**

**Present** - Dry floodproof the lower floor of Town Hall to protect the interior spaces

**Present/2030** - A berm-like landscaping feature (~1000 feet) could be constructed to reduce the likelihood of flooding (co-benefits for a number of local businesses).

**2070** - Consider relocating the Town Hall. This could involve purchasing land or utilizing a vacant lot already owned by the Town and constructing a new building. Alternatively, a suitable existing building elsewhere could be acquired/repurposed. (If the berm is constructed, the current building could potentially last up to or beyond 2070; the Town could monitor how SLR has been evolving before making a decision.)
Develop Adaptation Strategies

Taft Park – Woods Hole

Recommendations:

Present - No action. Although costly improvements should not be made to the baseball field.

2050/2070 - Consider looking for alternate locations to relocate these recreational assets.

2050/2070 - Consider transitioning Taft Park into a natural wetland area. Walking trails and/or boardwalks could be added to maintain the open space and recreational use.
Develop Adaptation Strategies

**Chapoquoit Road**

**Recommendations:**

**Present** - Due to the likelihood of roadway inundation during storms, and the disruption in transportation and emergency access this would cause, mandatory evacuations should be considered for the Chapoquoit neighborhood prior to a major storm.

**2070** - Daily tidal inundation of the road by 2070 will require intervention to maintain regular access to the Chapoquoit peninsula in the future. Raising the road would require elevating the roadway from Old Dock Road to the Chapoquoit Beach parking lot (a 2,000-foot length of road).
Develop Adaptation Strategies

Clinton Ave and Scranton Ave

Recommendations:

Present/2030 - Install or enhance bulkhead along shoreline to reduce the risk of flooding from minor storm events.

2050 - Install a multi-property resiliency feature to address minor flooding and more commonly occurring storms.

2070 - Rethink the use of this corner in the long-term. This may include a waterfront park and/or natural wetland feature, an elevated resiliency feature, an elevated or rerouted roadway, or some combination of all these adaptations.
Develop Adaptation Strategies
Menauhant Road Bridge (at Little Pond)

**Recommendations:**

**Present/2030** - Inspect bridge to ensure it is structurally sound and able to withstand floodwaters and daily tidal impacts; make repairs as necessary.

**2030** - Construct a temporary berm on the Little Pond side of Menauhant Road, west of the bridge, to protect the roadway from daily tidal inundation (this could be designed to function through 2050 conditions).

**2070** - Elevate 0.5 miles of road, replacing this existing undersized bridge with a wider crossing OR develop a long-term plan for abandonment of this roadway and bridge.
Develop Adaptation Strategies

**Recommendations for regional adaptations:**
1. Main Street/Top of Falmouth Inner Harbor
2. Woods Hole/Water Street
3. Top of Little Pond/Falmouth Mall

**Recommendations for natural resources adaptations:**
1. Washburn Island
2. Great Sippewissett Marsh
3. Chapoquoit Road Barrier
Develop Adaptation Strategies
Regional Strategy – Falmouth Harbor/Main Street
Develop Adaptation Strategies

Regional Strategy – Falmouth Harbor/Main Street
Develop Adaptation Strategies

Regional Strategy – Falmouth Harbor/Main Street

**PRESENT DAY**

Flood Risk:
The present day flood risk to this area is relatively minor. The 1% chance event (i.e., the 100-year water levels) impact only Robbins Road and the timeshare property across the street from the harbor.

Recommended Actions:
No direct action is needed at this time, but planning and fundraising should begin for 2030 adaptation recommendations.

---

**2030**

Flood Risk:
The flood risk due to storm inundation in 2030 will impact a greater area. The 1% chance event (i.e., the 100-year water levels) will also impact various businesses (e.g., Bank of America, Dairy Queen) as well as a portion of Main Street.

Recommended Actions:
1. The waterfront parcel currently owned by the Town should be elevated, using a berm or terraced design, providing flood protection, living shoreline habitat, and recreational space.
2. Raise lift station access hatches to meet berm.
3. Planning and fundraising should begin for 2070 adaptation recommendations.

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**2070**

Flood Risk:
The flood risk in 2070 will impact a greater area. The 1% chance event would impact various businesses along Davis Straits and Main Street.

Recommended Actions:
1. Work with adjacent waterfront landowners to extend the elevated feature around the head of the Harbor to fully protect the flood pathway.
2. Robbins Road could be eliminated for additional berm/park space; traffic could be rerouted through Main Street, or through a new connector road.
3. Optional: The proposed CCC greenway could be constructed, complete with open waterway and multi-use trails. Tidal control on the downstream end will be necessary to avoid increased flood risk.
Develop Adaptation Strategies

Regional Strategy – Woods Hole
Develop Adaptation Strategies

Regional Strategy – Woods Hole
Develop Adaptation Strategies

Regional Strategy – Woods Hole

Flood Risk:
The flood risk due to storm inundation in 2030 will impact an extensive portion of Woods Hole. The 1% chance event will impact numerous facets of town functionality, including roads, homes, and businesses.

Recommended Actions:
1. Prepare Living with Water Zones (elevate buildings, flood proof structures, etc).
2. Begin berm work.
3. Consider Water St. Bridge redesign and installation of tide control structure.

Flood Risk:
The flood risk due to storm inundation in 2050 (pictured) and 2070 continues to increase.

Recommended Actions:
1. Promote salt marsh expansion in Taft Park and School Street area.
2. Develop a new inlet and excavate material to form a new harbor area.
3. Use excavated material from new harbor to elevate roads and build higher ground around Water St, Bar Neck Rd, and Spencer Baird Rd.
4. Complete berms around harbor and salt marsh to increase storm protection.
5. (2070) Build bridge leading to Penzance Point.
Develop Adaptation Strategies

Regional Strategy – Little Pond/Falmouth Mall
Develop Adaptation Strategies

Regional Strategy – Little Pond/Falmouth Mall

Potential 2070 salt marsh expansion if low elevation areas are joined.
Develop Adaptation Strategies
Regional Strategy – Little Pond/Falmouth Mall

- Little pond extension
- Constructed stormwater wetlands for flood storage capacity and habitat improvements
- Undevelop site to create overlook and small parking area
- Atlantic Cedar Swamp
- Former mall parking converted to grassland habitat
- Pathway provides recreational access to greenway
- Proposed Chapter 40B residential Development
- Multifamily residential
- Public Gathering Area
- Future mixed use commercial/office development at higher elevation
- Loop road relieves traffic pressure from Route 28
- Restored Wetlands and Vegetated Buffer
- Mixed use residential with shared parking
- Small scale village commercial to support adjacent mixed use residential
Develop Adaptation Strategies

Regional Strategy – Little Pond/Falmouth Mall

Present Day

Flood Risk:
The present day flood risk to the area west of Little Pond is relatively minor. The 1% chance event (i.e., the 100-year water levels) impact only the bowling alley property and the undeveloped parcel to the south.

Recommended Actions:
No direct action is needed at this time, but planning and fundraising should begin for 2030 and 2070 adaptation recommendations.

2030

Flood Risk:
The flood risk due to storm inundation in 2030 will impact a greater area. The 1% chance event will also impact various businesses at and around the Falmouth Mall, as well as Spring Bars Road and the Sewer Pump Station.

Recommended Actions:
1. Take steps to acquire and undevelop the large parcels highlighted in orange.
2. Construct first part of berm to protect newly constructed 4OB Housing.
3. Consider raising or relocating sewer pump station.
4. Planning and fundraising should begin for 2070 adaptation recommendations.

2070

Flood Risk:
The flood risk in 2070 will impact a greater area. The 1% chance event would impact various businesses along Worcester Ct, as well as homes along Maravista Ave.

Recommended Actions:
1. Extend flood protection berm to protect adjacent businesses and development.
2. Undevelop properties (orange in above map) to create a large parkland with trails.
3. Install new culvert or bridge on Maravista to re-connect Teaticket Park to Little Pond.
4. Optional: Remove high elevation areas to facilitate salt marsh expansion in the southwestern corner.
Develop Adaptation Strategies

Recommendations for regional adaptations:
1. Main Street/Top of Falmouth Inner Harbor
2. Woods Hole/Water Street
3. Top of Little Pond/Falmouth Mall

Recommendations for natural resources adaptations:
1. Washburn Island
2. Great Sippewissett Marsh
3. Chapoquoit Road Barrier
Develop Adaptation Strategies

Washburn Island

**Goal:** Reinforce and increase the coastal resiliency of the barrier beach, thus ensuring a stable Waquoit Bay system

**Recommendations:**
- Short term: the Town should engage the state, WBNERR, the Town of Mashpee, the Menauhant Yacht Club, Waquoit Bay Yacht Club, and other relevant stakeholders about this issue, to develop a long-term plan to manage Waquoit Bay and Washburn Island.
- Long term: Dune and/or beach nourishment program on the south facing shoreline of Washburn Island.
Develop Adaptation Strategies

Great Sippewissett Marsh

**Goal:** Maximize health of the salt marsh

**Recommendations:**
- Enhance and increase the coastal resilience of the main salt marsh area. Elevation enhancement (e.g., thin layer deposition) will be necessary to maintain suitable salt marsh elevations.
- Expansion of salt marsh east of the bike path. Prior to 2070, portions of the bike path to be replaced with elevated pile-supported path.
Develop Adaptation Strategies

Chapoquoit Road Wetlands

Goal: Reinforce and enhance coastal resiliency for the barrier beach system and salt marsh enhancement.

Recommendations:
- Beach nourishment on the outer coast should be pursued if possible, but need to look at barrier holistically.
- Address salt marsh loss and erosion on the West Falmouth Harbor side as well.
  - Consider living shoreline designs, salt marsh restoration and/or enhancement; establishment of oyster beds
  - Elevation enhancement
- Expansion of salt marsh into existing tidal swamp. Prior to 2050, evaluate the tidal creek and repair/replace any existing culverts as necessary to ensure that daily tides can enter.
Questions?