## Strengths that help mitigate impacts - examples

**INFRASTRUCTURE**
Critical road elevated and passable by emergency management
Hurricane roof installed at school with improved sheltering capacity.
Hardened utility lines reduce outages due to ice storms.
Undersized culvert replaced to reduce flooding in key intersection.

**SOCIETAL**
Reliable communications protocols across departments for all employees.
"Neighbor-helping-neighbor" program aligned with emergency operations.
Faith-based and civic groups with hazard preparedness plans.

**ENVIRONMENTAL**
Oyster reefs and tidal wetlands help reduce wave damage to property.
Forested watersheds maintain drinking water supply during droughts.
Native, vegetated slopes remain stable after intense 24hr rain events.
Floodplains provide stormwater storage and downstream flood reduction



## What Types of Actions Could We Take?

Engineering/Construction
Protection/Conservation
Retreat/Avoidance
Preparations/Planning
Policy/Regulatory Changes
*[Short-term, Long-term, ongoing]*



## Some Recommendations From Hazard Mitigation Plan for Tisbury

- **Improve natural defenses** to minimize storm impacts (e.g., beach nourishment, dredging, structural reconfiguration of inlets)
- **Retrofit sewer pump stations** to increase storm resiliency
- **Reduce flood impacts** by identifying and correcting discharges from town and Commonwealth roadways
- **Reduce damaging volume of direct stormwater discharges** to beaches and surface waters by infiltration
- **Increase capacity in adaptation to climate change**, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning
- **Make long-range plans for public roads vulnerable to Sea Level Rise** working with the Joint Transportation Committee

## The Plan for Today – share your thoughts

- Presentation to **set the stage** for our discussion
- Determine which **climate change natural hazards** to focus on
- Identify the most **vulnerable features** in Tisbury
- Identify the **features that provide strength**
- Develop **actions** – what can the Town do to address vulnerabilities and protect/enhance strengths
- Prioritize the **most important actions** for Tisbury

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## Ground Rules for Discussions

**Share the stage**: Everyone should have an equal opportunity to talk.

**Focus:** Focus on the questions asked and your group's discussion.

**Land the Plane:** Respect limited time.

**Respect:** Listen, be honest, and avoid criticizing others' ideas.

**One mic:** One person speaks at a time.

**Phone etiquette.** Phones are off or on vibrate, take calls in the hall.

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## Thank You!

Will Keefer, MVP Certified
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**Tisbury Municipal Vulnerability Preparedness (MVP) Grant Project:**

# CLIMATE CHANGE PROJECTIONS[1]

## TEMPERATURE

### HIGHLIGHTS:

- ✓ Temperature increases could make Tisbury feel like present-day Maryland by 2050 and present-day North Carolina by 2100.[2]
- ✓ By 2050, we could have more than 3 – 11 times as many very hot days (over 90°F) than we do today. By 2100, we could have almost 4 – 32 times as many.
- ✓ We will have far fewer days with temperatures below freezing.
- ✓ We will have to expend less energy on heating in the winter, and far more on air conditioning in the summer.
- ✓ The growing season will increase by almost 40% by 2050 and could almost double by the end of the century.

**Table 1: TEMPERATURE PROJECTIONS**

| Martha's Vineyard Basin Climate Parameter | Baseline (1971-2000) | Mid-Century (2050s) | End of Century (2090s) |
|---|---|---|---|
| Average Annual Temperature (°F) | 50.6 | 53.0 – 55.8 | 53.6 – 59.7 |
| Maximum Annual Temperature (°F) | 58.8 | 61.0 – 63.9 | 61.6 – 67.7 |
| Minimum Annual Temperature (°F) | 42.3 | 44.9 – 47.6 | 45.6 – 51.4 |
| Annual Days with Max Temp over 90°F | 1 | 3 – 11 | 4 – 32 |
| Annual Days with Min Temp below 32°F | 105 | 80 – 94 | 42 – 82 |
| Annual Heating Degree-Days (Base 65°F) | 5772 | 4,481 – 5,116 | 3,703 – 5,003 |
| Annual Cooling Degree-Days (Base 65°F) | 486 | 753 – 1,075 | 848 – 1628 |
| Annual Growing Degree-Days (Base 50°F) | 2,553 | 3,046 – 3,622 | 3,201 – 4,574 |

[1] Source: Northeast Climate Science Center, 2018. *Massachusetts Climate Change Projections*. University of MA Amherst. Published by MA Executive Office of Energy and Environmental Affairs. January. 213 p. Available at: http://www.massclimatechange.org/resources/resource::2152/massachusetts-climate-change-projections-statewide-and-for-major-river-basins. Data is for the Martha's Vineyard Basin, which includes the land area of Tisbury.

[2] NOAA National Centers for Environmental Information, Climate at a Glance: Statewide Mapping, Average Temperature, published September 2018 from http://www.ncdc.noaa.gov/cag/.

## PRECIPITATION

**HIGHLIGHTS:**

- ✓ Average annual precipitation in Tisbury will increase up to 8% by 2050 and up to 11% by 2100.
- ✓ The largest increases in precipitation will occur in winter.
- ✓ The greatest increase in consecutive dry days will occur in the summer and fall.

**Table 2: PRECIPITATION PROJECTIONS**

| Martha's Vineyard Basin Climate Parameter | Baseline (1971-2000) | Mid-Century (2050s) | End of Century (2090s) |
|---|---|---|---|
| Total Precipitation (inches): | | | |
| Annual | 46.0 | 45.0 – 49.8 | 45.3 – 50.9 |
| Winter | 11.9 | 11.5 – 13.5 | 11.7 – 14.7 |
| Spring | 12.1 | 11.6 – 13.9 | 11.9 – 14.3 |
| Summer | 10.4 | 9.3 – 11.9 | 8.5 – 12.0 |
| Fall | 11.7 | 10.5 – 12.6 | 9.8 – 12.9 |
| Annual Days with Precipitation over 1 inch | 7 | 8 – 11 | 8 – 11 |
| Annual Days with Precipitation Over 2 inches | 1 | 1 – 2 | 1 – 2 |
| Annual Days with Precipitation Over 4 inches | <1 | <1 | <1 |
| Annual Consecutive Dry Days | 18 | 18 – 20 | 17 – 22 |

## SEA LEVEL RISE

**Table 3: SEA LEVEL RISE PROJECTIONS**

| Year | Emissions Scenario | Boston Likely Range (feet relative to mean sea level in 2000) | Woods Hole Likely Range (feet relative to mean sea level in 2000) |
|---|---|---|---|
| 2050 | Medium | 0.8 to 1.4 | 0.8 to 1.5 |
| | High | 0.8 to 1.5 | 0.9 to 1.6 |
| 2100 | Medium | 1.5 to 3.1 | 1.6 to 3.2 |
| | High | 2.0 to 4.0 | 2.1 to 4.1 |

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**Tisbury Municipal Vulnerability Preparedness (MVP) Grant Project:**

# SELECTED DEMOGRAPHIC DATA[1]

| Demographic Parameter | Result |
|---|---|
| Population | 3,949 people |
| Age | 0-19 = 20%<br>20-34= 25%<br>35-64 = 41%<br>65+ = 14% |
| Income | <$40K = 42%<br>$40-60K = 18%<br>$60K+ = 40% |
| % Below Poverty Line | 10% |
| Race | White = 87%<br>Black = 7%<br>Asian = 1%<br>Other = 5% |
| Ethnicity | Hispanic = 0%<br>Not Hispanic = 100% |
| Percent of Population over 65 Living Alone | 4.8 |
| Environmental Justice | 17.6% |
| Heart Attack Hospitalizations | 48.8(age-adjusted rate per 10,000 people) |
| Asthma Emergency Department Visits | 128.8 (age-adjusted rate per 10,000 people) |
| Pediatric Asthma Prevalence | 12.9% of all children enrolled in grades K-8 |
| Heat Stress Emergency Department Visits | 0.0 (age-adjusted rate per 10,000 people) |

[1] Source: MA Dept of Public Health, 2018. MA Environmental Public Health Tracking Community Profile for Tisbury. Report Created on September 27, 2018. 11 pages.

**Risk Matrix:** Examples of Features that may be identified in this process:

**INFRASTRUCTURE**

Examples of Vulnerabilities:

- Main road floods during storms, blocking emergency response.
- Power outages during heat waves lead to health concerns.
- Wildfire and high winds resulting in supply chain interruptions.
- Sewer pump stations become submerged and inoperable.

Examples of Strengths:

- Critical road elevated and passable by emergency management
- Hurricane roof installed at school with improved sheltering capacity.
- Hardened utility lines reduce outages due to ice storms.
- Undersized culvert replaced to reduce flooding in key intersection.
- Improvement to communication systems during extreme weather.

**SOCIETAL**

Examples of Vulnerabilities:

- Senior housing without backup generators during heat waves.
- Residents without access to transportation during hurricane evacuation.
- Household contamination and sewage mobilization during flooding.
- Limited areas of refuge in elementary schools during severe weather.

Examples of Strengths:

- Reliable communications protocols across departments for all employees.
- “Neighbor-helping-neighbor” program aligned with emergency operations.
- Well-supported volunteer organizations (fire, ambulance, CERTs).
- Faith-based and civic groups with hazard preparedness plans.

**ENVIRONMENTAL**

Examples of Vulnerabilities:

- Beachfront development reducing protection provided by dunes.
- Proliferation of subdivisions in flood prone areas.
- Lack of urban tree canopy increasing heat island effect.

Examples of Strengths:

- Oyster reefs and tidal wetlands help reduce wave damage to property.
- Forested watersheds maintain drinking water supply during droughts.
- Native, vegetated slopes remain stable after intense 24hr rain events.
- Floodplains provide stormwater storage and downstream flood reduction

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**Tisbury Municipal Vulnerability Preparedness (MVP) Grant Project:**

# KEY RECOMMENDATIONS FROM 2015 HAZARD MITIGATION PLAN

| CATEGORY OF ACTION | RECOMMENDATION | HAZARD |
|---|---|---|
| Structural, protection | Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts, particularly to reconfigure the southern jetty at Lake Tashmoo to provide better protection for the town mooring field and private boatyard in the pond; vegetation management for dune restoration. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge |
| Structural | Dredging in the harbor to provide better access to critical harbor facilities in the event of a storm and for storm damage prevention. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge |
| Structural | Retrofit main sewer pump station and generator in town parking lot on Water St. for storm resiliency and sea level rise. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Structural | Retrofit sewer pump station in Steamship Authority (SSA) lot for resiliency. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Prevention | Develop a prognosis and suitable plan for Beach Road and the adjacent seawall. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Prevention | Ensure that outdoor storage materials are secured from creating a flood hazard. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Structural | Reduce flood impacts by identifying and correcting discharges from town and Commonwealth roadways where they cross streams, including: Smith Brook in Tisbury. The road surface at each crossing should be adjusted during repaving to divert as much runoff as possible into roadside vegetation before it reaches the road crossing. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |

| CATEGORY OF ACTION | RECOMMENDATION | HAZARD |
|---|---|---|
| Structural | Reduce damaging volume of direct stormwater discharges to beaches and surface waters by infiltration of those segments of the systems where infiltration is possible back in the watershed | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Prevention | In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines. | Drought, Fire |
| Structural | In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest | Drought, Fire |
| Structural | In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. The Town of Tisbury, nearly at buildout, should focus its attention on redundancy plans in response to potential emergencies such as drought or wildfire. | Drought, Fire |
| Structural | Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire; build the necessary infrastructure. | Drought, Fire |
| Structural, prevention | Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Adaptation | Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |

**SOURCE:** Hazard Mitigation Plan For Seven Towns in Dukes County 2015

# EXISTING PROTECTIONS FROM 2015 HAZARD MITIGATION PLAN

| TYPE OF EXISTING PROTECTION | DESCRIPTION | HAZARD |
|---|---|---|
| Town participation in the National Flood Insurance Program (NFIP) | Provides flood insurance for structures located in flood-prone areas. | Hurricanes and Nor'Easters, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Floodplain District Zoning Bylaw | Requires Flood Plain Permit for new construction, substantial improvement; addition of increased water, electric or septic systems to conform to rules and regs of Board of Health; alteration of landforms by Special Permit from ZBA; within V-Zone new construction to be located landward of Mean High Water; within AO zones residential structures elevated. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Coastal District DCPC (District of Critical Planning Concern) | height and construction standards for inland zone, including site plan review, may be modified by special permit from ZBA; no residential construction in shore zone; Special Permit by ZBA in shore zone for nonresidential structures or for additions to existing residential structures < 500 sf with no increase in plumbing or septic; septic 200' from salt water body; minimum separation 200' between septics; septics at least 5' above groundwater; septics 600' from public water supply and 200' from private well; private well 200' from salt water body; no road > 10' except by special permit. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Lagoon Pond DCPC | Density restrictions; pier regulations. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Fire Wise Outreach | Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response. | Fire |
| Structural protection, emergency services | Relocation of Fire/Ambulance Departments out of floodplain | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Emergency Services | Land purchase for new Emergency Services facility out of floodplain. | Hurricanes and Nor'Easters, Sea Level Rise, Coastal Flooding, Storm Surge, Intense Rain/Flooding |
| Structural, protection | Hardened utilities – electric lines on Main St, Union St., Beach St., and Water St. | All Hazards |
| Emergency Services | Generator for Tisbury School, which is the primary shelter in town. | All Hazards |
| Emergency Services | foam trailer for fighting ethanol-based fires. | Fire |

**SOURCE:** Hazard Mitigation Plan For Seven Towns in Dukes County 2015

# COUNTY WIDE GOALS FROM 2015 HAZARD MITIGATION PLAN

- Protect critical public facilities and services from damage due to natural hazards.
- Ensure that critical infrastructure is protected from natural hazards.
- Promote strong natural shore defenses such as coastal beaches and dunes.
- Improve circulation for tidally restricted harbors, ponds and marshes.
- Develop programs and measures that protect residences and other structures from natural hazards.
- Develop mitigation strategies that consider area businesses, including marinas, and protect the economic vitality of the region.
- Protect and preserve irreplaceable cultural resources, particularly for recreation, located in hazard-prone areas.
- Support the communities with information concerning hazard mitigation funding opportunities, and assist the communities in the identification and development of specific mitigation projects.
- Increase each town's capacity for responding to a natural hazard event by promoting the adequate provision of emergency services capabilities.
- Increase awareness and support for natural hazard mitigation among municipalities, private organizations, and area residents through outreach and education.
- Discourage future development in vulnerable areas and encourage restoration of vulnerably-developed properties to more natural and defensible conditions or to open space.
- Reduce vulnerability to drought, by improving water supply infrastructure and by encouraging conservation measures such as low-maintenance landscaping.
- Support greater resiliency by developing and implementing climate change adaptation strategies.

**SOURCE:** Hazard Mitigation Plan For Seven Towns in Dukes County 2015

# Attachment C: Tisbury Base Maps

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# Legend

## Critical Infrastructure Category

- Beach
- Ferry Terminal
- Fire Station
- Info Center
- Landfill
- Library
- Lighthouse
- Medical Facility
- Park-n-Ride
- Police Station
- Public Restroom
- School
- Town Hall
- Waste/RecycleTransfer Station
- Wastewater Treatment Plant

## Features

- Town Boundary
- Structures*
- Coastline

## Flood Hazard Area

**eff. 07/20/2016**

- 100 Year Flood Area (AE Zone)
- 100 Year Flood Area (VE Zone)
- 500 Year Flood Area
- Area of minimal flood hazard

Structure may be house, shed, garage, business, etc.

N W E S

Vineyard Sound

Lake Tashmoo

Lagoon Pond

WEST TISBURY

OAK BLUFFS

TISBURY OAK BLUFFS

IROQUOIS AVENUE
ALGONQUIN AVENUE
MAIN STREET
GOLF CLUB ROAD
FRANKLIN STREET
GOFF ROAD
MITCHELL ROAD
HILLTOP ROAD
BIGELOW ROAD
ASHTON'S WAY
CONNIES WAY
COVE ROAD
HOLLY TREE LANE
PINE TREE LANE
OLD LIGHTHOUSE ROAD
BERNARD CIRCLE
LEWETT LANE
CHAPPAQUONSETT ROAD
SANDPIPER LANE
BETTYS LANE
FAIRFIELD AVENUE
HATCH ROAD
MEADOW LANE
STONEGATE LANE
DAGGETT AVENUE
HARDING ROAD
TASHMOO AVENUE
FRANKLIN TERRACE
HYSLEF WAY
IRENE'S WAY
GREENWOOD AVENUE
NORTH WILLIAM STREET
JUNIPER PLACE
OSPREY LANE
BEACH ROAD
MAYRAND WAY
CLOUGH LANE
DRUMMER LANE
CHURCH STREET
CENTRE STREET
PINE STREET
PILOT HILL FARM ROAD
KENNEBAGO AVENUE
ARMY ROAD
NORTHERN PINES ROAD
CHRISTMAS HILL LANE
PILOT HILL LANE
ELECTRIC ROW
KINGS WAY
SPRING STREET
LOOK STREET
CAUSEWAY ROAD
PAGE WAY
WATER GATE ROAD
PAULA AVENUE
JOHN HOFF ROAD
LAMBERTS COVE ROAD
PASTURE GATE ROAD
WEST SPRING STREET
PINE TREE ROAD
FOSTER AVENUE
EEL LANE
ROGERS FARM ROAD
COOK STREET
EVELYN WAY
MECHANIC STREET
HIGH POINT LANE
SKIFF AVENUE
BURTS WAY
HINES POINT
MAYFLOWER LANE
MICHAEL'S WAY
WINNYAH CIRCLE
WINNYAH LANE
MAURA WAY
WEAVER LANE
CANTERBURY LANE
CLOVER HILL DRIVE
HILLSIDE PATH
ELM STREET
LAGOON AVENUE
CRONIG AVENUE
BORDER ROAD
RED COAT HILL ROAD
STONEY HILL ROAD
HEAD OF THE POND ROAD
CHECAMO PATH

0 0.25 0.5 1 Miles

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# Tisbury, MA
# Critical Infrastructure and FEMA Flood Zones

Date: 10/11/2018

Figure 1

# Legend

## Critical Infrastructure Category

- Beach
- Ferry Terminal
- Fire Station
- Info Center
- Landfill
- Library
- Lighthouse
- Medical Facility
- Park-n-Ride
- Police Station
- Public Restroom
- School
- Town Hall
- Waste/RecycleTransfer Station
- Wastewater Treatment Plant

## Features

- Town Boundary
- Structures*
- Coastline

## Hurricane Surge Inundation (Flooding)

**(Worst Case Scenario as of 2013 draft USACE)**

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

Structure may be house, shed, garage, business, etc.

N W E S

Vineyard Sound

Lake Tashmoo

Lagoon Pond

TISBURY
OAK BLUFFS

WEST TISBURY
OAK BLUFFS

IROQUOIS AVENUE
ALGONQUIN AVENUE
MAIN STREET
GOLF CLUB ROAD
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LAMBERTS COVE ROAD
PASTURE GATE ROAD
MAYFLOWER LANE
RED COAT HILL ROAD
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DRUMMER LANE
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EVELYN WAY
HIGH POINT LANE
MICHAEL'S WAY
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MAURA WAY
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0 0.25 0.5 1 Miles

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# Tisbury, MA
# Critical Infrastructure and Hurricane Surge Inundation

Date: 10/11/2018

Figure 2

## Legend

### Critical Infrastructure Category

- Beach
- Ferry Terminal
- Fire Station
- Info Center
- Landfill
- Library
- Lighthouse
- Medical Facility
- Park-n-Ride
- Police Station
- Public Restroom
- School
- Town Hall
- Waste/RecycleTransfer Station
- Wastewater Treatment Plant

### Features

- Town Boundary
- Structures*
- Coastline

### Sea Level Rise

**(based on LiDAR Elevation)**

- <=1ft
- >1ft to 2ft
- >2ft to 3ft
- >3ft to 4ft
- >4ft to 5ft
- >5ft to 6ft
- >6ft to 7ft
- >7ft to 8ft
- >8ft to 9ft
- >9ft to 10ft

*Structure may be house, shed, garage, business, etc.

N
W
E
S

Vineyard Sound
Lake Tashmoo
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TISBURY
OAK BLUFFS
WEST TISBURY
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BERNARD CIRCLE
JEWETT LANE
CHAPPAQUONSETT ROAD
SANDPIPER LANE
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ELECTRIC ROW
PILOT HILL LANE
WATER GATE ROAD
PAGE WAY
KINGS WAY
SPRING STREET
COOK STREET
CAUSEWAY ROAD
PAULA AVENUE
JOHN HOFT ROAD
LAMBERTS COVE ROAD
PASTURE GATE ROAD
WEST SPRING STREET
PINE TREE ROAD
FOSTER AVENUE
EEL LANE
ROGERS FARM ROAD
COOK STREET
HINES POINT
SKIFF AVENUE
BURTS WAY
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# Tisbury, MA
# Critical Infrastructure and Sea Level Rise

Date: 10/11/2018

Figure 3

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