Targeted Vulnerability Assessment of
Low-Lying Roadways in the Town of Eastham, Massachusetts

June 2020

Prepared for:
Town of Eastham
2500 State Highway
Eastham, MA, 02642

Prepared by:
Woods Hole Group
A CLS Company
107 Waterhouse Road
Bourne, MA 02532 USA
(508) 540-8080

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1.0 INTRODUCTION

Given its geographic location on the Outer Cape, the Town of Eastham is particularly vulnerable to coastal storm impacts, coastal erosion, and coastal flooding. Coastal storms and high winds in the Town of Eastham result in frequent power outages, downed power lines and utility poles, and extensive tree damage. Increased frequency and intensity storm events have exacerbated rates of erosion along the Eastham shoreline within the Cape Cod National Seashore and along the Cape Cod Bay beaches, resulting in unprecedented impacts to coastal bank, coastal dune, and salt marsh resource areas. Coastal flooding of public and private property, once an infrequent occurrence, now renders high-traffic roadways in the Town of Eastham impassible on higher-high and/or storm tides, creating a very real public safety concern. The Town is also concerned about the present day and future risk that coastal flooding and erosion pose to coastal resource areas located along low-lying sections of roadway, including the stability of roadway side slopes (particularly those that terminate in salt marsh resource areas), undersized culverts, municipal beach and harbor parking lots, new municipal water main infrastructure and landward-migrating salt marsh. Specific vulnerabilities facing the Town of Eastham include:

- *Numerous low-lying roadways within FEMA AE and VE designated flood zones.*
- *Vulnerable infrastructure: culverts, utilities, shellfishing grants, Town parking areas, etc.*
- *Actively eroding shorelines (Cape Cod National Seashore and Cape Cod Bay).*
- *Threatened salt marsh resource areas located in Areas of Critical Environmental Concern.*

These vulnerabilities have prompted the Town to take decisive action. In 2019, the Town of Eastham applied for and secured grant funding through the Massachusetts Coastal Zone Management (CZM) Office Coastal Resilience Grant Program to perform a targeted vulnerability assessment of low-lying roadways. Leading up to the project, Town officials expressed concern about:

- *The risks flooded roadways pose to public safety.*
- *The ability to access public and private property to secure assets as storms approach.*
- *The ability to evacuate or access community sheltering facilities once a storm arrives.*
- *The ability for emergency personnel and utility crews to respond in an emergency.*

The 4 low-lying roadways included in this initial scope were: Samoset Road, Bridge Road, Dyer Prince Road, and Smith Lane (Figure 1). The purpose of the assessment was to develop a better understanding of site-specific vulnerabilities, risks associated with sea level rise and coastal storm impacts, and alternatives to improve the long-term resilience of municipal infrastructure, positioning the Town to move forward with engineering solutions to improve the resilience of low-lying roadways.

1.1 ACKNOWLEDGEMENT OF FUNDING

The Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham project was funded by a $149,014 Massachusetts CZM Coastal Resilience Grant awarded to the Town of Eastham. The CZM Coastal Resilience Grant Program is designed to: *provide financial and technical support for local and regional efforts to increase awareness and understanding of climate impacts, identify and map vulnerabilities, conduct adaptation planning, redesign and retrofit vulnerable public facilities and infrastructure, and restore shorelines to enhance natural resources and provide storm damage protection.* The Woods Hole Group assisted the Town of Eastham in the completion of all project Tasks. The project included extensive collaboration between Town Conservation Department, Department of Public Works, Planning Department, Fire Department and Police Department officials, Massachusetts CZM staff, and Woods Hole Group Scientists and Engineers.

Figure 1. **Locus map of vulnerable low-lying roadway sites in the Town of Eastham, MA.**

1.2 MUNICIPAL PLANNING EFFORTS

The low-lying roadways included in the targeted vulnerability assessment project were identified during previous planning efforts undertaken by the Town of Eastham: the Municipal Vulnerability Preparedness (MVP) certification process, the Hazard Mitigation Planning process, and the Municipal Harbor and Waterways planning process. Each planning effort recognized ongoing problems at each site relative to nuisance and storm flooding as well as the need to investigate alternatives to improve resilience. Planning efforts that prompted the most recent CZM-funded vulnerability assessment are summarized below.

Municipal Vulnerability Preparedness

In January 2019, the Town of Eastham hosted an eight-hour MVP workshop facilitated by the Cape Cod Commission. The workshop identified coastal erosion, coastal flooding, and high wind events as the top three hazards impacting the Town. The workshop and subsequent report identified coastal flooding as the hazard having the greatest direct impact on the Town of Eastham, both currently and in the recent past, particularly the impact of flooding on local and regional roadways. The targeted vulnerability assessment project addressed three of the six *Areas of Concern* identified during the MVP workshop as detailed in the MVP summary report. Site-specific concerns detailed during the MVP workshop are summarized below:

- ***Transportation:*** *"Bridge Road by Boat Meadow and Herring River and Eastham/Orleans rotary; other low-lying roads … Dyer Prince Road, and private roads." "Flooding along Bridge Road and Eastham/Orleans rotary limits access to emergency medical facilities and results in lack of egress options during flooding with limited evacuation transportation routes."*
- ***Public Amenities/Facilities:*** ***"****Town beach parking lots and amenities- concerns about loss of parking facilities and access due to increased flooding and erosion".*
- ***Neighborhoods:*** *"Bayside coastal development is vulnerable to flooding and erosion; senior population town-wide lack of access to communication, seasonal property owners lack of contact information for emergency notification."*

The top recommendation identified through the MVP process was also supported by the targeted vulnerability assessment:

- *"Improve the resilience of Smith Lane and Bridge Road to flooding. Workshop participants agreed that Bridge Road and Smith Lane flooding presents a significant transportation impediment. While raising the road appears to be a solution, the group felt that the Town needs to conduct a feasibility study to understand potential impacts, costs, and other considerations of elevating the road as well as identifying other alternatives for mitigating the flooding."*

Hazard Mitigation Planning

In conjunction with the MVP certification process, the Town of Eastham prepared a comprehensive Hazard Mitigation Plan to improve the Town's resilience to climate change impacts and natural hazards. The Hazard Mitigation planning effort is outlined below:

> *The purpose of hazard mitigation is to reduce loss from future natural disasters. Storms and other natural disasters can cause loss of life, damage to buildings and infrastructure, and have devastating consequences to a community's economic, social, and environmental well-being. One step towards reducing loss in a community is to have a plan for the future…The purpose of the Eastham Hazard Mitigation Plan is to reduce damages resulting from natural hazards by implementing sustained actions to reduce or eliminate long-term risk to human life and property from hazards. The Eastham Hazard Mitigation Plan also helps build a successful, long-term outreach strategy to educate residents about natural hazards that could affect the Town, to prepare them in case a storm impacts the Town, and create a resilient Town that can recover after a storm event.*

Municipal Harbor and Waterways Plan

In 2018, the Town of Eastham received funding from the Massachusetts Seaport Economic Council to develop a Harbor and Waterways Management Plan focused on assessing and improving access to the Town landings and Rock Harbor. The plan included a comprehensive engineering assessment of landing infrastructure and recommendations to improve the resilience of Town landings and approaches to sea level rise (SLR) and coastal storm impacts. Notably, Strategic Objective #1 in the Harbor and Waterways Management Plan recommended: maintaining and improving the Town's existing infrastructure, access points, and natural resource areas.

1.3 EXISTING CONDITIONS

The targeted vulnerability assessment of low-lying roadways project focused on four acutely vulnerable roadways: Samoset Road, Bridge Road, Dyer Prince Road, and Smith Lane. Existing conditions, recent coastal impacts, and the scope of work are descried below.

Samoset Road extends from Herring Brook Road to First Encounter Beach, providing access to over 100 dwellings that are currently impacted by coastal flooding (Figure 2). A total of 81% of this section of roadway is located within in a FEMA AE Zone. Samoset Road is already experiencing acute climate impacts. In one particularly low-lying area, the road floods during higher high tides and minor to moderate coastal storms. In this frequently flooded area, the roadway has become undermined and needs immediate attention by the Department of Public Works (DPW). In the past, the DPW has placed stone and other filler materials to prevent the road from undermining, but it has become apparent that the roadway is in the beginning stages of failure. This area along with the roadway directly abuts densely vegetated low salt marsh within a designated Area of Critical Environmental Concern (ACEC). Samoset road also provides access to culturally and recreationally important First Encounter Beach, located at 1620 Samoset

Road. First Encounter Beach provides ample beach parking for recreational use, serves as the primary access point for 28 acres of commercial shellfish grants, and is also a historically significant site to the Commonwealth of Massachusetts. The beach is also an important habitat to wildlife and is monitored annually for plover and diamond-backed terrapin nesting activity. As such, Samoset Road experiences a significant amount of traffic throughout the year, and repairs to this roadway are imminently needed. The Town would like to ensure the repairs allow for continued access to public and private property, avoid impacts to salt marsh, and allow flood waters to drain quickly, avoiding impacts to adjacent coastal resource areas.

Figure 2. **Calm and flood conditions along Samoset Road. Frequently inundated sections of roadway are at imminent risk of failure.**

Bridge Road is a primary north-south thoroughfare for the Town of Eastham. Whenever State Highway Route 6 is closed or congested, Bridge Road becomes the alternate (and only) route to Orleans, the Mid-Cape area, and regional hospitals (Figure 3). The importance of Bridge Road as an alternate route became apparent when a significant rain event flooded Route 6 and high winds felled a large power line on August 9, 2018. Eastham received the highest storm total rainfall at 8.0 inches. Traffic immediately was at a standstill for several hours as sections of Bridge Road also flooded, cutting off a secondary evacuation route. Bridge Road also contains a bridge and causeway that spans a low-lying salt marsh. The seaward side of the bridge is within the FEMA VE Zone. During recent coastal storms, the bridge was inundated, and wave action directly impacted the roadway surface and associated municipal infrastructure and utilities. Flooding from recent winter storms also deposited large chunks of pack ice on the roadway that required removal by the DPW using heavy machinery during the storm. This type of emergency response puts municipal personnel at risk to ensure the roadway remains passable. The Town is focused on improving the resilience of areas surrounding the causeway and bridge while minimizing impacts to the adjacent salt marsh, located in an ACEC. It is important to the Town that the

roadway remain passable at all times for emergency purposes, that floodwaters drain from the area quickly, and that wildlife, including State-listed diamond-backed terrapins, can move through the area safely.

Figure 3. Calm and flood conditions along Bridge Road.

Dyer Prince Road is a 0.8-mile-long section of roadway that provides the only access to Rock Harbor through the Town of Eastham (Figure 4). Two 30-inch culverts under the roadway provide the only linkage between Rock Harbor and adjacent salt marsh resources north or the roadway. Although the culverts were recently replaced in-kind, the road is frequently overtopped causing the roadway surface to flood and rendering Dyer Prince Road impassible. The Town is interested in having the size and functionality of both culverts evaluated to determine if the structures need to be resized to provide sufficient continuity and drainage. A total of (12) private dwellings and the Town harbor and dockage facility are situated beyond the first culvert, with 92% of said properties located within the FEMA AE Zone. An additional (24) private dwellings and conservation easements have and will continue to be impacted by overtopping and associated

flooding along Dyer Prince Road. Failing to improve the resilience of Dyer Prince Road may result in more restricted access to public and private property, including commercial fishing assets at Rock Harbor. As sea levels continue to rise, it will be imperative to adapt the roadway to coastal storm impacts while improving the resilience of adjacent coastal resource areas. The Town is particularly concerned with improving the resilience of Dyer Prince Road prior to investing in improvements to Rock Harbor, as identified during the Municipal Harbor and Waterways planning process.

Figure 4. Calm and flood conditions along Dyer Prince Road. Roadway particularly vulnerable to flooding adjacent two existing culverts.

Smith Lane is a smaller side road that intersects Rock Harbor Road at the Orleans Rotary (Figure 5). Smith Lane is located entirely within the FEMA AE Zone. The road services a Town-owned conservation area, (2) dwellings, and the WildCare facility – a wildlife rehabilitation center. Beneath Smith Lane, an undersized culvert provides connectivity between significant salt marsh resource areas and the upper reaches of Boat Meadow creek. The Town has received concerns about limited access after significant rain events and moderate coastal storms. Given the proximity to Route 6 and the importance of maintaining salt marsh connectivity, the Town would like to ensure continued access to public and private property and better understand implications of flooding adjacent Route 6, which is a major transportation artery for the Outer Cape. The Town also has an interest in improving conditions within the hydrologically restricted side of the salt marsh to improve overall resilience and buffering capacity.

Figure 5. Calm and flood conditions along Smith Lane.

1.4 SCOPE OF WORK

To assist the Town of Eastham in improving the resilience of low-lying roadways, the Woods Hole Group completed the following Tasks:

Task 1 – Data Collection and Feature Identification

- Establish study parameters and data sets relative to current and future tidal, sea level rise and storm surge scenarios at each of the locations described above.
- Identification of public and private assets along Dyer Prince Road, Bridge Road, Samoset Road, and Smith Lane.
- Collection of tidal data, identification of regulations and/or restrictions relative to proposed improvements.
- Identify parcel ownership.
- Development of education and outreach materials describing project goals, objectives, and long-term public benefits of proposed alternatives.

Task 2 – Conduct Vulnerability Assessment

- Develop GIS-based inundation maps and figures for Dyer Prince Road, Bridge Road, Samoset Road, and Smith Lane showing areas of inundation for the present day, 2030, 2050, and 2070 planning horizons.
- Develop site-specific maps for each roadway to assist the municipal project team in prioritizing action across each of the sites.
- Generate a consequence scoring matrix illustrating roadway priority.

- Generate asset risk profiles for individual assets identified by the Town of Eastham.
- Host a public meeting to introduce inundation maps and figures and solicit feedback from stakeholders.

Task 3 – Development of Adaptation Strategies and Reporting

- Utilize data and analysis from previous Tasks to develop a suite of alternatives that could be used to improve the resiliency of vulnerable assets.
- Determine relative timelines for implementation, general permitting requirements and constraints, and preliminary costs for alternatives.
- Host a public meeting to review conceptual design imagery and solicit feedback from stakeholders.
- Draft a technical report and conceptual design imagery for each alternative.

2.0 DATA COLLECTION AND FEATURE IDENTIFICATION

The first step in the low-lying roadways vulnerability assessment was to establish study parameters and assemble supporting data to inform the roadway assessment and development of asset risk profiles. Tide gauge data, roadway topography, and asset locations and elevations were collected in the field. Individual assets along each section of low-lying roadway were identified by the municipal project team along with a summary of municipal regulations and/or restrictions relative to potential future improvements. A database of parcel ownership along each section of roadway was also developed to initiate the stakeholder engagement process. Once all data collection Tasks were complete, the municipal project team worked to establish a project website, and interface with local press prior to the first public meeting. The data collection process and results are outlined in the following sections.

2.1 TIDAL DATA

To develop a better understanding of the hydrodynamics influencing the Rock Harbor, Boat Meadow, and First Encounter salt marsh systems, a series of 7 tide gauges (Eastham 1-7) were deployed from November – December 2019, capturing a full, monthly tidal cycle (Figure 6). Tide gauge Eastham 1 was deployed near the mouth of Rock Harbor and was used to document tidal fluctuations in Cape Cod Bay (as closely as possible) that drive changing water levels in all 3 marsh systems. Tide gauges Eastham 2 and 3 were deployed further upstream in the Rock Harbor system, upstream of each culvert under Dyer Prince Road. Tide gauges Eastham 4, 5, and 6 were deployed upstream of the Bridge Road bridge span, downstream of the Cape Cod Rail Trail culvert, and downstream of the Smith Lane culvert, respectively. Tide gauge Eastham 7 was deployed in First Encounter marsh abutting Samoset Road. Monthly tidal curves for Rock Harbor Creek, Boat Meadow Marsh, and First Encounter Marsh are provided in Figures 7, 8, and 9. Tide gauges Eastham 1-7 are abbreviated EH 1-7 in Figures 7, 8, and 9.

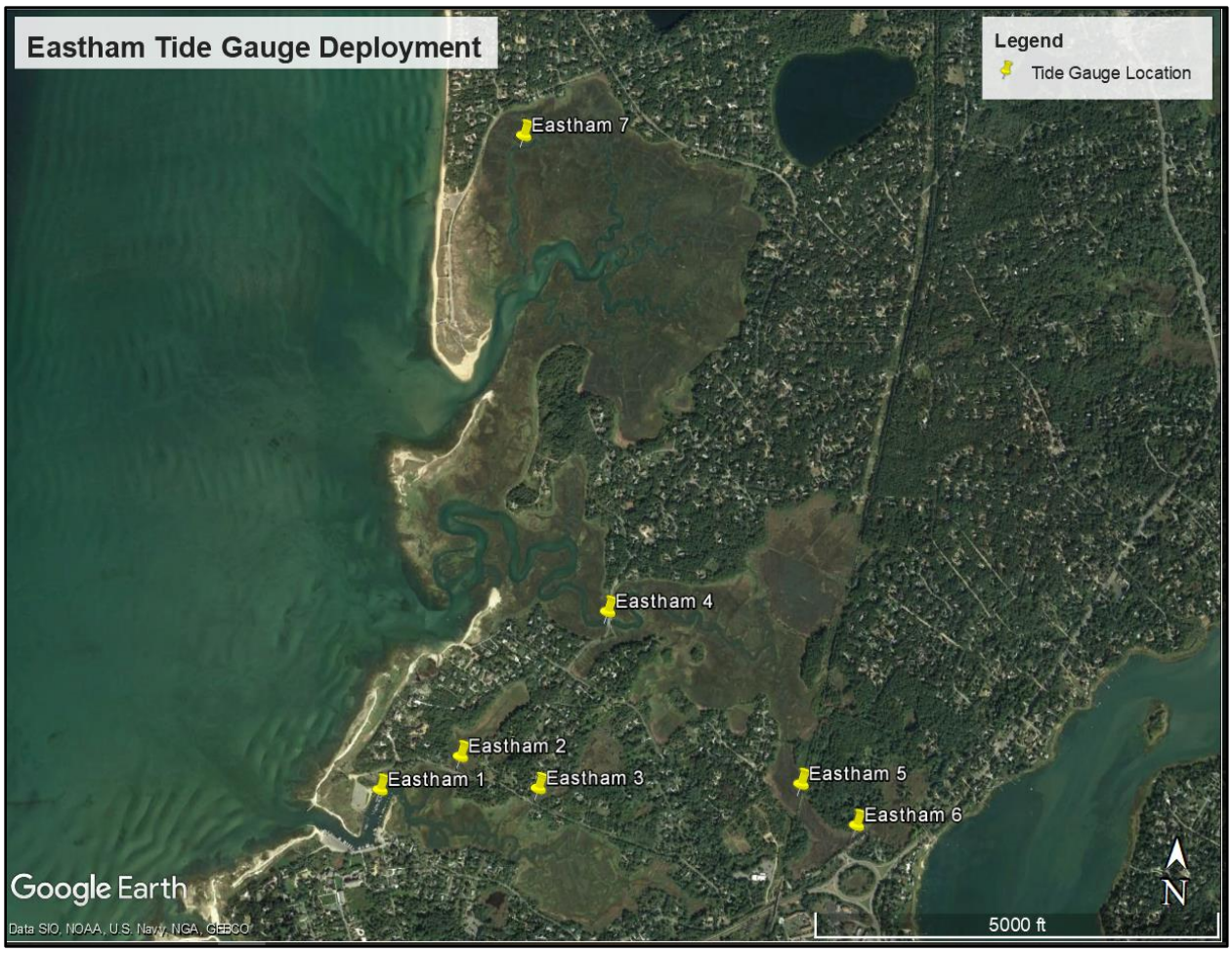


Figure 6. Eastham tide gauge locations.

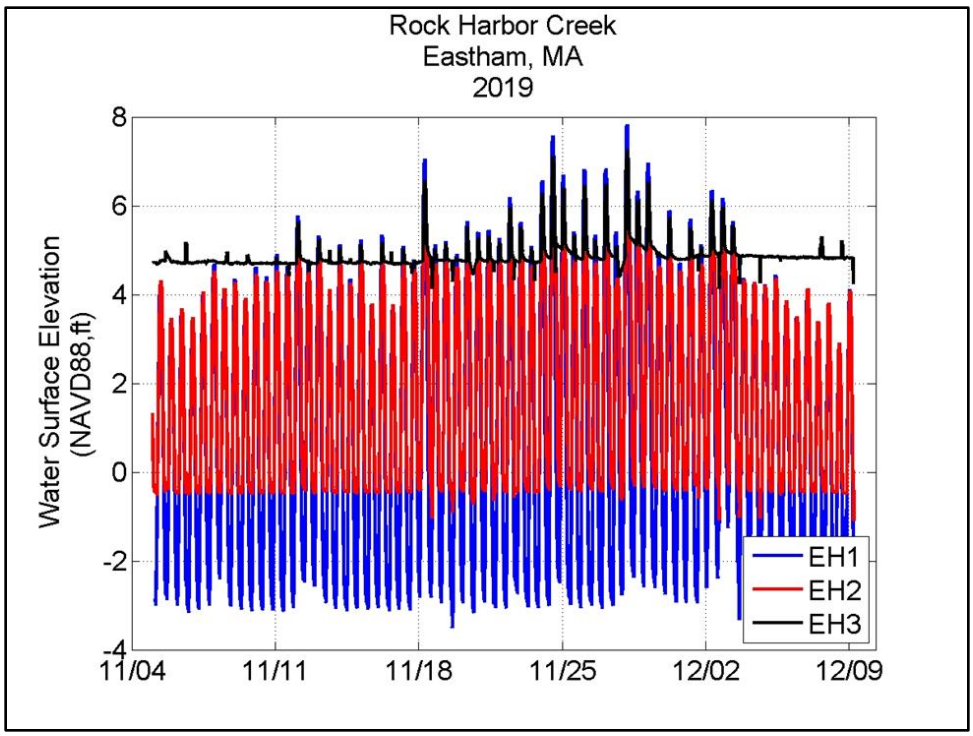


Figure 7. Rock Harbor Creek tidal dataset.

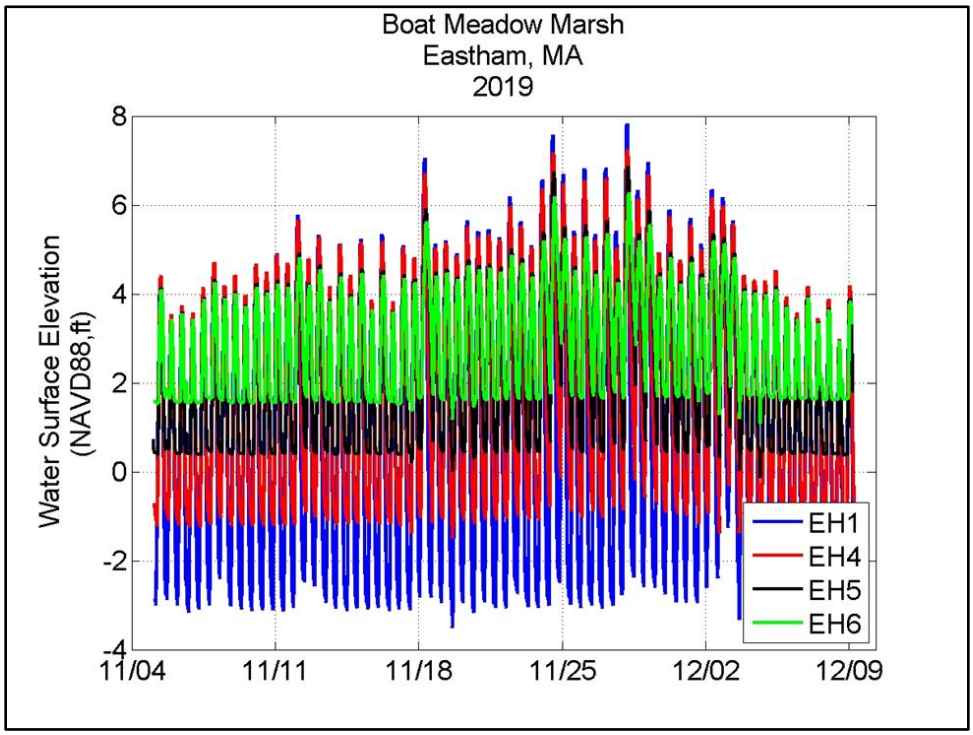


Figure 8. Boat Meadow Marsh tidal dataset.

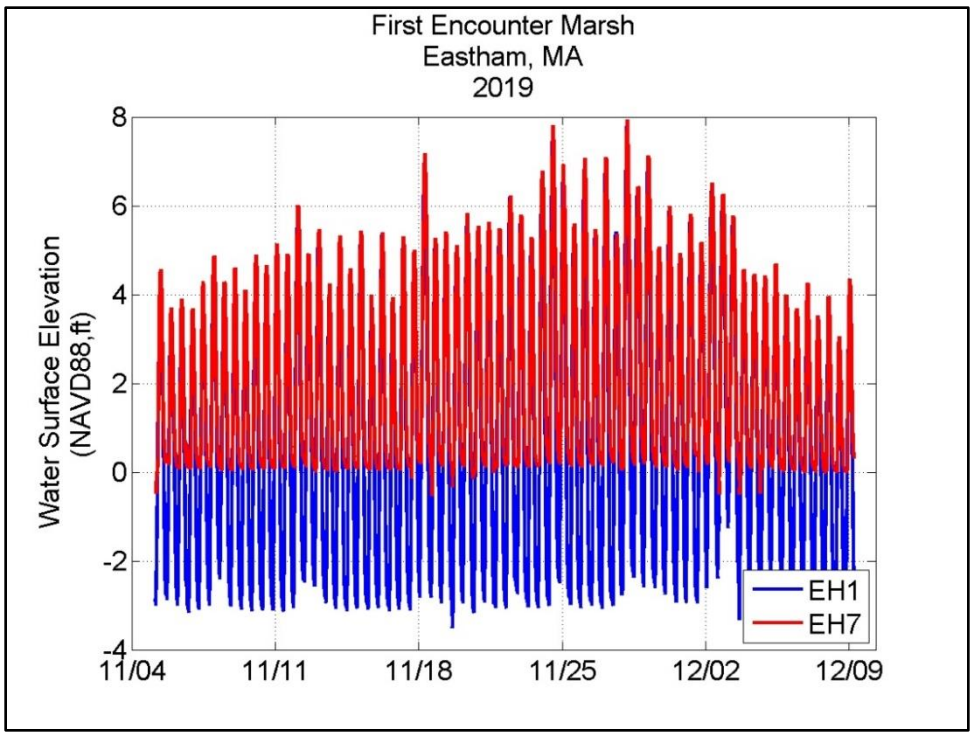


Figure 9. First Encounter Marsh tidal dataset.

Eastham 1 documented regular tidal fluctuations between approximate elevations ~ (-2.0) and 8.0 NAVD88. Eastham 2 and 3 mirrored the high tides observed at Eastham 1, but did not allow the upstream marsh systems to drain effectively. Consequently, the lowest water levels observed at Eastham 2 and Eastham 3 were approximately ~ (-0.5) and 4.5 NAVD88, respectively. Eastham 4, located adjacent the Bridge Road bride, mirrored the high tide conditions observed at Eastham 1, but only drained to approximately ~ (-1.0) NAVD88. Further upstream, there appears to be a tidal restriction in the Boat Meadow system between Eastham 4 and Eastham 5, where observed high water levels were approximately 0.5' NAVD88 below the observed high-water levels at Eastham 4. Low water levels at Eastham 5 never drained below 0.5 NAVD88. Eastham 6 mirrored the high tide conditions at Eastham 5, but never drained below 1.5 NAVD88. Eastham 7 mirrored high tide conditions at Tide Gauge 1, but never drained below 0.0 NAVD88.

2.2 ASSET IDENTIFICATION

Prior to conducting site surveys, the municipal project team identified existing Town assets, utilities, and resources located along Dyer Prince Road, Bridge Road, Samoset Road, and Smith Lane. A total of 9 asset categories and roadway characteristics were identified for Smith Lane, 14 asset categories and characteristics for Dyer Prince Road, 13 asset categories and characteristics for Bridge Road, and 10 asset categories and characteristics for Samoset Road (Tables 1-4). Based on this feedback, Woods Hole Group identified and surveyed a total of 242 individual assets (utility poles, culverts, water gates, catch basins etc.) across the low-lying roadway sites. A complete list of all asset locations and elevations for each roadway is included in Appendix A.

Table 1. **Asset categories and roadway characteristics for Smith Lane.**

Smith Lane / Rt. 6
Catch Basins
Electrical Utility Poles
Evacuation Route / Access to Residential Dwellings
Gas Utility Infrastructure
Primary Town-Wide Evacuation Route
Roadway Surface
Salt Marsh Resource Areas
Telephone Utility Infrastructure
Water Main Infrastructure

Table 2. **Asset categories and roadway characteristics for Dyer Prince Road.**

Dyer Prince Road
Access to Boat Ramp
Access to State Parking Area
Access to Town Beach Parking
Access to Town Docks
Catch Basins
Culvert 1 (Large)
Culvert 2 (Small)
Electrical Utility Poles
Evacuation Route / Access to Residential Dwellings
Gas Utility Infrastructure
Roadway Surface
Salt Marsh Resource Areas
Telephone Utility Infrastructure
Water Main Infrastructure

Table 3. Asset categories and roadway characteristics for Bridge Road.

Bridge Raod
Evacuation Route / Access to Residential Dwellings
Access to Town Beach Parking
Bridge Superstructure
Catch Basins
Culvert 1 (Small-with connectivity)
Electrical Utility Poles
Gas Utility Infrastructure
Raised Utilities (over bridge)
Roadway Surface
Salt Marsh Resource Areas
Secondary Town-Wide Evacuation Route
Telephone Utility Infrastructure
Water Main Infrastructure

Table 4. Asset categories and roadway characteristics for Samoset Road.

Samoset Road
Evacuation Route / Access to Residential Dwellings
Access to Town Beach Parking
Access to Town Shellfishing Resources
Catch Basins
Electrical Utility Poles
Gas Utility Infrastructure
Roadway Surface
Salt Marsh Resource Areas
Telephone Utility Infrastructure
Water Main Infrastructure

2.3 SITE SURVEY AND EXISTING CONDITIONS PLANS

Over 4 days in the field, the Woods Hole Group conducted a comprehensive site survey of the 4 low-lying roadway sites. Per consultation with Massachusetts CZM, edge of pavement survey points and roadway centerline survey points were shot at 50 linear foot intervals to develop precise topography along each low-lying roadway. In addition to topographic points, the survey also captured the 242 individual assets referenced above. The existing conditions plans developed as part of this initial targeted vulnerability assessment have positioned the Town well as it advances through the requisite planning stages and towards the design-engineering phase. For reference, the existing conditions plan sheet for Bridge Road is included in Figure 10. The complete set of existing conditions plans for all low-lying roadways is included in Appendix B.

To supplement the existing conditions plans, the Town Planning Office identified existing property ownership along Smith Lane, Dyer Prince Road, Bridge Road, and Samoset Road providing a spreadsheet of all direct and indirect abutters. Indirect abutters refer to parcel owners located in neighborhoods that are only accessible via one of the 4 low-lying roadways included in this assessment. In total, 348 parcels were identified. The Town of Eastham utilized the database to send direct mailings to all direct and indirect abutters to advertise each public meeting held to present the results of the targeted vulnerability assessment. The parcel data prepared by the Town will also prove useful as the project advances toward the design phase, which will require open dialogue between municipal officials and abutters to secure any easements that may be required to improve the resilience of low-lying roadways. The extent of the parcel data query for Smith Lane, Dyer Prince Road, and Bridge Road is included in Figure 11. The extent of the parcel data query for Samoset Road is included in Figure 12. The complete list of direct and indirect abutters identified by the Town planning department is included in Appendix C.

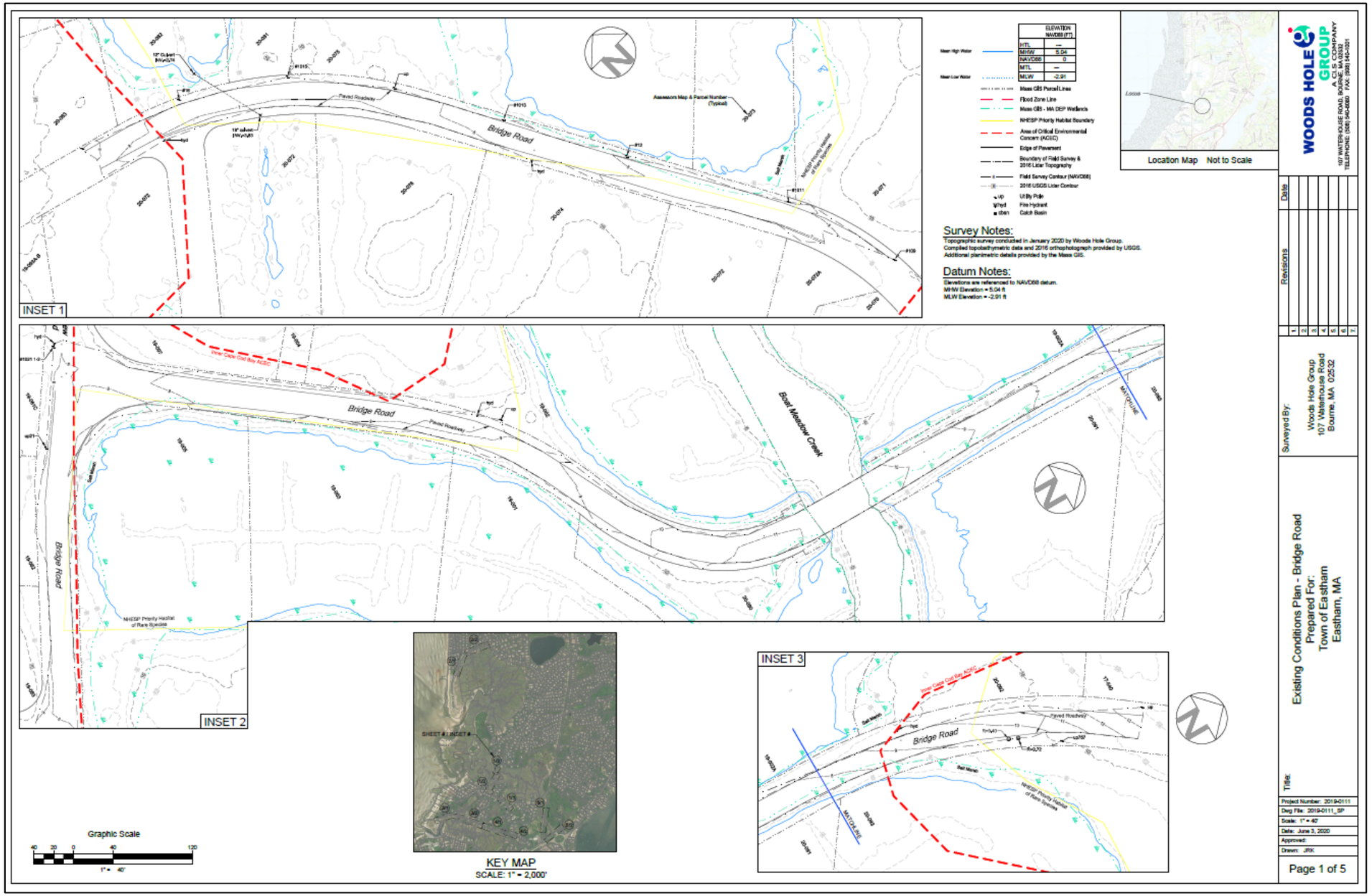


Figure 10. Bridge Road, Eastham, MA existing conditions plan sheet.

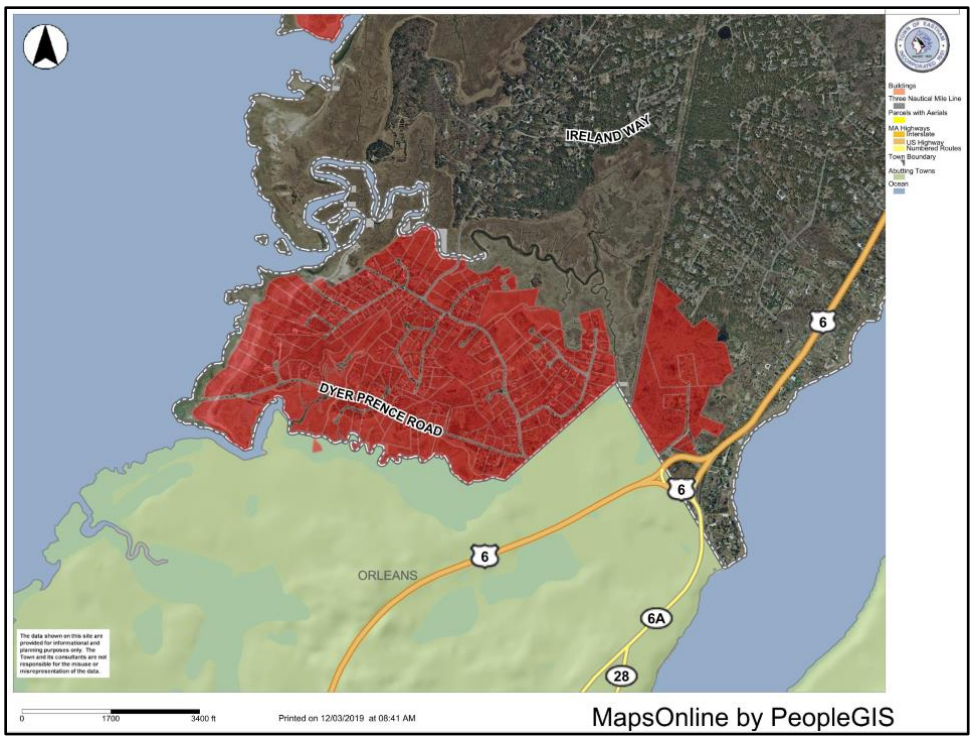


Figure 11. **Parcel query for Smith Lane, Bridge Road, and Dyer Prince Road indicated in red.**

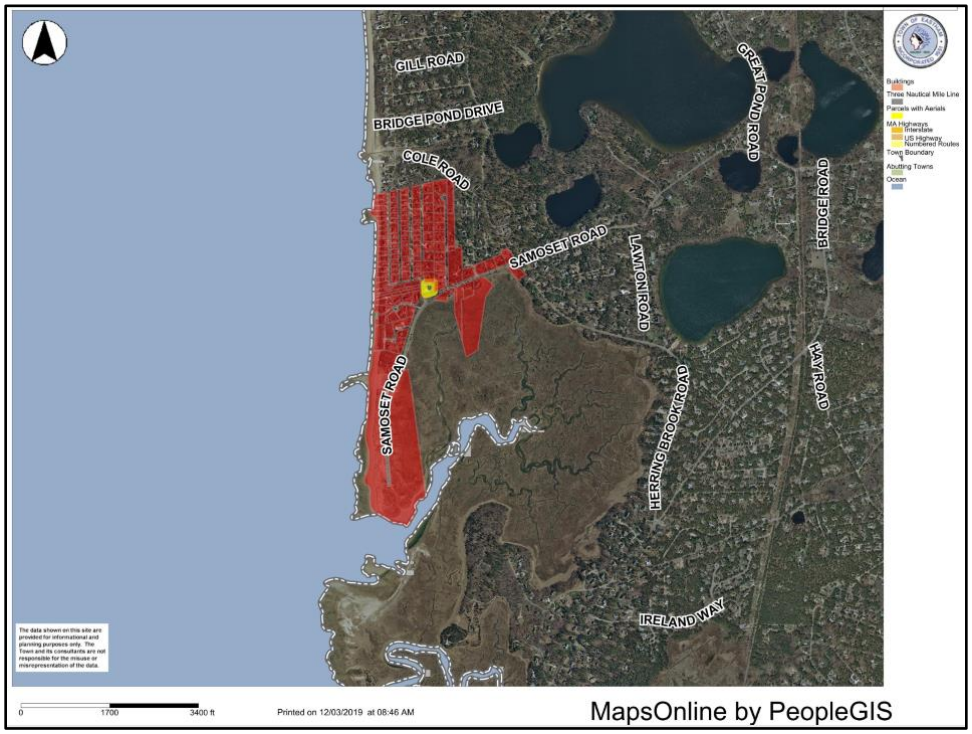


Figure 12. **Parcel query for Samoset Road indicated in red.**

2.4 REGULATIONS AND RESTRICTIONS RELATIVE TO ROADWAY IMPROVEMENTS

Prior to completing the assessment and developing alternatives to improve the resilience of low-lying roadways, the Town of Eastham Conservation Agent, DPW Director, and Planner reviewed existing Town bylaws and regulations to identify municipal permitting requirements or reviews that may be required to improve low-lying roadways. Town officials emphasized the following in their review:

- The **Conservation Agent** emphasized the need for Conservation Commission (Notice of Intent) filings for any improvements as well as compliance with existing Town Area of Critical Environmental Concern (ACEC) bylaw.
- The Town **DPW Director** cited the need for compliance with municipal stormwater regulations (which mirror State of Massachusetts Stormwater Standards), and the Town's existing MS4 comprehensive stormwater permit.
- The **Town Planner** did not anticipate the need for any review by the Town Zoning Board, so long as any future work was completed within existing rights-of-way and did not impact and public or private buildings.

Each municipal official supplied links to relevant documents and written summaries of their findings, which were reviewed by Woods Hole Group. Further documentation is provided in Appendix D.

2.5 MUNICIPAL OUTREACH AND EDUCATION

Early in the project, the Town Conservation Administrator established a project webpage on the Town of Eastham website to keep residents informed of project goals and objectives. Links to deliverables and presentation slides were added and updated regularly throughout the course of the project. In addition, municipal officials and Woods Hole Group staff remained in regular contact with the local press, generating publicity about the project, its goals, objectives, and impacts on public and private property. Articles published in the local press included features on the CZM Grant Award, inundation maps and figures to prioritize action between each of the low-lying roadways, and feedback received from stakeholders during the public meeting process. A screenshot of the municipal website and June 2020 article in the Provincetown Independent are included in Figure 13. Full-text articles from the Provincetown Independent are included in Appendix E. The project website can be accessed via the following link: https://www.eastham-ma.gov/conservation/news/low-lying-roadways-vulnerabilities-assessment-czm-coastal-resilience-grant-project

In addition to electronic resources, the municipal project team also distributed direct mailings to the ~350 abutters to generate interest in scheduled public meetings. Approximately 65 individuals participated in the 2 public meetings held during later phases of the project. The Town continues to cultivate dialogue and participation between abutters as the project advances towards the design phase.

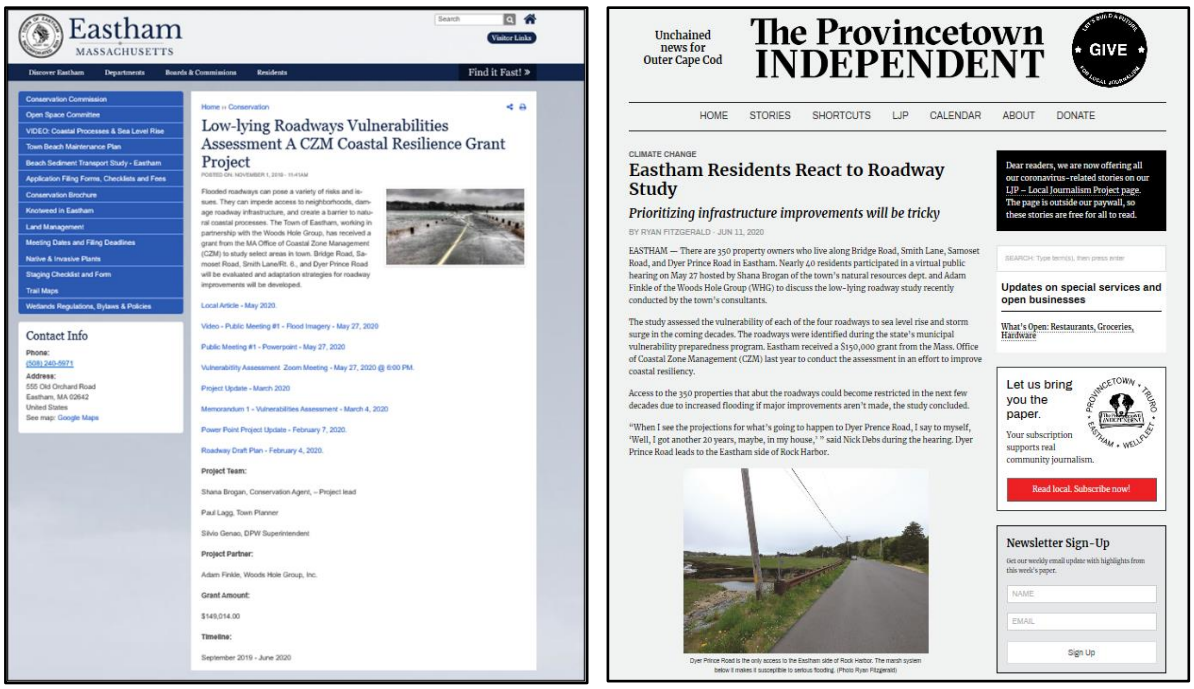


Figure 13. Screen shots of the publicly accessible project website and recent press coverage of the Targeted Vulnerability Assessment of Low-Lying Roadways Project.

Municipal Project Team

The municipal project team, made up of representatives from the Conservation Department, Department of Public Works, Planning Department, Fire Department, and Police department met with the Woods Hole Group and Massachusetts CZM staff regularly throughout all phases of the project to review deliverables and provide feedback on behalf of the Town. Regular meetings with the municipal project team helped to ensure that questions and concerns voiced by residents were heard and that the deliverables were representative of the Town's vision for each of the low-lying roadway sites. Agendas and minutes for each municipal project team meeting are included in Appendix F.

3.0 METHODOLOGIES

This section of the technical report provides information about the model used to determine the tidal, SLR and storm surge parameters and planning horizons used to calculate the probability and depth of inundation for low-lying roadways in the Town of Eastham.

3.1 VULNERABILITY ASSESSMENT MODEL PARAMETERS

The hydrodynamic modeling utilized for this targeted vulnerability assessment simulates a full suite of processes that affect coastal water levels, including tides, waves, winds, storm surge, sea level rise, and wave set-up at a fine enough resolution to evaluate sections of roadway and individual assets that may require adaptation. Water surface elevations were modelled using the ADvanced CIRCulation (ADCIRC) software to predict storm surge flooding coupled with the Simulated WAves Nearshore (SWAN) software, a wave generation and transformation model. This modeling was performed as part of the Massachusetts Coast Flood Risk Model (MC-FRM), which was developed for the Massachusetts Department of Transportation (MassDOT) to assess potential flooding vulnerabilities to highways and other transportation infrastructure throughout the state of Massachusetts. Since the MC-FRM domain includes the entire Massachusetts coastal area, including the Town of Eastham, this model is ideally suited to assess the vulnerability and risk of coastal flooding to Eastham's roadway infrastructure. Using this existing model is beneficial to the Town since much of the upfront work and cost in developing the model was already conducted as part of the MassDOT project.

The spatial resolution of the model is 10 meters or less between nodal points, and sometimes as low as 2-3 meters to capture important changes in topography and physical processes related to storm dynamics. Figure 14 shows an example of the MC-FRM model grid in Eastham, MA that was developed by the Woods Hole Group. This high-resolution model offers more accuracy than other storm surge models, such as the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model developed by the U.S. Army Corps of Engineers (USACE) and the National Oceanic and Atmospheric Administration (NOAA). The MC-FRM is also superior to a more rudimentary "bathtub" approach, since the latter does not account for critical physical processes that occur during a storm event, including waves and winds, nor can it determine the limited volume of water that may be able to enter certain areas, particularly those with narrow entry points.

The model quantitatively incorporates climate change influences on SLR, tides, waves, storm track, and storm intensity for the 2030, 2050, 2070, and 2100 time horizons, providing discrete risk estimates at various time horizons to assist with both near- and long-term planning. To do so, it evaluates a statistically robust sample of storms, including hurricanes, tropical storms and nor'easters, based on the region's existing and evolving climatology. Using this storm set, the model then calculates resulting water elevations to estimate the probability that different flood depths will be exceeded at each nodal point within the model boundary. The resulting flood risk maps and probability curves can then be interpreted using geographic information systems (GIS) to identify the estimated annual probability, or likelihood, that any node within the model will experience flooding, and if so, up to what elevation.

Figure 14. Sample MC-FRM model grid in the Town of Eastham, MA.

The probability-based approach of the model is beneficial to the Town when assessing the vulnerability of and risk to low-lying roadways and infrastructure and when developing adaptation strategies to mitigate future flooding damage. It can also be leveraged to inform engineering design criteria since it provides the probability of an event occurring in this changing regime, such as the "new" 1% event flood levels (equivalent to a 100 year recurrence water level). In particular, an accurate and precise assessment of the exceedance probability of combined SLR and storm surge is provided that can help Town managers and decision makers identify areas of existing and near-term vulnerability requiring immediate action, as well as areas that will benefit from long-range planning for future preparedness and risk reduction.

The relative sea-level rise (RSLR) projections used in the MC-FRM represent the most up to date RSLR projections for the Massachusetts coastline, drawing on long-term water level datasets from a series of tide gages around the State. For Eastham, RSLR was estimated using the NOAA tidal gage at Boston (station ID 8443970), which has recorded an increase in relative mean sea level of 2.82 mm (+/- 0.16

mm) annually based on monthly mean sea level data from 1921 to 2017 (Figure 15). This equates to approximately 10.7 inches of mean sea-level rise over the last 96 years. Over that same time period, the global rate of sea level rise was about 1.7 mm annually (approximately 6.4 inches over the last 96 years). This significant difference between the RSLR experienced locally and the global SLR trend highlights the importance of accounting for local conditions.

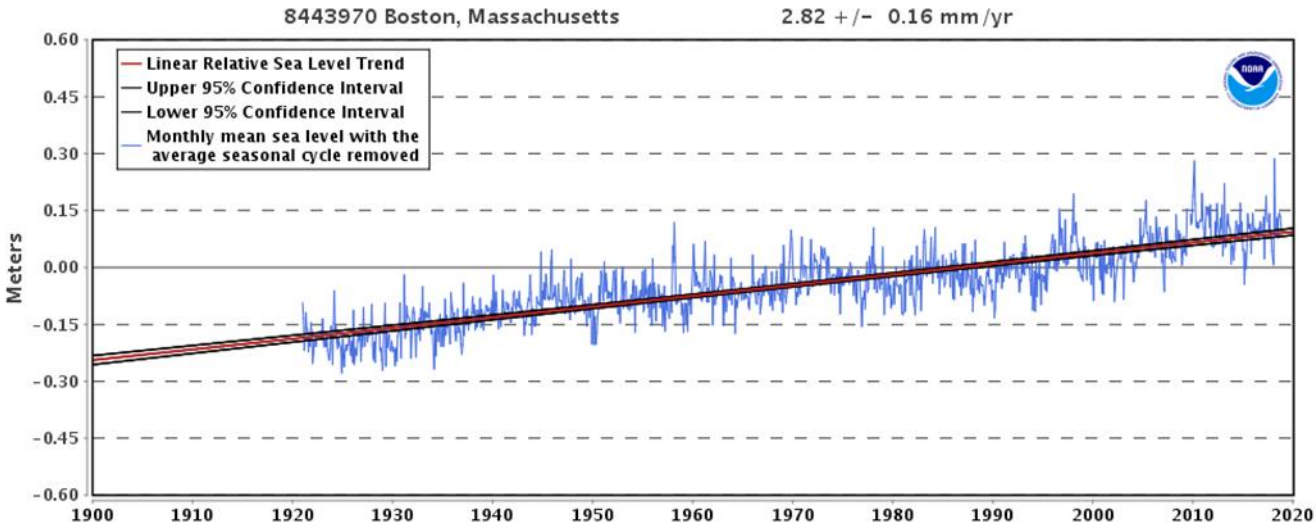


Figure 15. Mean sea-level rise trend at the Boston tide gauge (#8443970).

To compare future mean sea level to "present day" conditions, a starting elevation for mean sea level was first calculated. For this analysis, site-specific tidal data collected in Eastham were used to derive "present day" highwater levels for each low-lying roadway site. The site-specific 2019 highwater elevations were then compared to projected relative mean sea-level elevations for 2030, 2050, and 2070 derived from the Boston NOAA tidal gauge, generating estimated highwater levels for each low-lying roadway site (Table 5). Note that the values in Table 5 are water level elevations relative to a vertical datum of NAVD88, not the magnitude of change over time. Based on the projected change in high-water levels presented in Table 5, this means that the mean high-water level for Bridge Road is expected to increase from 5.41 ft. NAVD88 in the present day to 6.46 ft. by 2030, 7.66 ft. by 2050, and 9.46 ft. by 2070 based on the "High" SLR scenario. Mean High Water (MHW) refers to the average elevation of all high tides. Mean Higher High Water (MHHW) refers to the average elevation of the higher high tide that occurs each day. The calculations assume that attenuation remains constant with SLR except where man-made restrictions (bridges/culverts) are overtopped. In instances when this occurs, it is assumed that there is no attenuation.

The data in Table 5 are recommended by Massachusetts CZM for assessing sea-level rise and are being used by the Massachusetts Department of Transportation and other state agencies and communities for vulnerability assessments. The "High" SLR scenario was chosen for the MC-FRM because MassDOT and

the state were interested in inundation risk probabilities that were unlikely to be exceeded (there is a 99.5% confidence level that the "High" scenario chosen will not be exceeded). In addition, selecting the "High" scenario also allows for the evaluation of inundation risk probabilities under other scenarios due to the bracketed nature of the results. For example, the "High" results in 2030 are equivalent to "Intermediate" results in 2050, and the "High" results in 2050 are the equivalent to the "Intermediate" results in 2070. In this way, the selected scenarios provide an upper bound of potential risk.

The Town of Eastham Low-Lying Roadways Vulnerability Assessment project will focus on three of the modeled out-years for sea-level rise and storm surge flood effects: 2030, 2050, and 2070. These planning horizons were selected by the municipal project team because they provide the most useful data for planning purposes. Flood risk probabilities for 2030 represent a near-term risk, which will be useful in driving actionable items now, while flood risk probabilities for 2050 and 2070 will provide mid- and long-range planning tools that will be useful when planning for larger capital projects, designing and siting new infrastructure and guiding municipal bylaws and zoning regulations.

Table 5. Estimated high water elevations at Eastham low-lying roadway sites based on MC-FRM SLR rates adjusted for November 2019 (based on MSL calculated at Boston NOAA tide gage).

Smith Ln* NAVD88 ft.				
	Nov, 2019	2030	2050	2070
MHHW	4.65	5.70	6.90	9.46
MHW	4.38	5.43	6.63	9.05

* Based on Eastham 6 tide station

Dyer Prince Rd*, Samoset Rd* NAVD88 ft.				
	Nov, 2019	2030	2050	2070
MHHW	5.51	6.57	7.77	9.57
MHW	5.04	6.09	7.29	9.09

* Based on Eastham 1 tide station

Bridge at Bridge Rd* NAVD88 ft.				
	Nov, 2019	2030	2050	2070
MHHW	5.41	6.46	7.66	9.46
MHW	4.99	6.05	7.25	9.05

* Based on Eastham 4 tide station

Model Disclaimer

The flood maps and probabilistic data presented in this report are derived from output of MCFRM for sea level rise and coastal storm simulations. These maps and data are provided without any guarantees or warranty. This information is not intended for use as a flood insurance determination, nor should it be directly related to Federal Emergency Management Agency's Flood Insurance Rate Maps (FIRMs) maps or data since the MC-FRM data and FEMA data were generated for different purposes. This information cannot be used for the purpose of boundary resolution or location.

This public information should be accepted and used by the recipient with the understanding that the maps and data received were developed and collected for future flooding analyses purposes only. No liability is assumed as to the accuracy, sufficiency or suitability of the information contained herein for any other particular use. While every effort has been made to assure the accuracy and correctness of the data presented, it is acknowledged that inherent mapping inaccuracies are present due to interpolation between MC-FRM calculation nodes. Any reliance upon the maps or data presented herein used to make decisions or conclusions is at the sole discretion and risk of the user. This information is provided with the understanding that these data are not guaranteed to be accurate, correct, or complete and assumes no responsibility for errors or omissions. Data and documents may not be the most currently available data, and the data is subject to constant change given the changing climate.

Assets located near boundaries of a probability zone may or may not be within the probability zone due to mapping scales and interpolation between model nodes. MC-FRM nodal spacing varies throughout the Town of Eastham. The GIS rasters interpolate values between model nodes and create probabilities that may be averaged between model nodes. Therefore, care should be taken when using the raster data to evaluate site-specific properties or locations. The probability maps should not be applied at such a granular level as to assess the fate of individual buildings or properties. Rather, they should be used as a tool to identify areas that may be vulnerable to flooding. Once those areas are identified, detailed information for individual assets can then be extracted from the closest model nodes. Nodal data are more accurate on a property scale than interpolated values shown on the maps

3.2 INUNDATION MAPS AND FIGURES

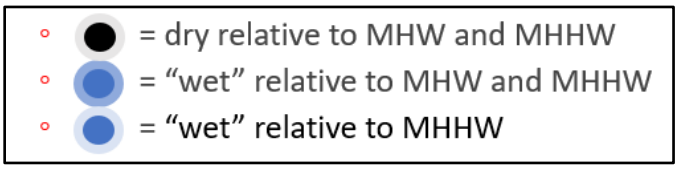
Detailed SLR, Coastal Flood Exceedance Probability (CFEP), and Probability and 1% Depth of Inundation figure sets were developed for the present day and out-year 2030, 2050, and 2070 planning horizons. The inundation maps and figures were used by the municipal project team to gauge the Town's risk tolerance for both nuisance (daily) and storm induced flooding, which helped to prioritize action required at each of the low-lying roadways.

Probability-based inundation maps were developed for the 1% event flood levels (equivalent to the 100-year event) as the outputs. The 1% probability level was selected because this is the benchmark for the FEMA FIRMs. Although FEMA FIRMs are not forward-looking and do not incorporate sea-level rise into the mapping, FEMA does periodically update their modeling to account for increased sea level that has occurred (as well as other changes, such as changes in topography or armoring of particular areas). As such, the 2030, 2050, and 2070 1% probability of inundation extents may provide a projection for the

expected future FEMA flood zones. Additionally, the 1% probability level corresponds to a 39.5% cumulative probability over a 50-year period, and a 63.4% cumulative probability over a 100-year period. Thus, the 1% event flood level is highly relevant to the design and assessment of infrastructure that may have a design life of 50 to 100 years.

3.2.1 Sea Level Rise Figures

The first set of figures focused on site-specific SLR scenarios for each of the low-lying roadways. The SLR figures illustrate the changes in daily high tides (MHW, MHHW) along each roadway, projected from the present day through the 2030, 2050, and 2070 planning horizons. By including high resolution topographic survey points on each figure, the Woods Hole Group and the municipal project team were able to identify specific sections of each roadway most vulnerable to nuisance flooding, the expected timing of nuisance flooding, and the elevation of the roadway where nuisance flooding is likely to occur. It is important to note that the SLR figures are focused on daily tidal conditions and do not account for storm-driven flooding. The series of SLR figures developed for low-lying roadways in Eastham are included in Figures 16-20. As a reminder, mean high water (MHW) refers to the average elevation of all high tides while mean higher high water (MHHW) refers to the average elevation of the higher high tide that occurs each day. The following symbology applied to individual survey points illustrate the expected timing of daily inundation along each roadway:



Based on the site-specific sea level rise projections, Smith Lane, Dyer Prince Road, and Samoset Road will each be impacted by daily, nuisance flooding by 2050, with more significant impacts expected by 2070. Initial impacts along Bridge Road may be slightly delayed, but significant sections of the roadway are likely to experience daily inundation by 2070.

- Daily nuisance flooding along Smith Lane will be concentrated to the northeastern section of roadway relative to the 2050 planning horizon. By 2070, daily nuisance flooding is expected to extend west beyond the Orleans rotary on/off ramps serving Smith Lane and Rock Harbor Road.
- Impacts along Dyer Prince Road are expected by 2050, with daily nuisance flooding impacting the small, western culvert and low-lying areas approaching the Dyer Prince Beach parking area. By 2070, significant linear footage of roadway adjacent both culverts and low-lying areas approaching Dyer Prince Beach parking area will be impacted by daily tides.
- Similar impacts are expected along Samoset Road, where daily nuisance flooding begins to impact the lowest-lying sections of roadway by 2050, with significant impacts expected by the 2070 planning horizon.
- Daily nuisance flooding impacts along Bridge Road adjacent the bridge span and further south around the hairpin turn may be delayed beyond 2050. However, by 2070, most low-lying sections

of Bridge Road will be inundated by the tide on a daily basis. Given the importance of Bridge Road as an evacuation route, not just for Eastham residents, but for the Outer Cape region, it is important not to discount the delay in nuisance flooding impacts.

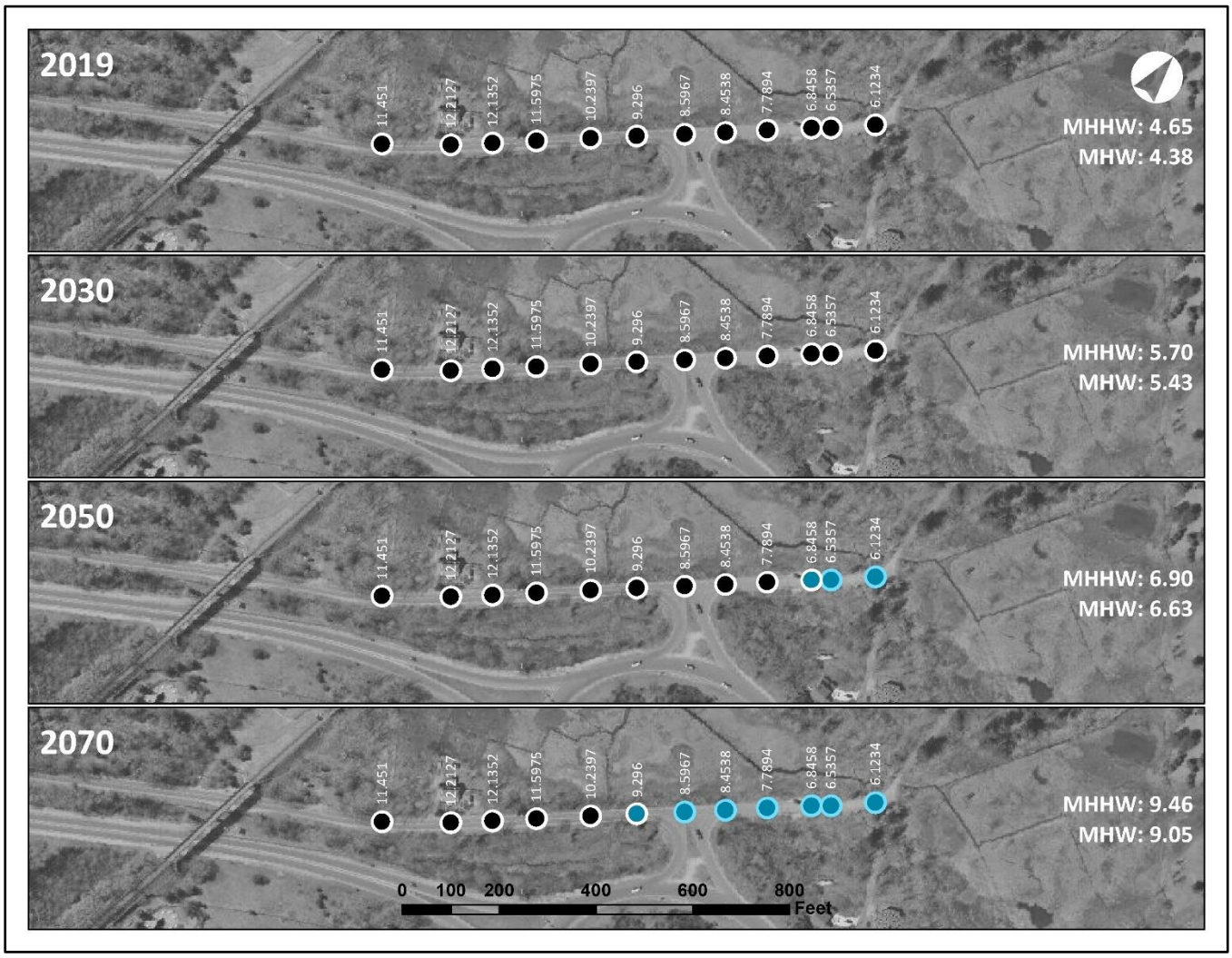


Figure 16. SLR imagery developed for Smith Lane illustrating daily nuisance flooding projected out to 2070. Daily nuisance flooding begins impacting roadway between by 2050 with significant impacts expected by 2070.

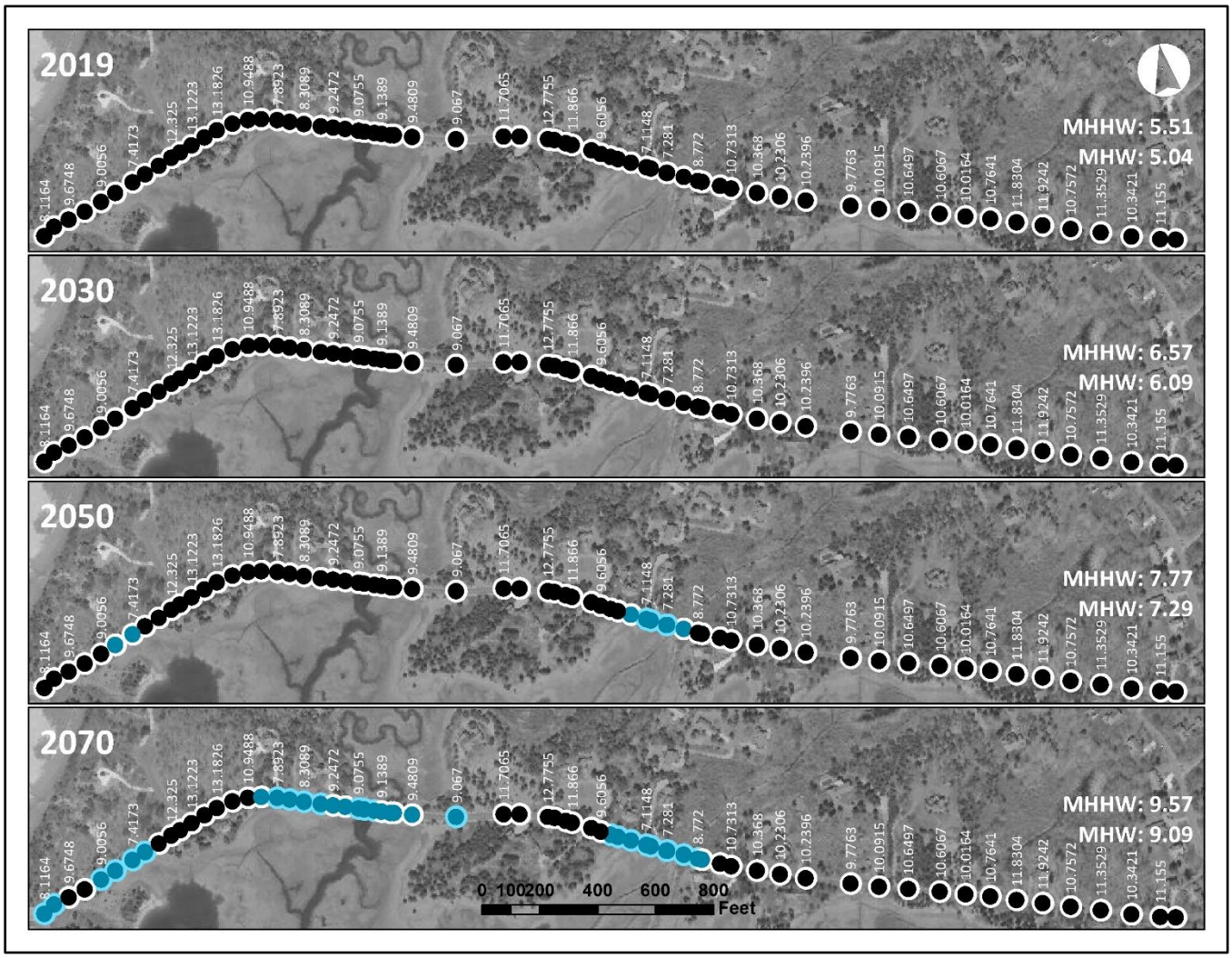


Figure 17. **SLR imagery developed for Dyer Prince Road illustrating daily nuisance flooding projected out to 2070. Daily nuisance flooding begins impacting roadway between by 2050 with significant impacts expected by 2070.**

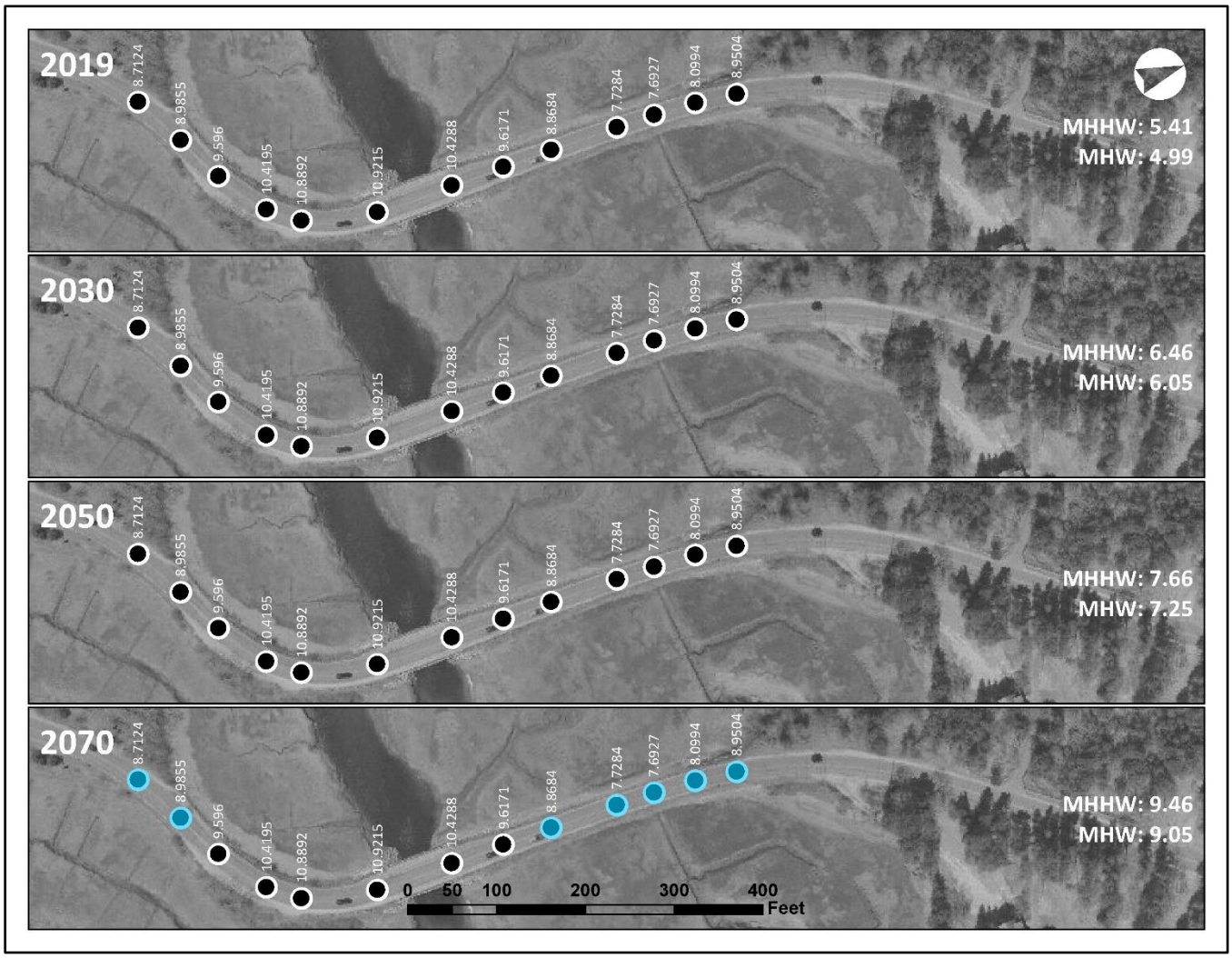


Figure 18. **SLR imagery developed for Bridge Road (adjacent the existing bridge span) illustrating daily nuisance flooding projected out to 2070. Significant impacts due to daily nuisance flooding are expected by 2070.**

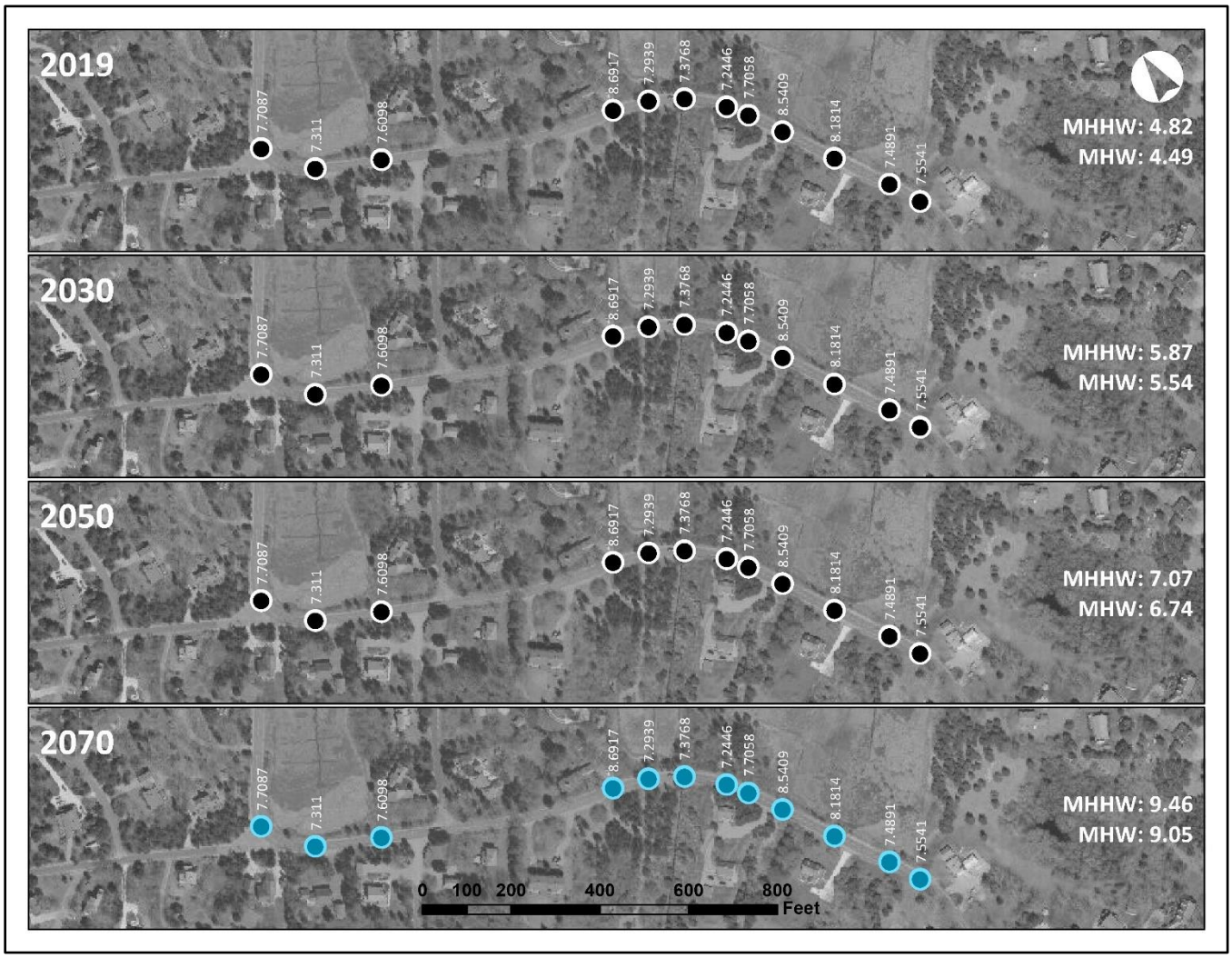


Figure 19. **SLR imagery developed for Bridge Road (south of existing bridge span and hairpin turn) illustrating daily nuisance flooding projected out to 2070. Significant impacts due to daily nuisance flooding are expected by 2070.**

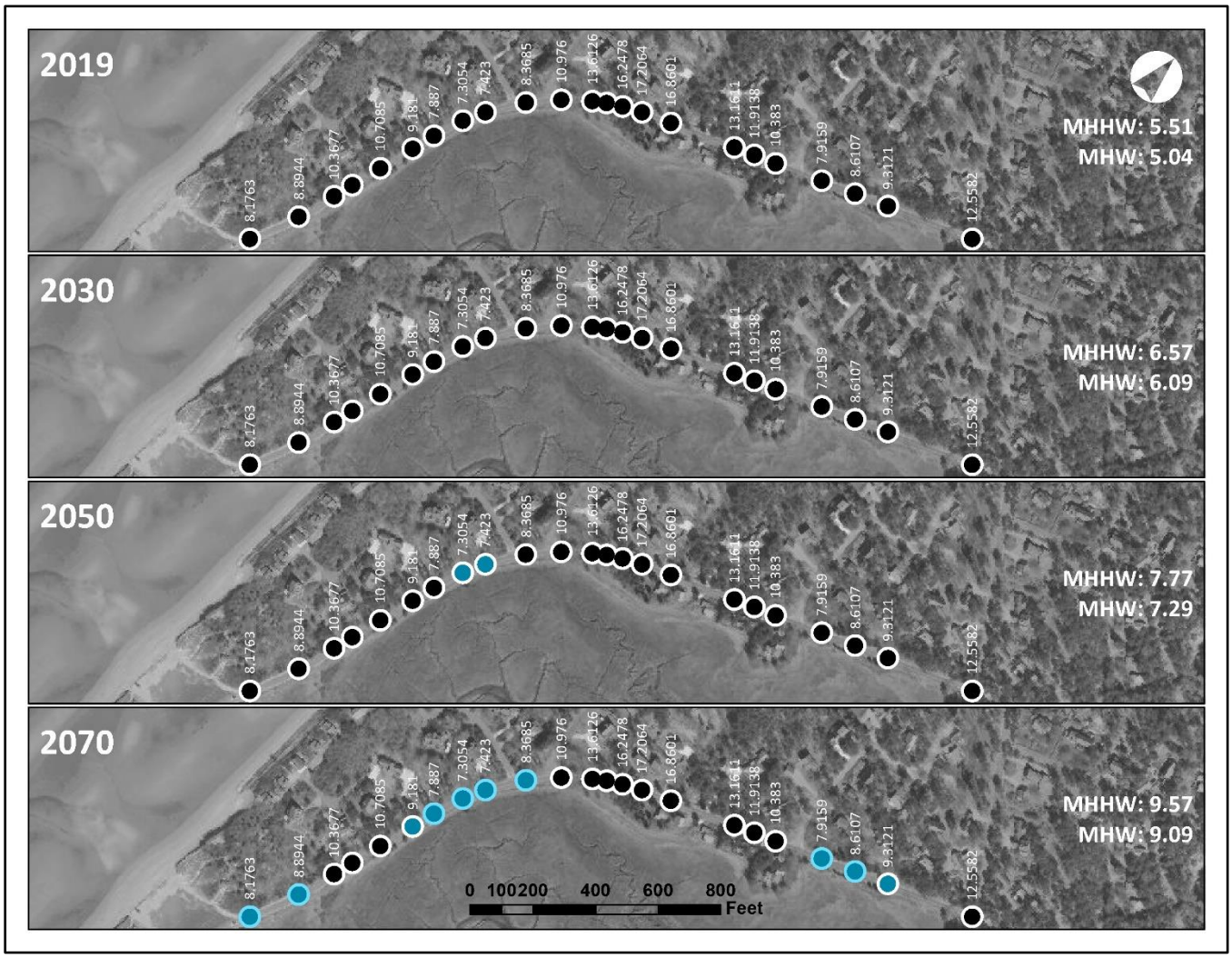


Figure 20. SLR imagery developed for Samoset Road illustrating daily nuisance flooding projected out to 2070. Daily nuisance flooding begins impacting roadway between by 2050 with significant impacts expected by 2070.

3.2.2 Coastal Flood Exceedance Probability Figures

The next series of images utilized MC-FRM risk profiles to illustrate the probability during a calendar year that coastal storm surge would flood a roadway to depths impassable to passenger vehicles and/or high-water emergency vehicles. The critical elevations identified by municipal public safety personnel were 6" of water depth over the roadway surface for passenger vehicle egress and 18" inches of water depth over the roadway surface for emergency vehicle egress. The figures modeled various storm scenarios and surface water elevations projected out to 2070, allowing the municipal project team to assess its risk tolerance for storm-induced flooding along each low-lying roadway. Municipal thresholds for flooding were set at a maximum depth of 6.0" for passenger vehicle egress and 18.0" for high water emergency vehicle egress. Though emergency vehicles could navigate deeper waters, it was made clear

that immersion in salt water would result in significant damage to emergency apparatus. Taking a conservative approach, the roadway elevations on each Coastal Flood Exceedance Probability (CFEP) figure represents the lowest-lying point surveyed along each road. Instructions for interpreting CFEP curves are included on the Dyer Prince Road CFEP figure (Figure 21). Coastal flood exceedance probability figures for all other roadways are included in Figures 22-24.

Under present-day conditions, each roadway is at risk of inundation that exceeds the critical elevations set by the municipal project team (6" for passenger vehicle egress; 18" for emergency vehicle egress). Over time, the probability of 6" of inundation and 18" of inundation increases with higher risk of significant (greater than 18" water depth) impacts expected between 2030-2050. Short-term, present-day-2030 planning horizon probabilities of inundation are summarized below.

- Under present conditions, there is nearly a 100% chance that the lowest-lying sections of Smith Lane will be inundated by at least 6" of water on an annual basis and approximately a 5% chance that the roadway will be inundated with at least 18" of water. By 2030, the probability of inundation with at least 18" of water increases to nearly a 100% annually.
- Under present conditions, there is a 30% chance that the lowest-lying sections of Dyer Prince Road will be inundated with 6" of water during a given year and a 10% chance the roadway will be inundated with at least 8" of water. By 2030, the probability of 6" of inundation increases to 80% and the probability of 18" of inundation increases to 40%.
- Present day conditions along the lowest-lying sections of Bridge Road indicate a 30% probability of at least 6" of inundation and 5% chance of at least 18" of inundation during a given year. By 2030, the probability of 6" of inundation increases to 60% and the probability 18" of inundation increases to 20%.
- Along the lowest-lying sections of Samoset Road, probability of present-day flooding of least 6" is 30% and the probability of 18" of flooding is between 5-10%. By 2030, the probability of 6" of flooding increased to 80% and the probability of 18" of flooding increases to 40%.

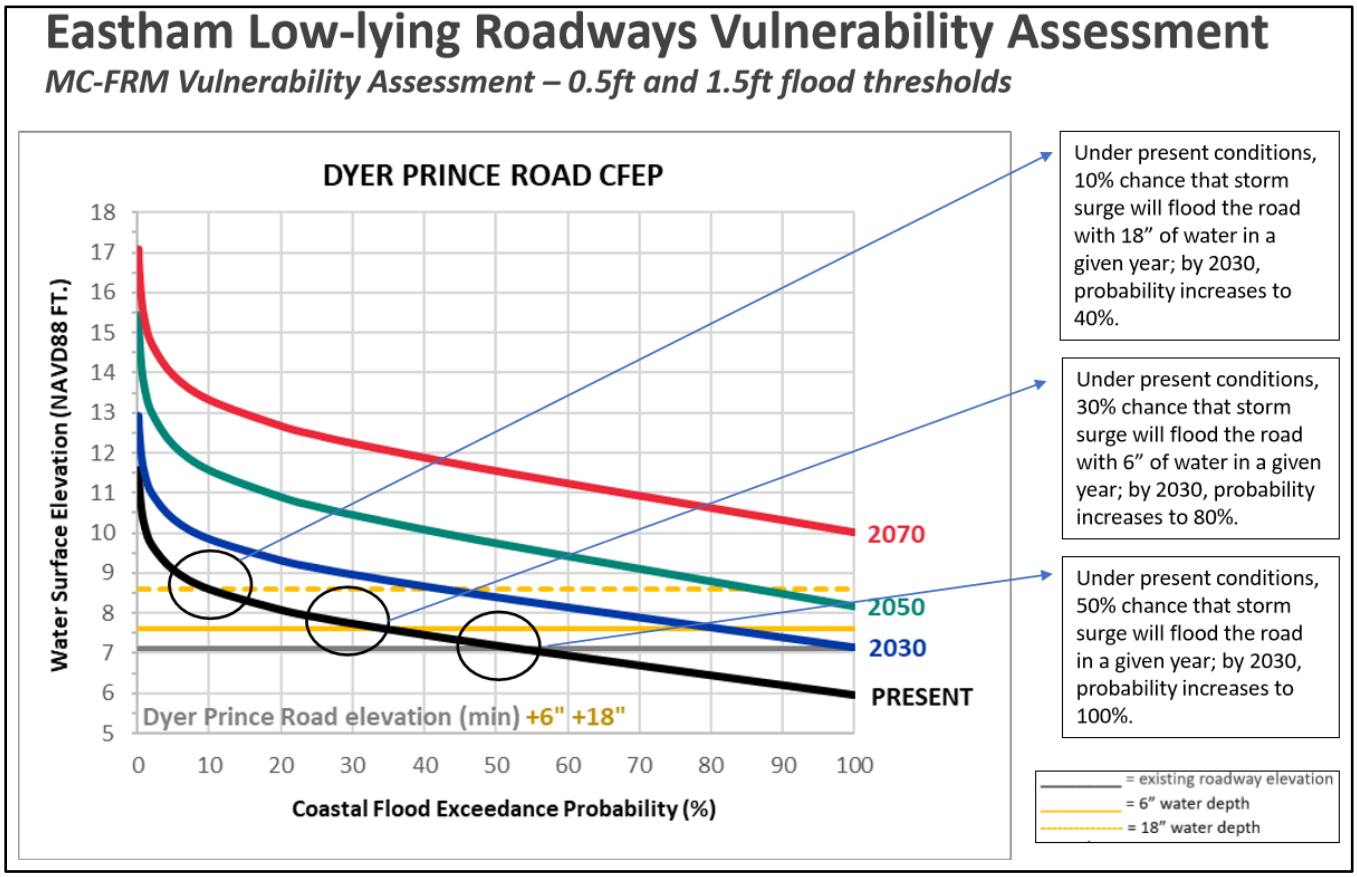


Figure 21. Interpretation of CFEP for Dyer Prince Road illustrating probability of inundation and water surface elevation (above roadway elevation) for present day, 2030, 2050, and 2070 planning horizons.

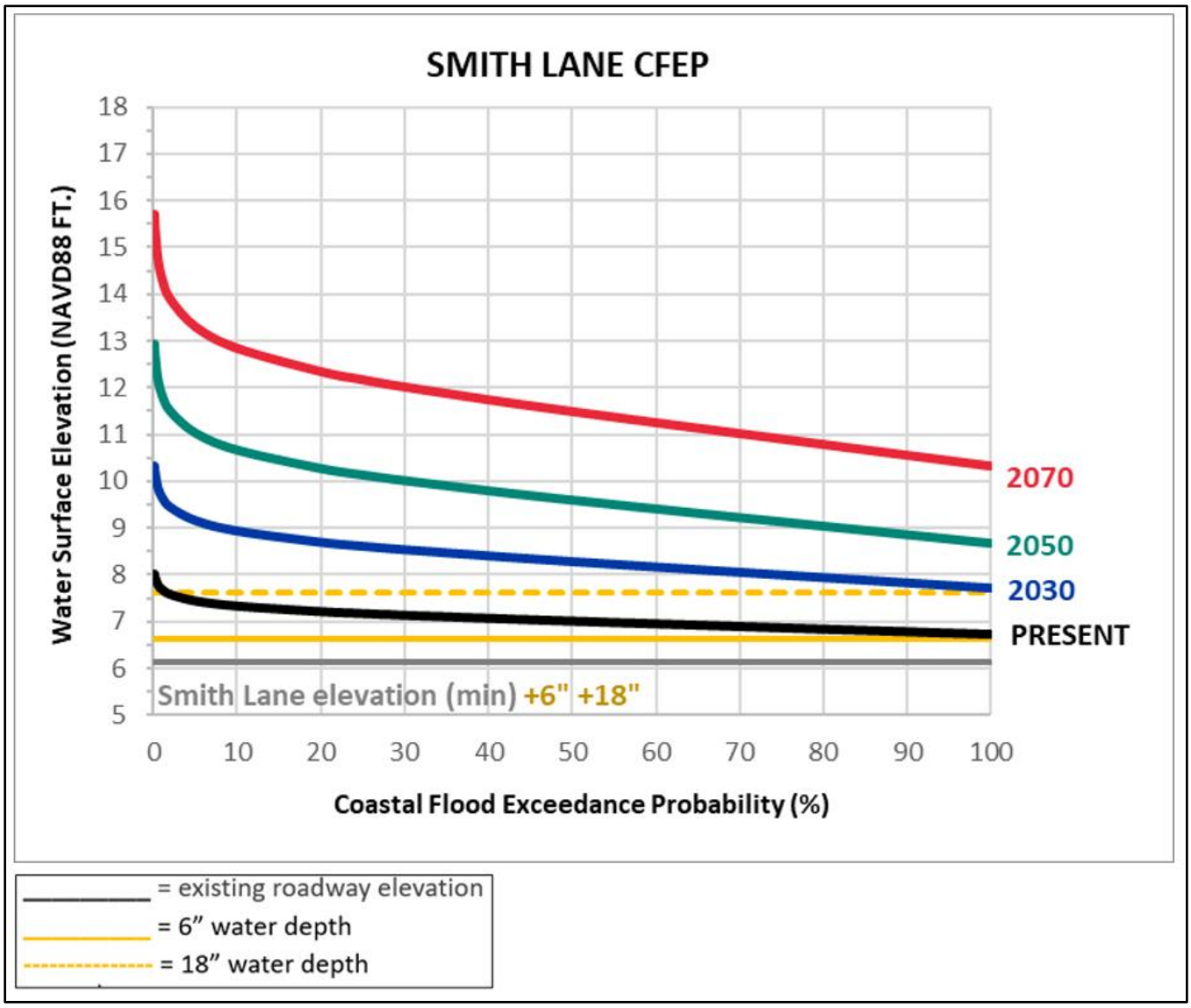


Figure 22. **CFEP for Smith Lane illustrating probability of inundation and water surface elevation (above roadway elevation) for present day, 2030, 2050, and 2070 planning horizons.**

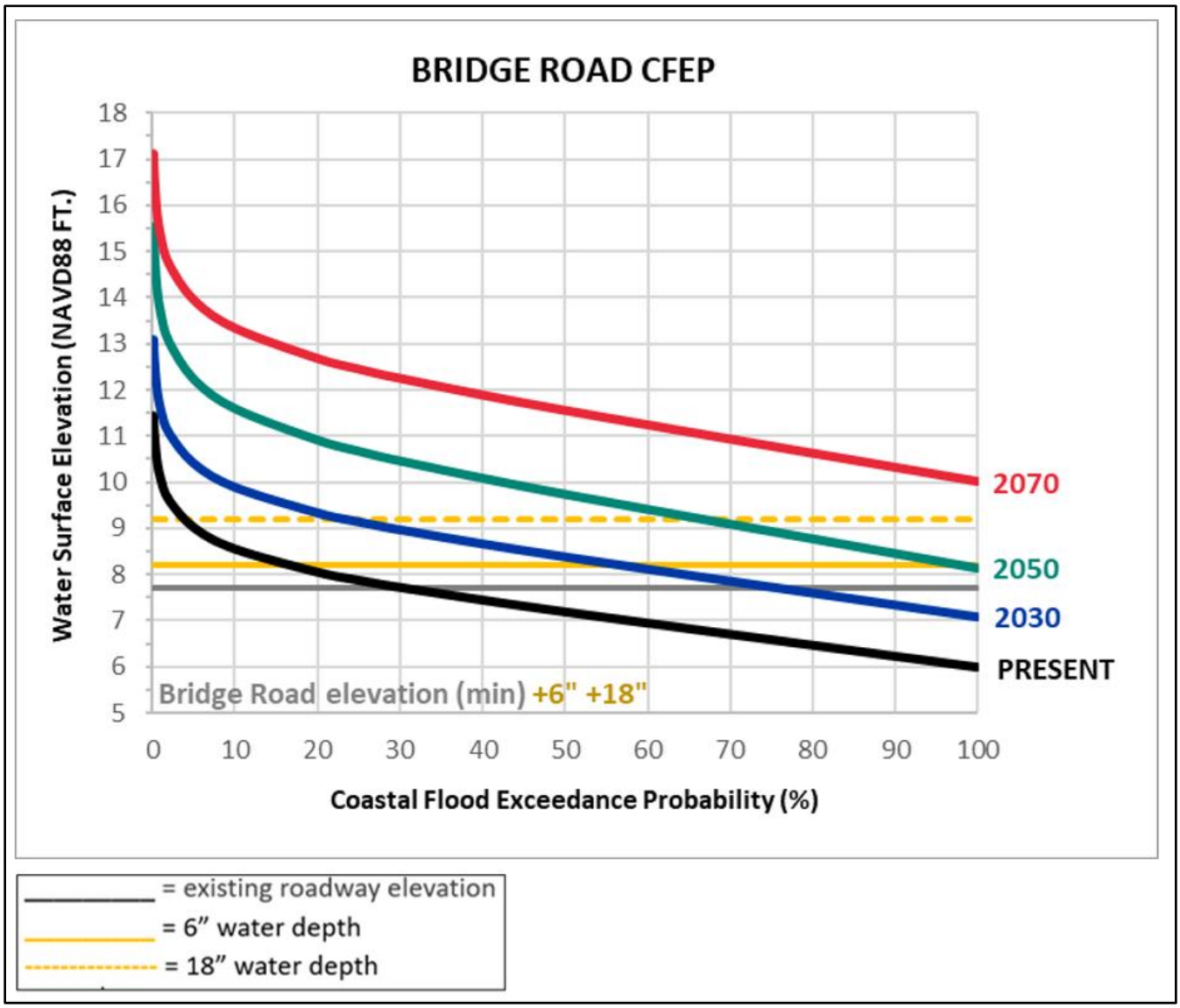


Figure 23. **CFEP for Bridge Road illustrating probability of inundation and water surface elevation (above roadway elevation) for present day, 2030, 2050, and 2070 planning horizons.**

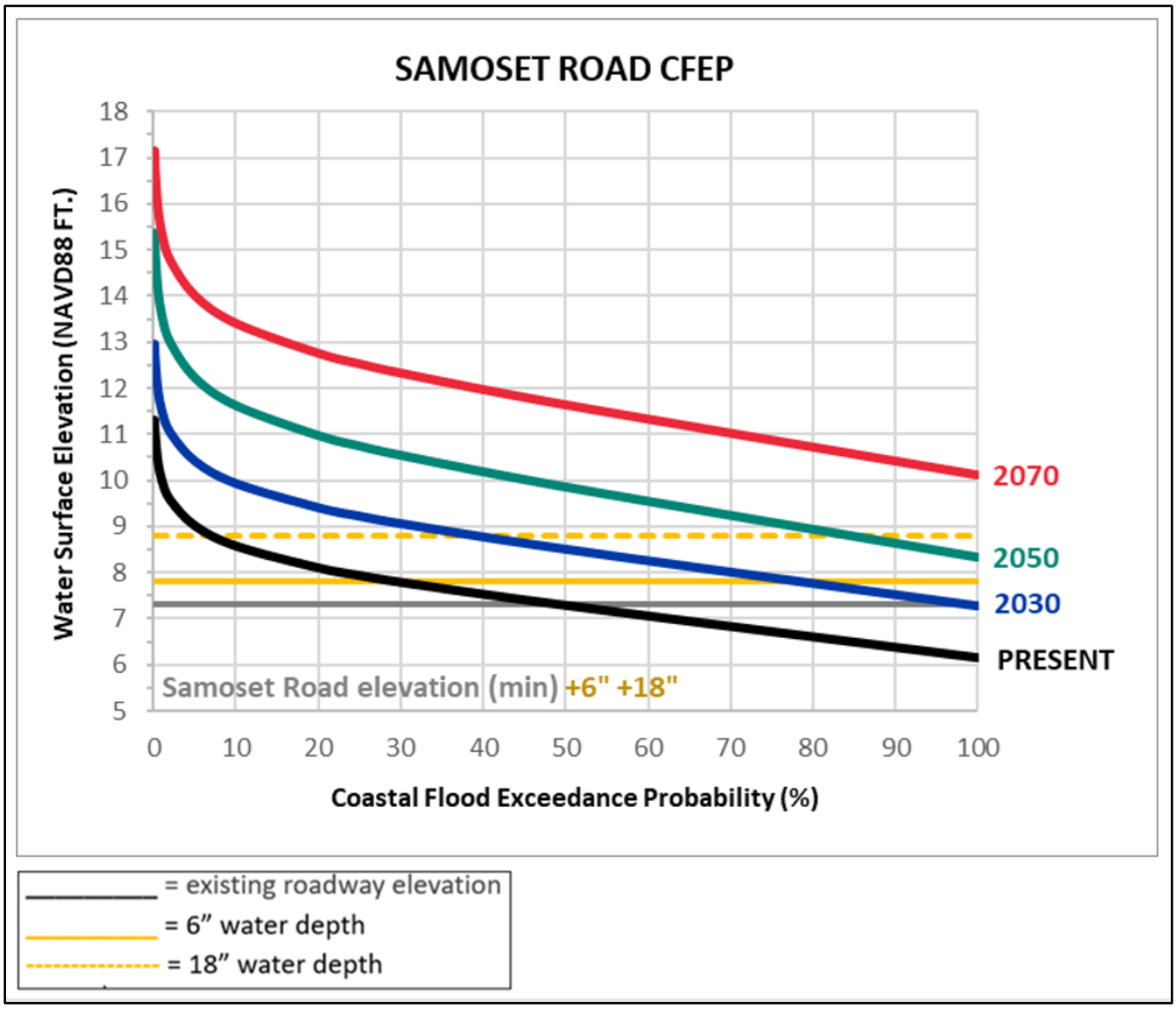


Figure 24. **CFEP for Bridge Road illustrating probability of inundation and water surface elevation (above roadway elevation) for present day, 2030, 2050, and 2070 planning horizons.**

3.2.3 Probability of Inundation and 1% Depth Figures

Town-wide and site-specific Probability of Inundation and 1% Depth of Inundation figures were developed using the results of the MC-FRM model to illustrate 1) the chances that a specific point along a given roadway will get wet during a given year and 2) the depth of water at that point during a 1% (100-year) probability storm event. As a reminder, a 1% storm event is a storm that has a 1-in-100 chance of occurring each year. All Probability and Depth figures were developed for the present day, 2030, 2050, and 2070 planning horizons and were used to solicit direct feedback from the municipal project team and members of the public regarding how needs, access, and impacts might change over the course of time. The series of Town-wide Probability and Depth figures are included in Figures 25-28. Site-specific Probability of Inundation and 1% Depth of Inundation figures are included in Figures 28-44.

The Probability of Inundation and 1% Depth of Inundation figures effectively illustrate the expected changes in flood probability and depth for each low-lying roadway, helping to identify site-specific tipping points, appropriate timelines for adaptation, and specific sections of roadway to concentrate resources. The series of Town-wide figures suggest that action will be required in the short-term (present day-2030 planning horizon) along low-lying sections of Bridge Road, especially in areas located south of the bridge span and along the lowest sections of Samoset Road. Significant action will be required along other sections of low-lying roadway by 2050, to avoid the high probability of inundation and significant depths of inundation expected during the 2050-2070 planning horizon. Site-specific figures allow for a more detailed analysis of incremental increases in flood probability and depth of inundation for all low-lying roadways through the 2030, 2050, and 2070 planning horizons.

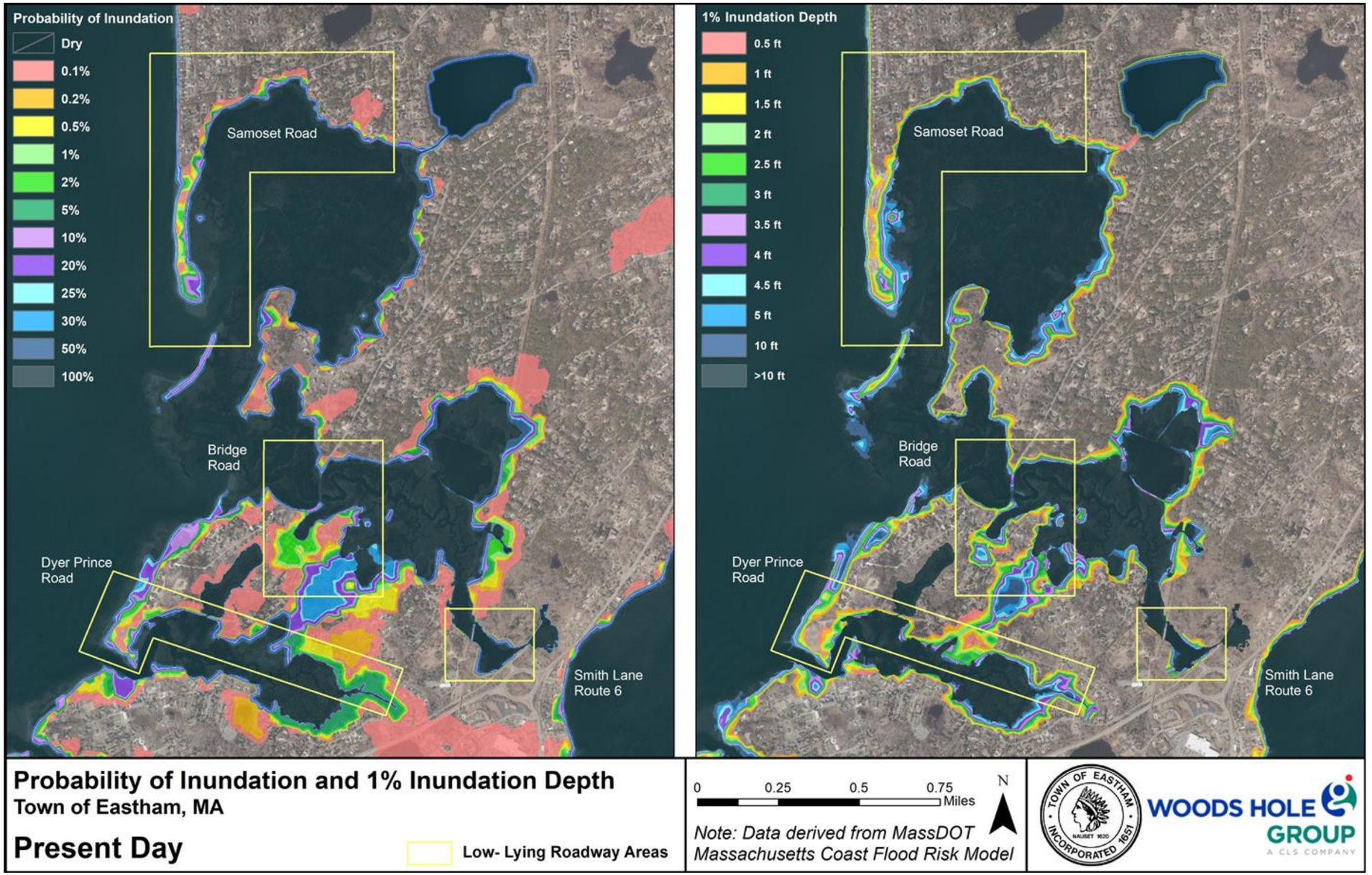


Figure 25. **Present day Town-wide probability of inundation (left) and 1% depth of inundation (right).**

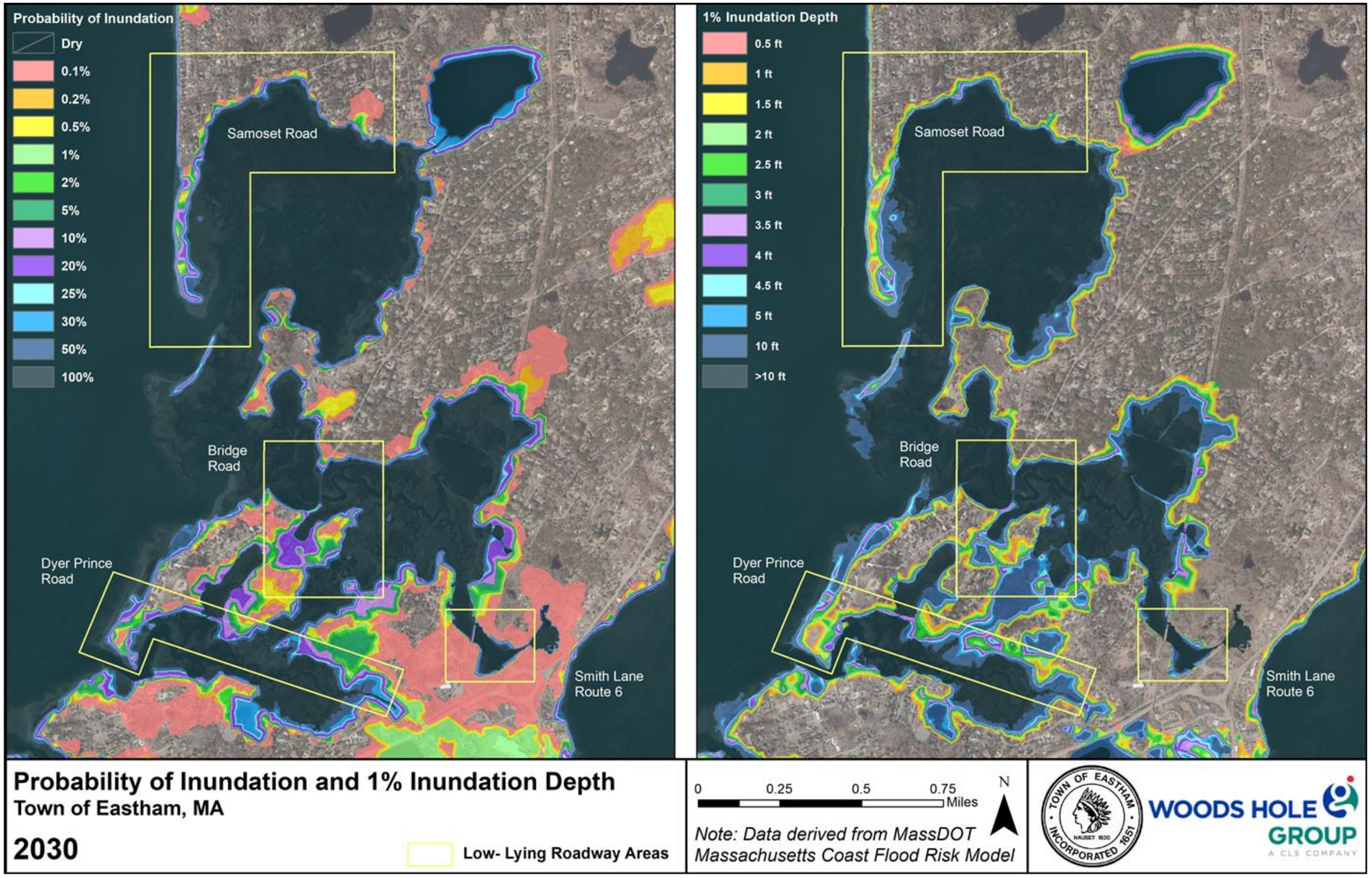


Figure 26. 2030 Town-wide probability of inundation (left) and 1% depth of inundation (right).

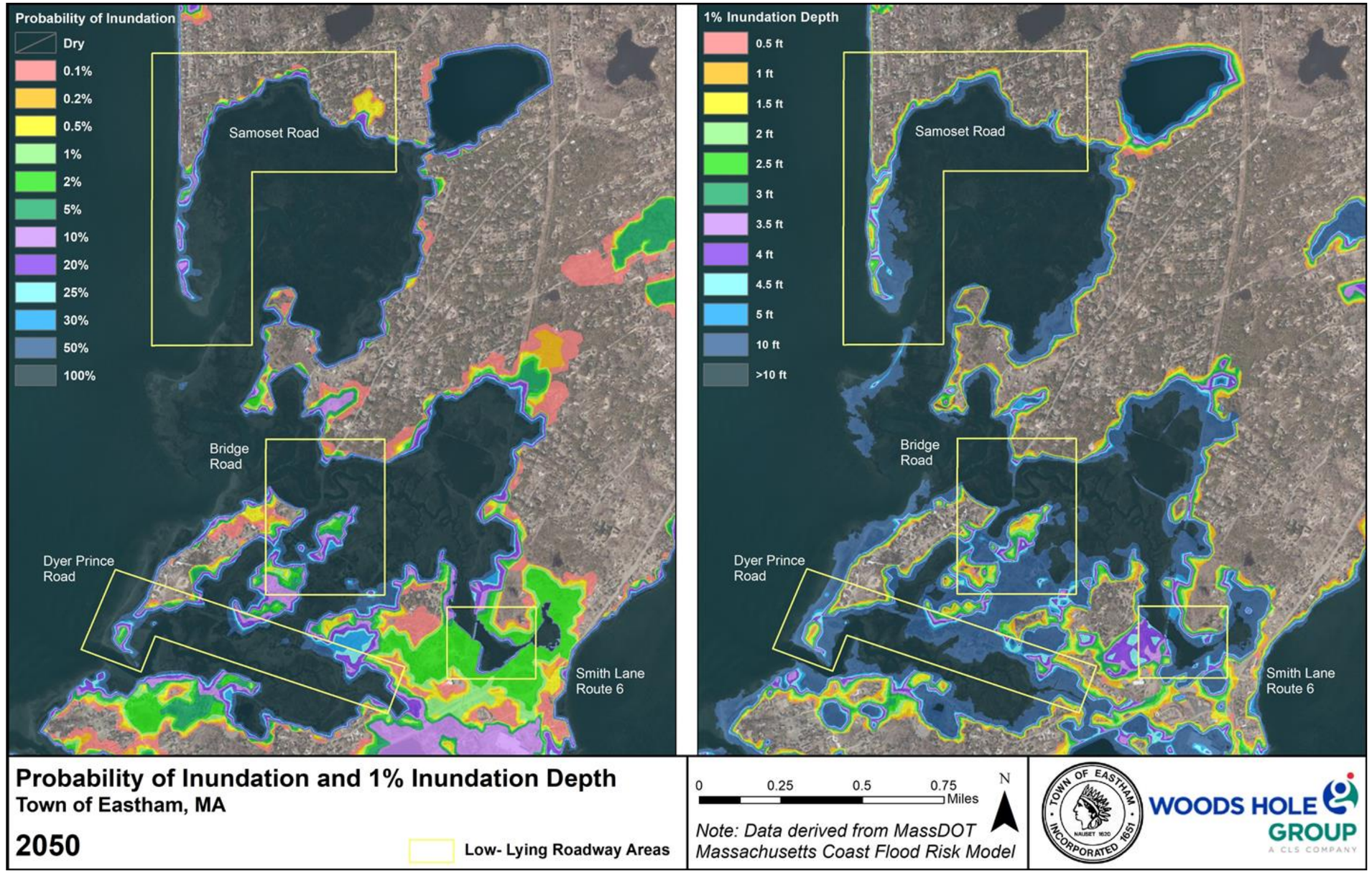


Figure 27. 2050 Town-wide probability of inundation (left) and 1% depth of inundation (right).

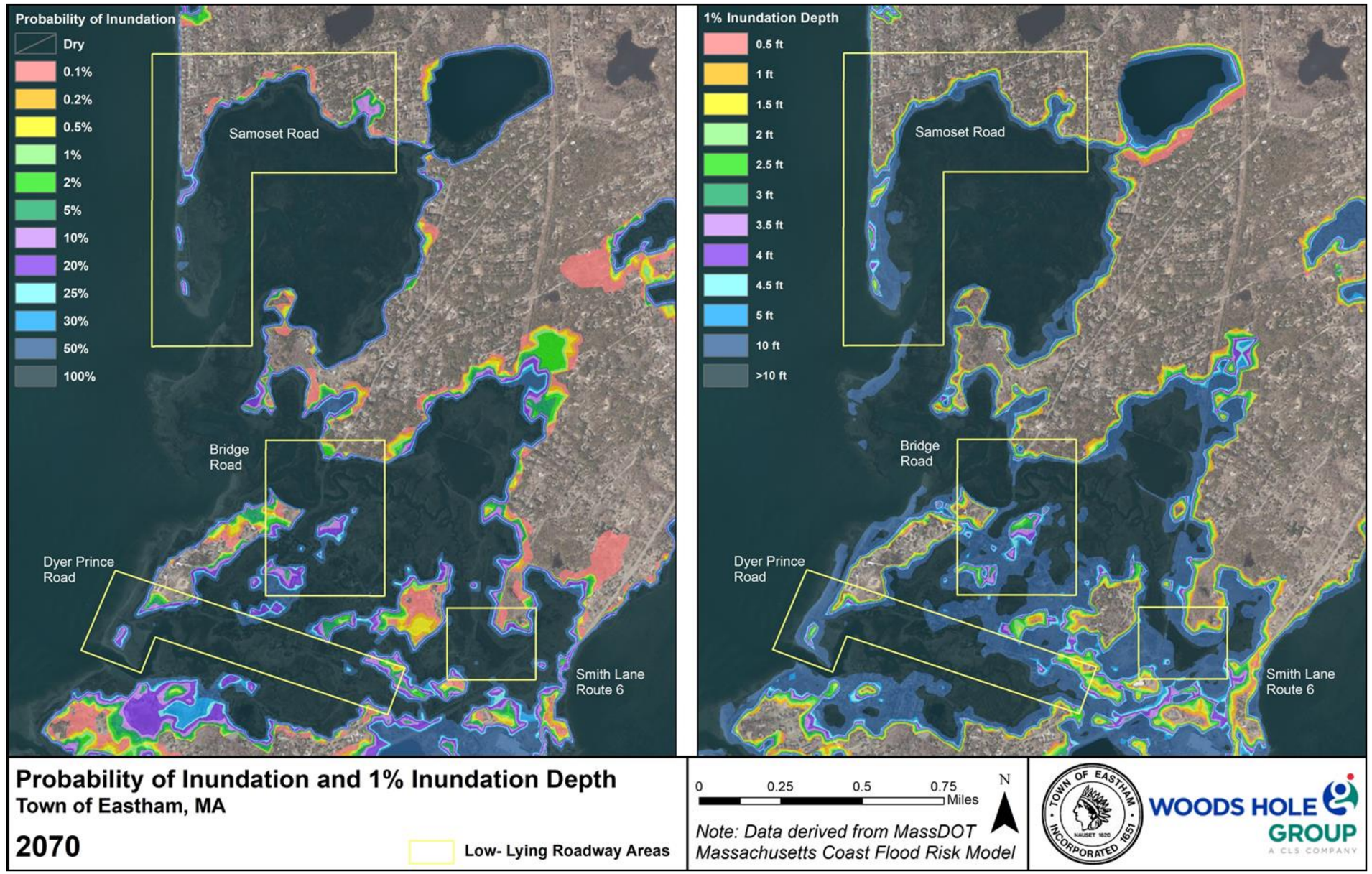


Figure 28. **2070 Town-wide probability of inundation (left) and 1% depth of inundation (right).**

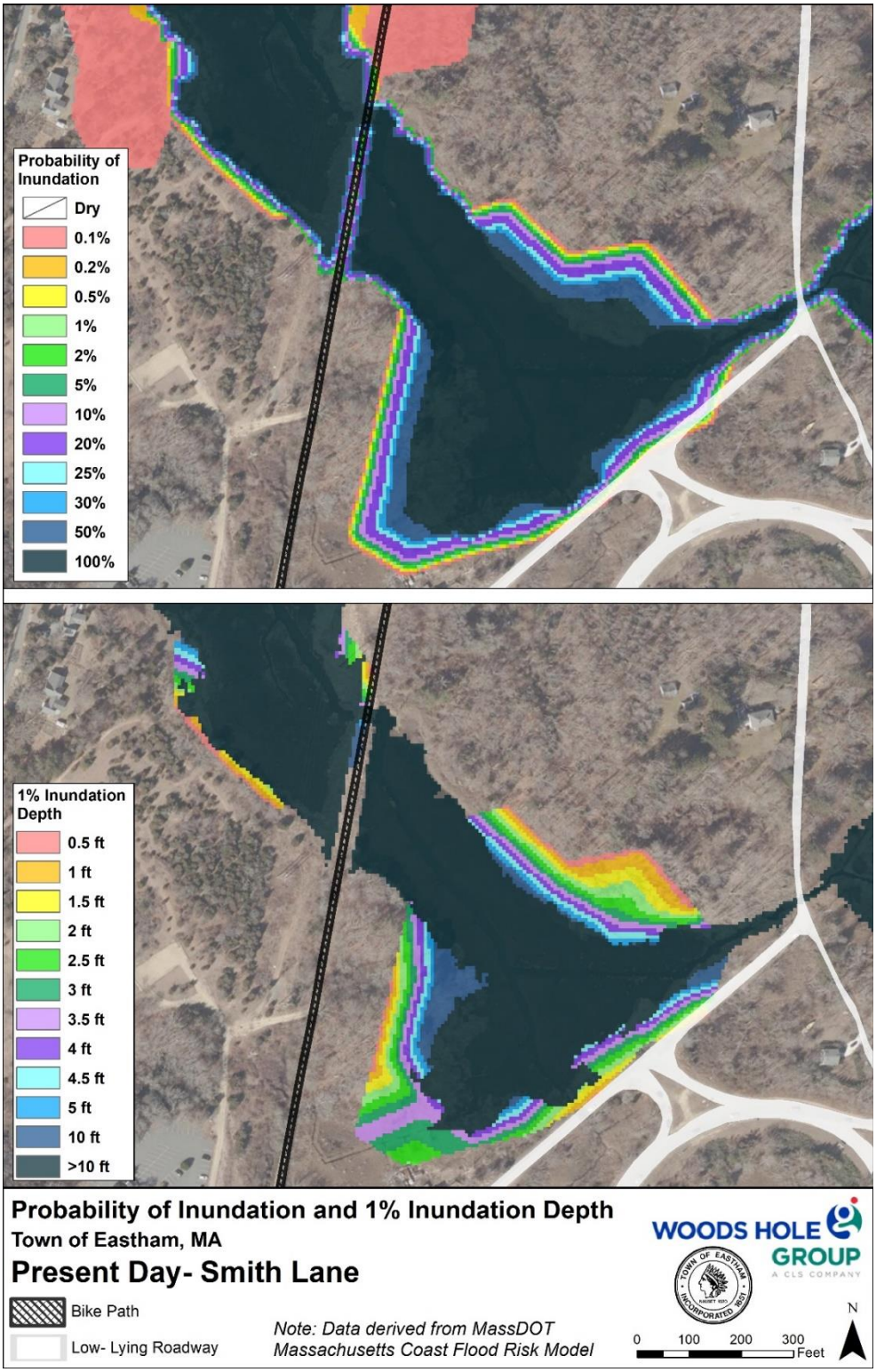


Figure 29. **Present day Smith Lane probability of inundation (above) and 1% depth of inundation (below).**

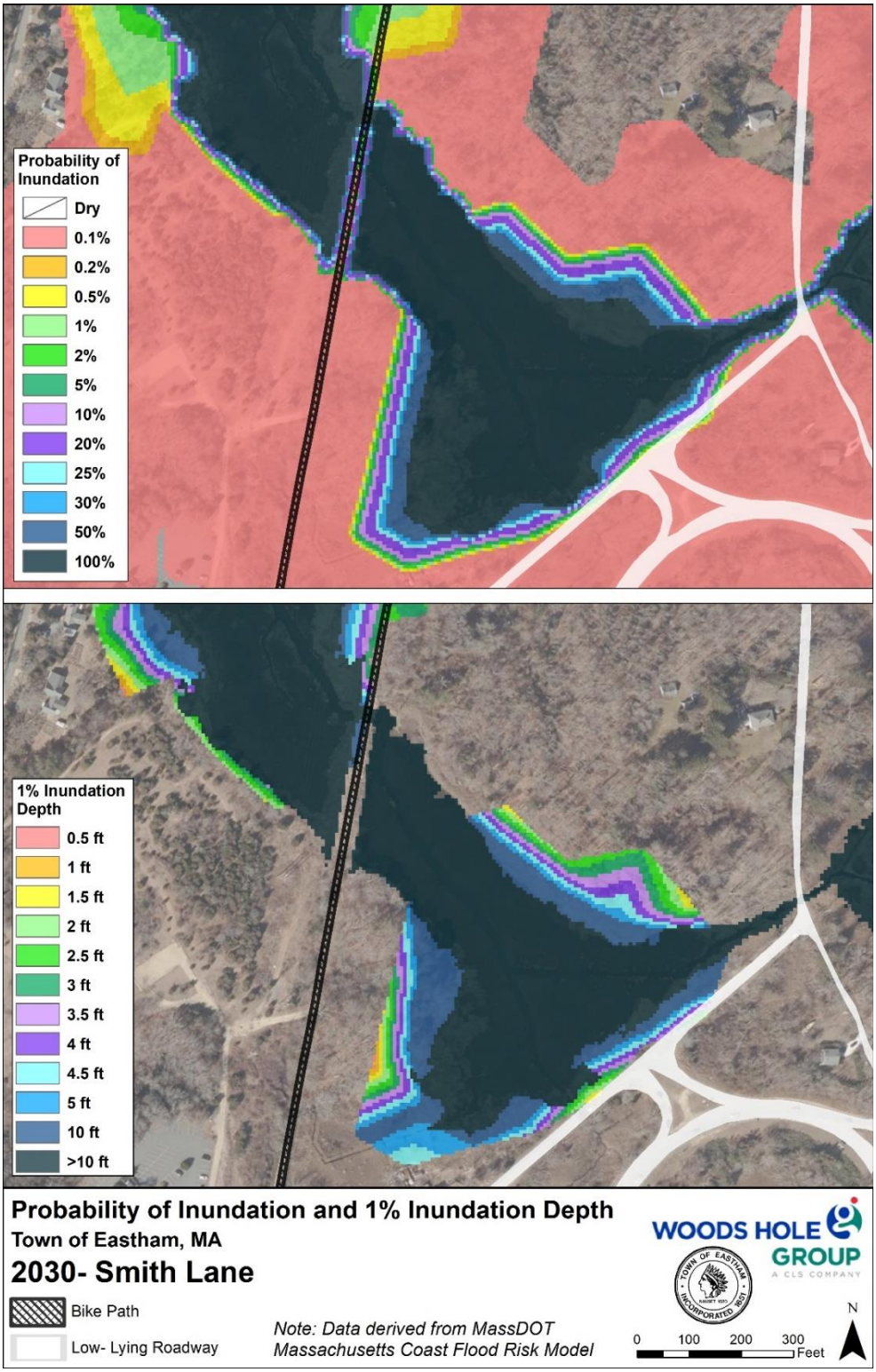


Figure 30. **2030 Smith Lane probability of inundation (above) and 1% depth of inundation (below).**

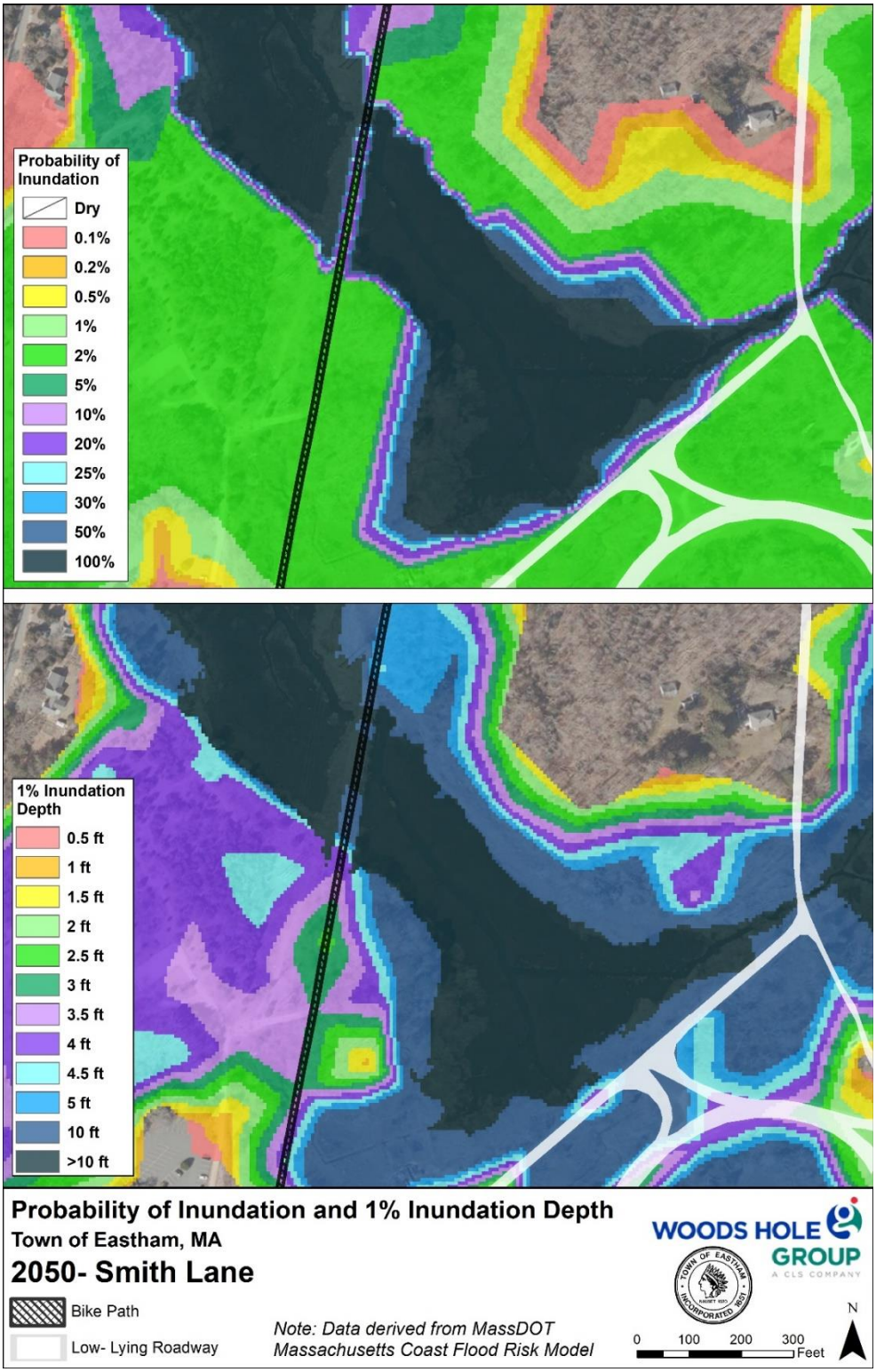


Figure 31. **2050 Smith Lane probability of inundation (above) and 1% depth of inundation (below).**

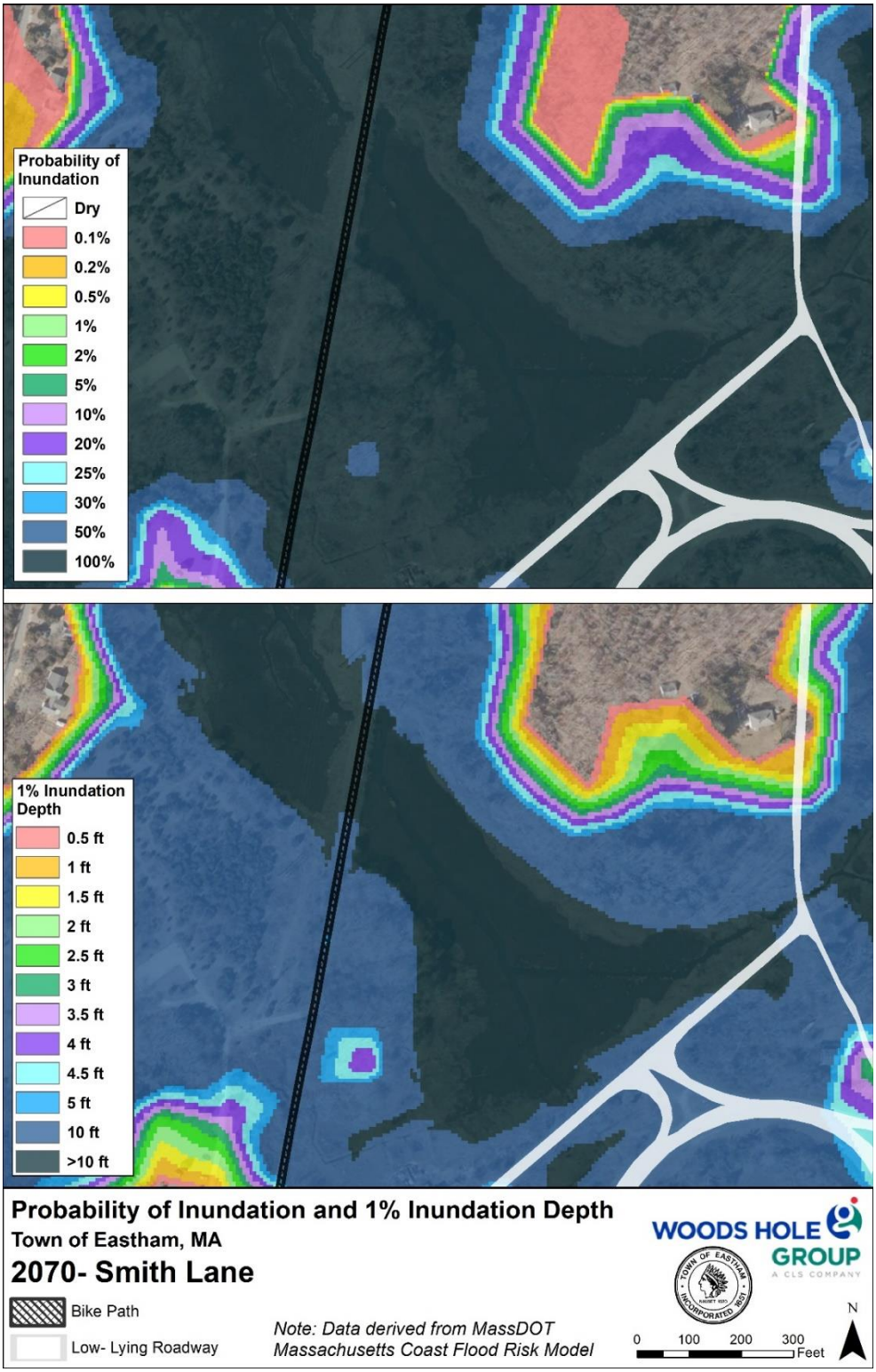


Figure 32. **2070 Smith Lane probability of inundation (above) and 1% depth of inundation (below).**

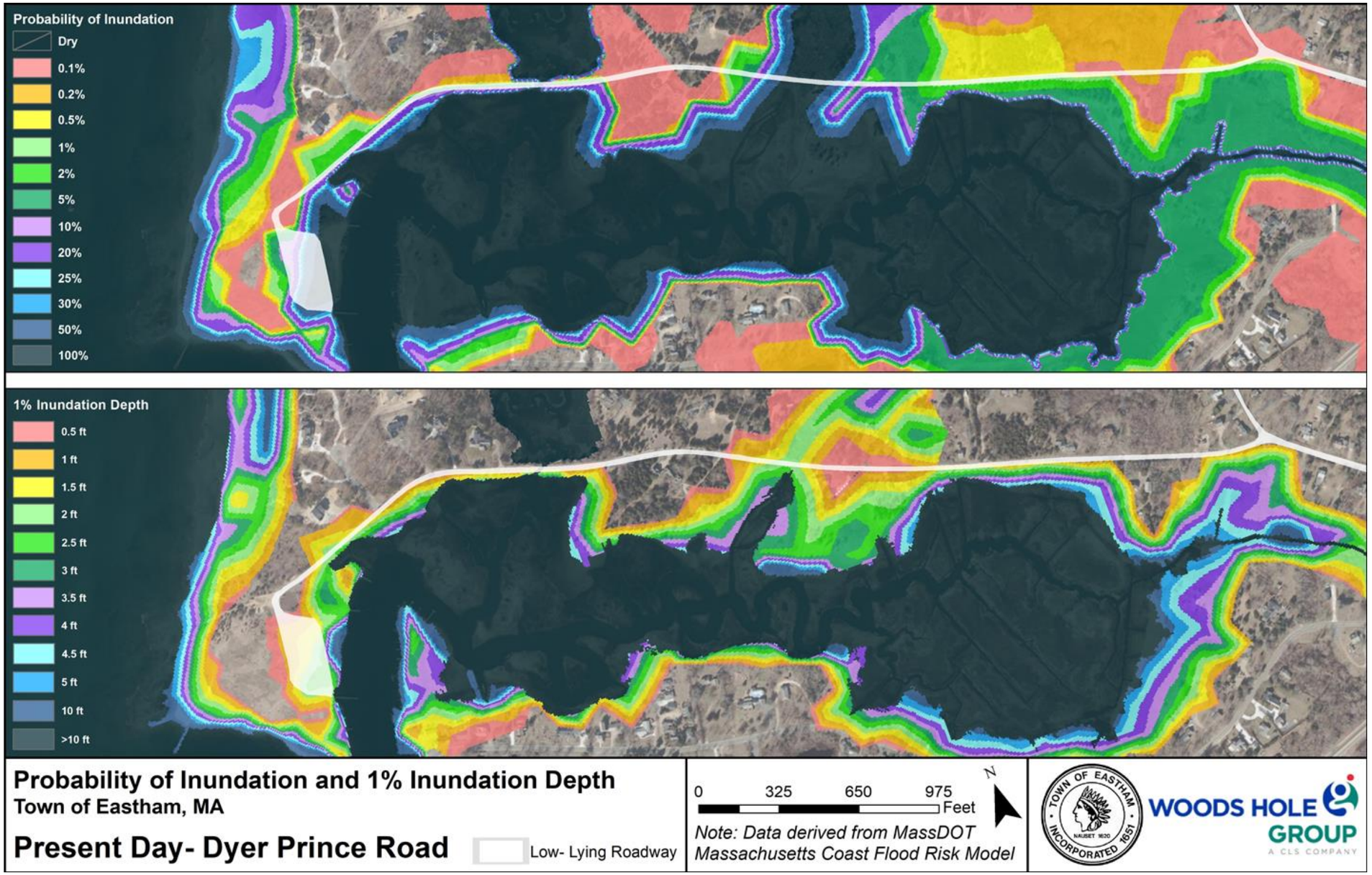


Figure 33. **Present day Dyer Prince Road probability of inundation (above) and 1% depth of inundation (below).**

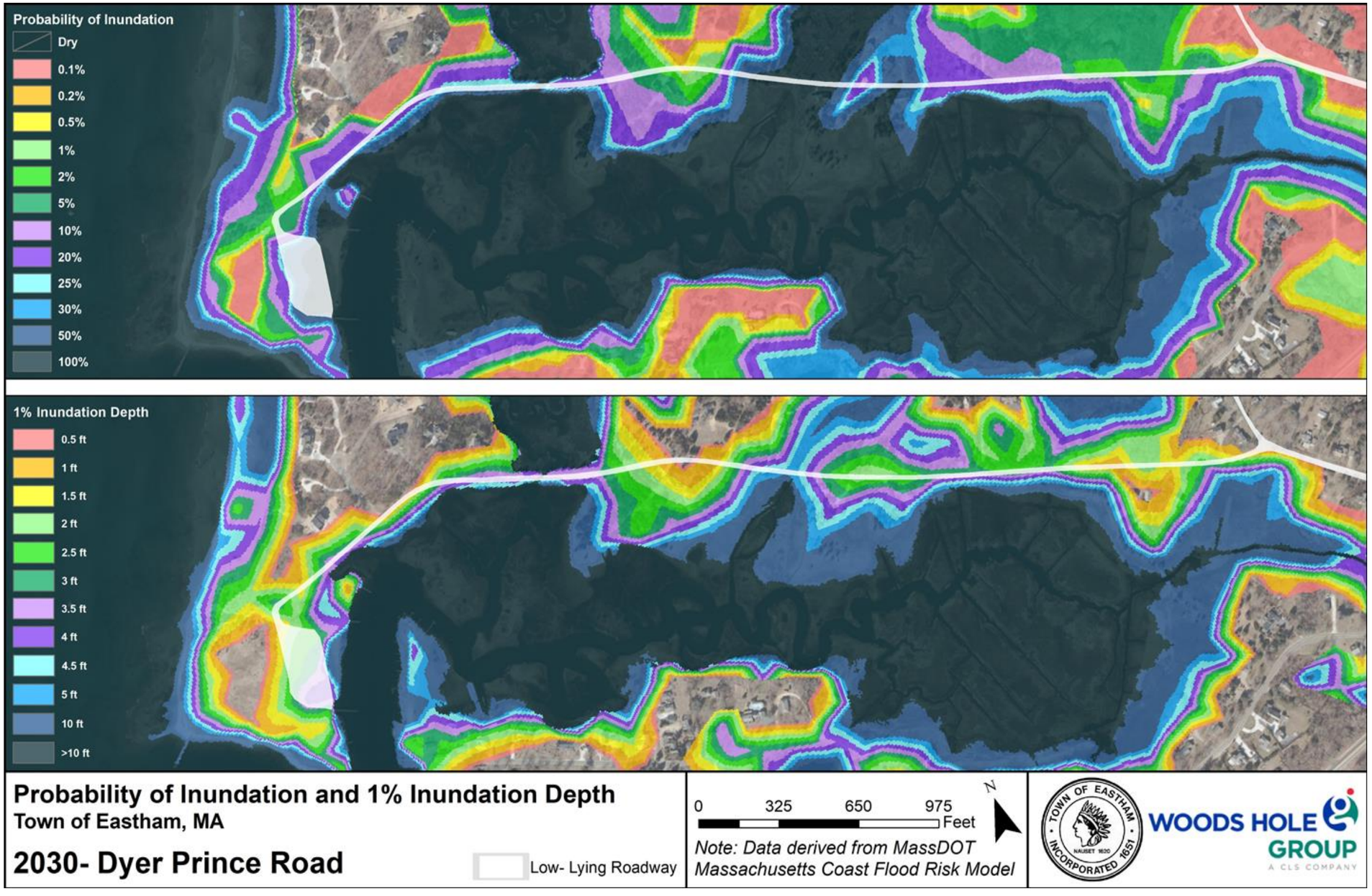


Figure 34. 2030 Dyer Prince Road probability of inundation (above) and 1% depth of inundation (below).

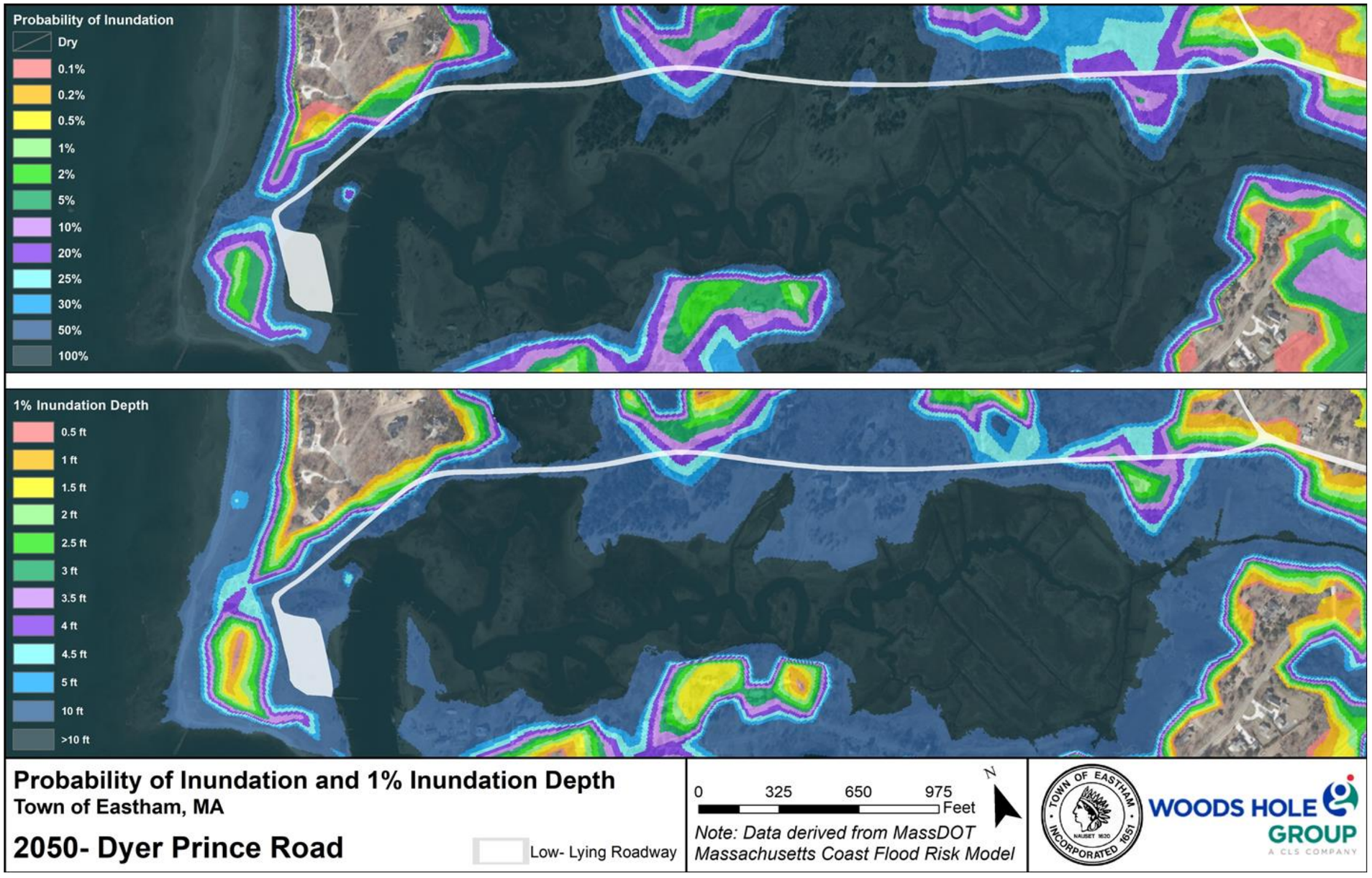


Figure 35. 2050 Dyer Prince Road probability of inundation (above) and 1% depth of inundation (below).

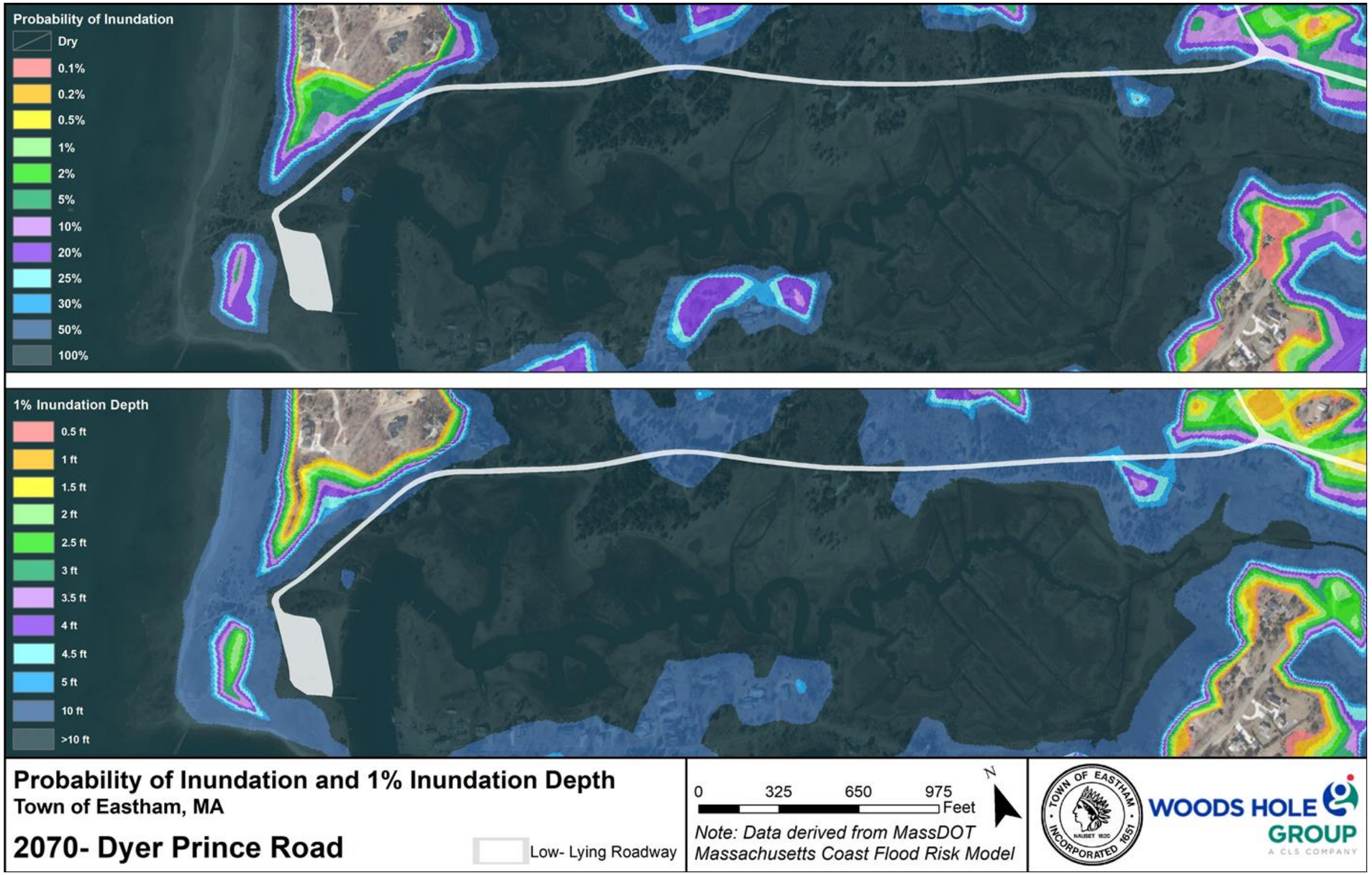


Figure 36. 2070 Dyer Prince Road probability of inundation (above) and 1% depth of inundation (below).

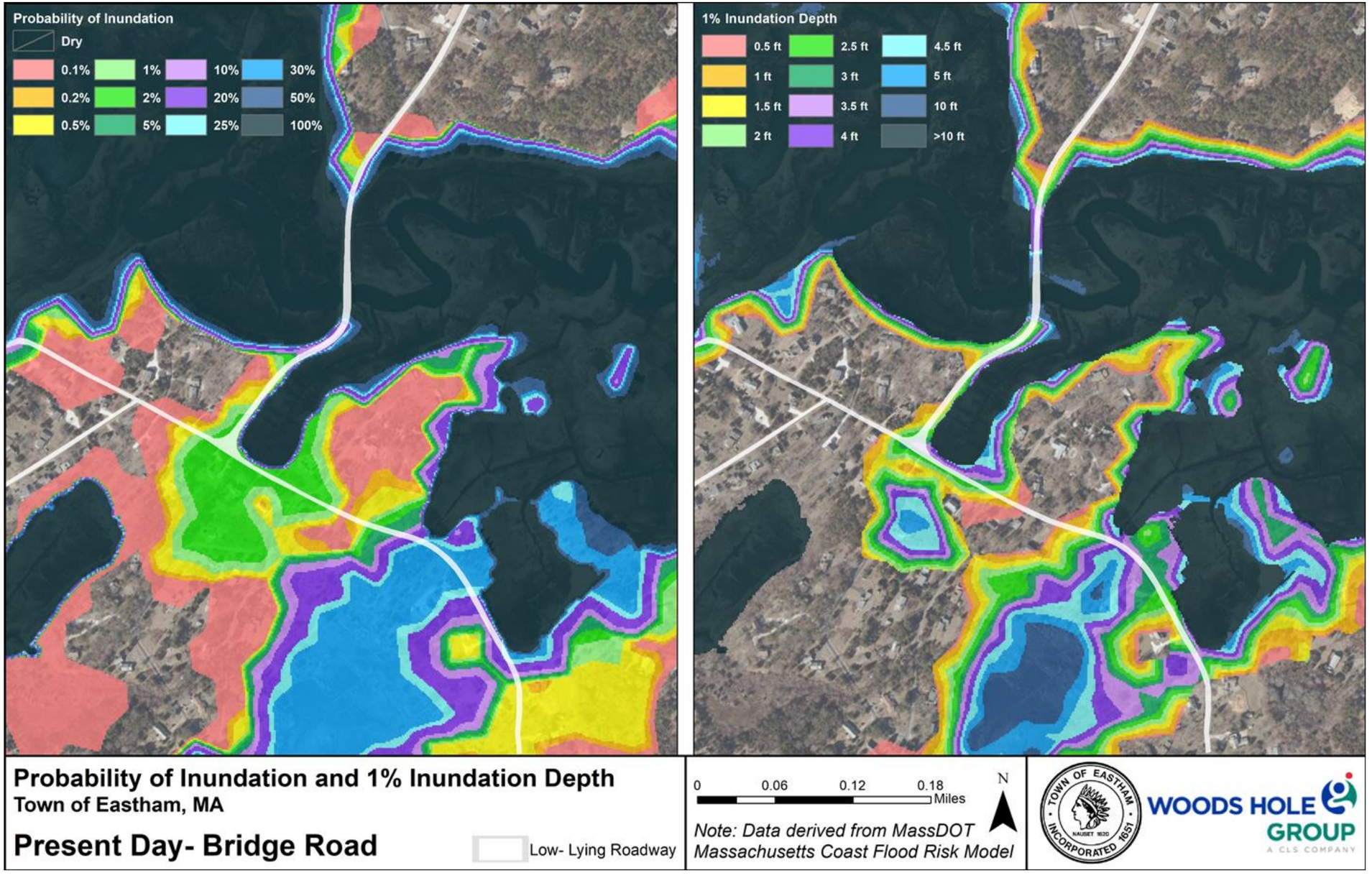


Figure 37. **Present day Bridge Road probability of inundation (left) and 1% depth of inundation (right).**

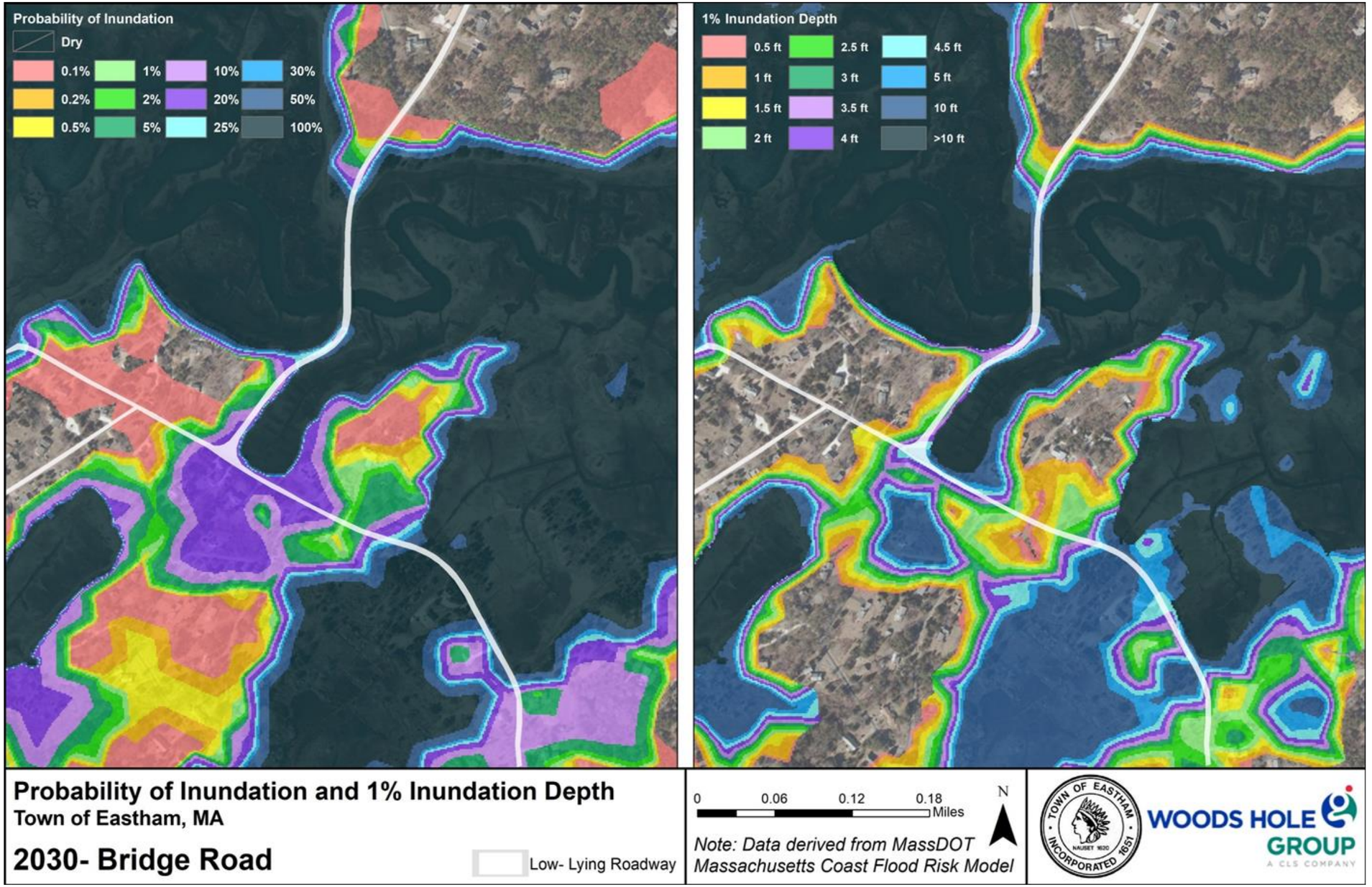


Figure 38. **2030 Bridge Road probability of inundation (left) and 1% depth of inundation (right).**

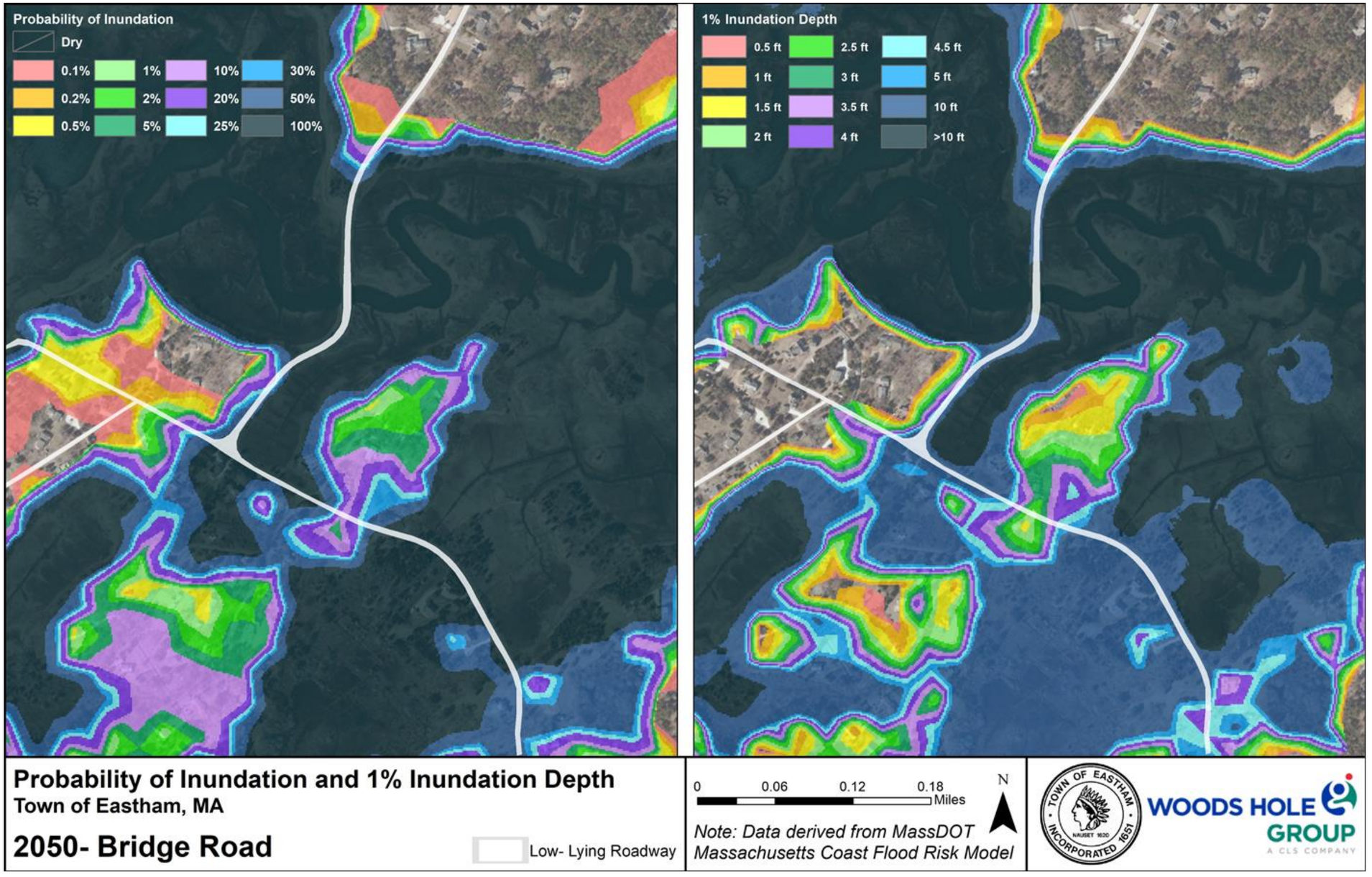


Figure 39. 2050 Bridge Road probability of inundation (left) and 1% depth of inundation (right).

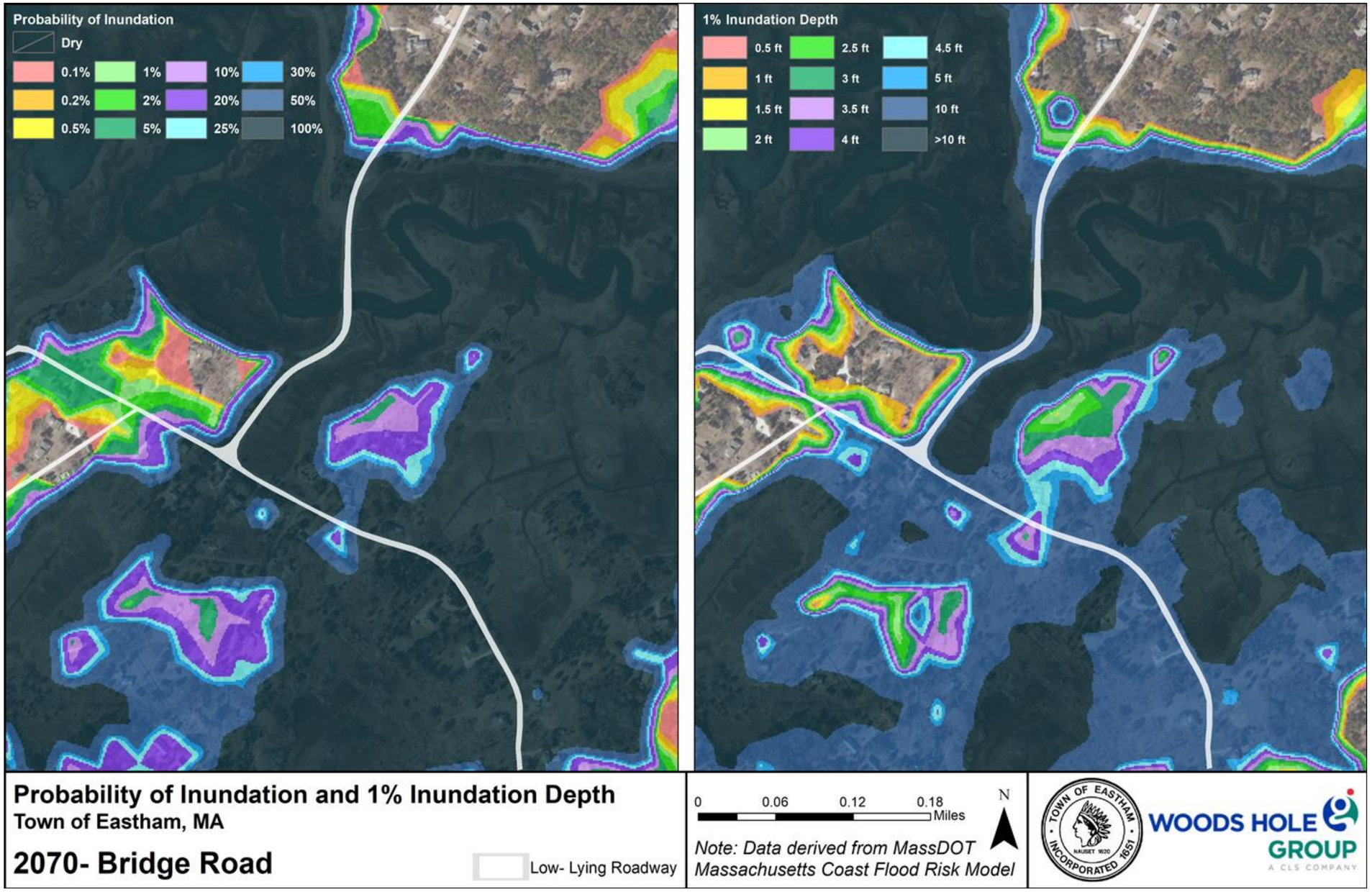


Figure 40. **2070 Bridge Road probability of inundation (left) and 1% depth of inundation (right).**

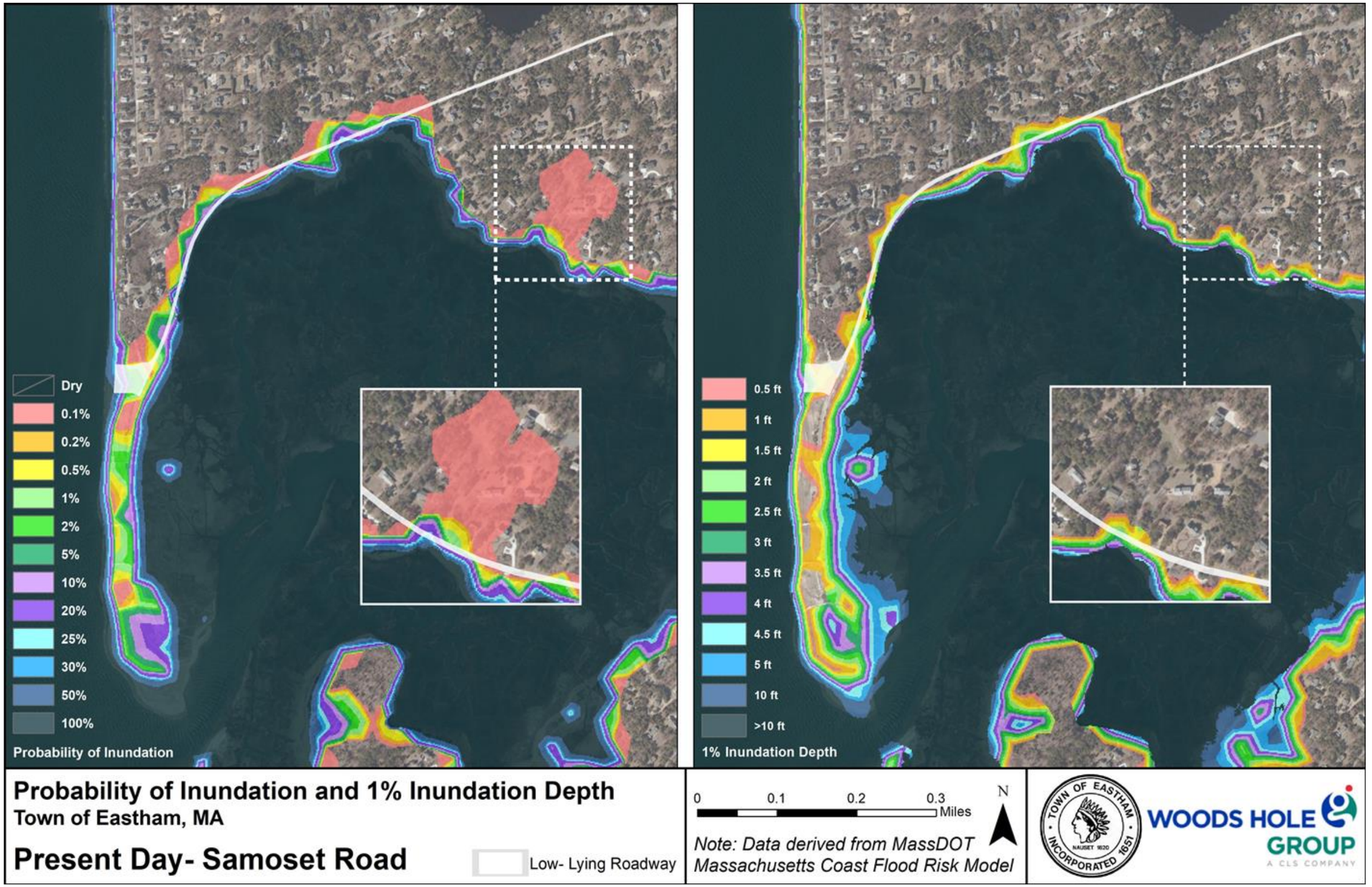


Figure 41. **Present day Samoset Road probability of inundation (left) and 1% depth of inundation (right).**

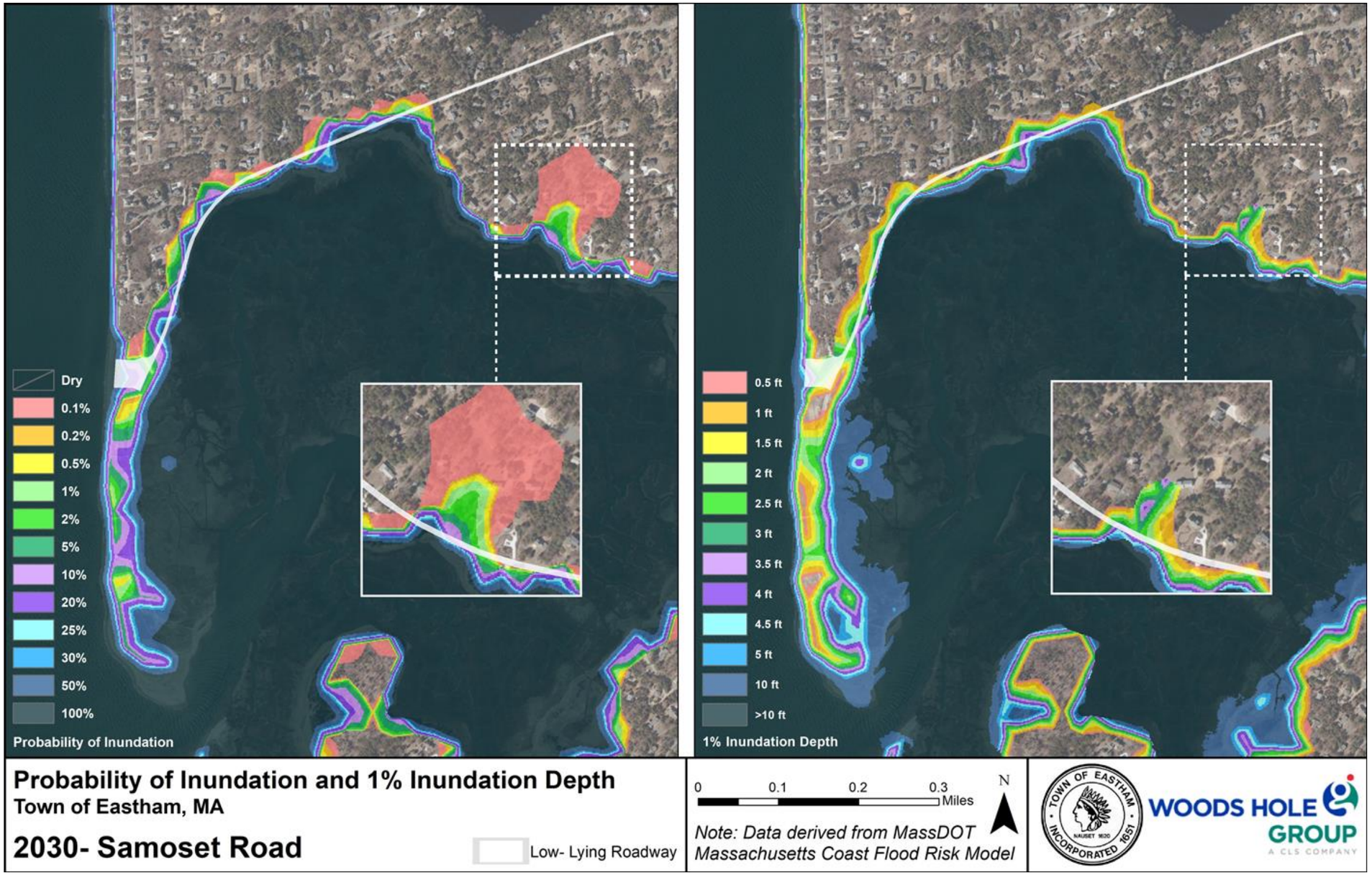


Figure 42. **2030 Samoset Road probability of inundation (left) and 1% depth of inundation (right).**

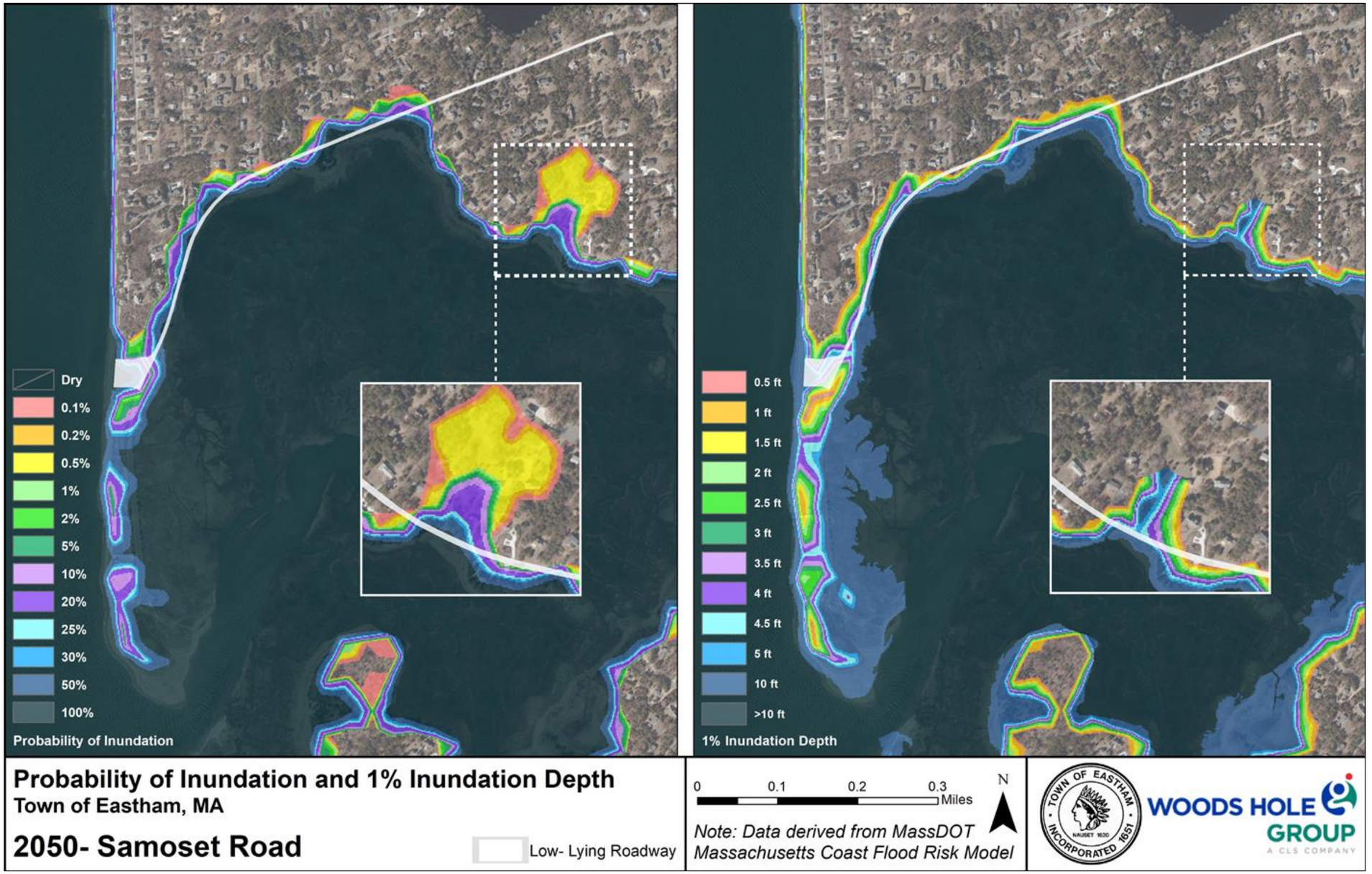


Figure 43. 2050 Samoset Road probability of inundation (left) and 1% depth of inundation (right).

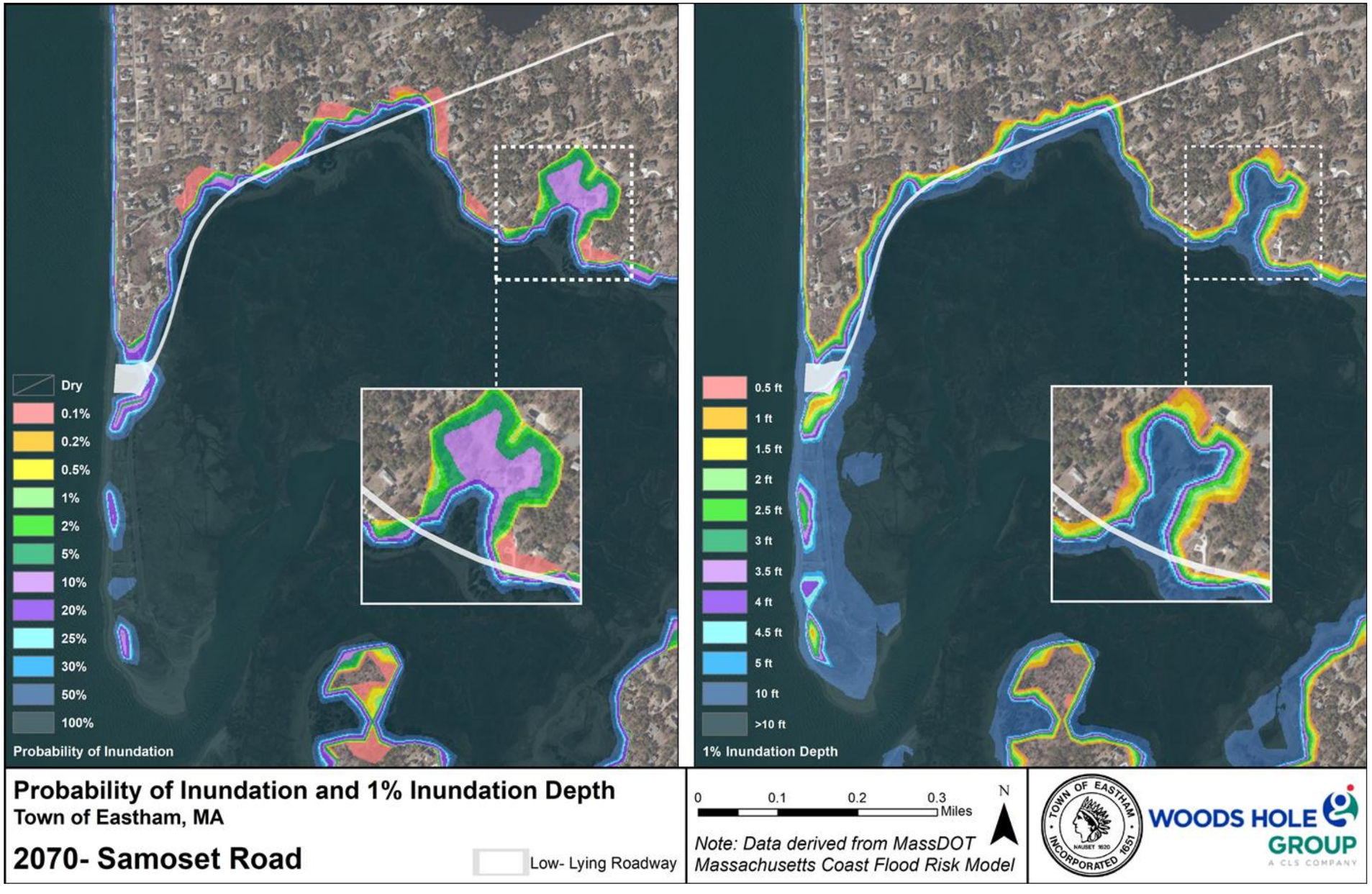


Figure 44. 2070 Samoset Road probability of inundation (left) and 1% depth of inundation (right).

3.3 EVALUATING THE CONSEQUENCE OF ROADWAY LOSS

The Woods Hole Group reviewed each series of inundation maps and figures with members of the municipal project team and local stakeholders during the first public meeting. Based on feedback received from the project team and from the public, the Woods Hole Group was able to begin differentiating between evaluating the importance of each roadway to the Town and its residents, a process called ***consequence scoring***. The consequence scoring methodology and results are important tools for stakeholders to discuss, build consensus on, and ultimately use for decision-making. They help answer the questions of which roadways are most important for the Town to maintain in the context of flooding and why. This section breaks down the consequence scoring process into more easily defined categories and scales. An iterative process of adjusting ratings for individual roadways relative to others helps calibrate the scores and rankings to better reflect stakeholder values and ultimately provides better inputs to the overall assessment. Stakeholder values influence the priority assigned to public investments of time and money, and the same is true for adaptation investment.

Once the inundation maps and figures were presented and reviewed, consequence scores for each low-lying roadway were developed in coordination with the Town of Eastham municipal project team comprised of multi-departmental municipal staff and public safety officials. To ensure a consistent understanding of the different scoring categories, the municipal project team first agreed to a basic set of assumptions relative to each roadway, prior to providing written responses to the various scoring criterion. Although each criterion was originally given a qualitative response by each municipal project team member, to ultimately compare the overall importance of each roadway to another, a numerical score was applied to each qualitative input. These numerical scores ranged from 1 to 10 for each criterion, with the most pressing responses (i.e., critical for emergency response, evacuation, high importance, etc.) earning a "high" score of 10. Less pressing responses received "moderate-high" scores of (8), "moderate" scores of (5), and "low" scores of (1), respectively. The explanations of the scoring criterion and evaluation categories are included in Table 6. Select feedback from the municipal project team regarding each roadway is included below. Full written responses from the municipal project team are included in Appendix G.

Smith Lane

- *"Need long-term planning for alternative access to WildCare and other properties. Road already flooding during storms. Increased frequency and magnitude of flooding will need to be addressed." – Shana Brogan, Conservation Agent*
- *"Road already prone to flooding from storm surge." – Adam Bohannon, Chief of Police*
- *"No alternative access if roadway is blocked." – Paul Lagg, Town Planner*
- *"Only means of egress for abutters." – Silvio Genao, DPW Director*

Dyer Prince Road

- *"Town's emergency response vessel is located at Rock Harbor. It also used to assist other towns, such as Orleans, who does not have an emergency response vessel in the Harbor and shares the responsibility with Eastham." – Shana Brogan, Conservation Agent*
- *"Road provides access to the harbor should a marine response be needed." – Adam Bohannon, Chief of Police*
- *"Rock Harbor facilities are important, and Town is investing in major infrastructure improvements." – Paul Lagg, Town Planner*
- *"Dyer Prince Road contains enough homes to warrant a concern if access is impeded." – Silvio Genao, DPW Director*

Bridge Road

- *"Bridge Road is the secondary evacuation route for the Outer Cape area. It is critical to remain passible, especially during peak population times as well as prior, after, and during storm events to maintain public safety, access impacted areas, and the remainder of the Town should Route 6 be impacted". – Shana Brogan, Conservation Agent*
- *"Bridge Road is a main artery within the town and essential for evacuation, travel, and emergency response." – Adam Bohannon, Chief of Police*
- *"Bridge Road provides the only alternate access to Route 6." – Paul Lagg, Town Planner*
- *"Bridge Road is the only alternate route through Eastham besides Route 6." – Silvio Genao, DPW Director*

Samoset Road

- *"The roadway needs to be passible in peak seasons as it leads to 30 acres of aquaculture businesses operated by residents, mooring fields, and the Town's most popular bathing beach. Several residential neighborhoods are located off Samoset." – Shana Brogan, Conservation Agent*
- *"Samoset Road is moderately populated with side and connecting roadways…It is important for access to municipal assets and Eastham's largest bathing beach is located at the end of the road. – Adam Bohannon, Chief of Police*
- *"Samoset is an important access point to the Bridge Road evacuation route and for access to commercial and recreational assets at First Encounter Beach" – Paul Lagg, Town Planner*
- *"Samoset Road and side streets contain enough homes to warrant a concern if access is impeded. Road is already experiencing erosion and loss of road edge in various locations. Loss of access to Eastham's largest beach and aquaculture grants would severely effect commercial shellfishing community." – Silvio Genao, DPW Director*

Results of the consequence scoring exercise are illustrated in the consequence scoring matrix (Table 7). The score for each criterion was determined separately and then a composite consequence of roadway

loss score was calculated by summing the scores for each low-lying road. The results allowed the municipal project team to gauge the overall importance of each roadway to the Town and to prioritize actions across each low-lying roadway site.

- Bridge Road and Samoset Road received "high" consequence scores, prompting the municipal project team to prioritize adaptation at each site in the near-term.
- Dyer Prince received a "moderate-high" consequence score, with adaptation required on the 2030-2050 planning horizon.
- Smith Lane received a "low" overall score but is still one of the most vulnerable low-lying roadways in Eastham, requiring adaptation on the 2050-2070 planning horizon, if not sooner.

Table 6. Consequence scoring criteria for low-lying roadway prioritization.

Evaluation Criteria	Explanation	Evaluation Categories
Importance of roadway for evacuation	Primary, secondary, non-critical for evacuation, etc. *Please explain.*	1 – Non-Critical 5 – Somewhat Important 8 – Secondary 10 – Primary
Importance of roadway for emergency response	Number of homes, vulnerable populations, etc. *Please explain.*	1 – Non-Critical 5 – Somewhat Important 8 – Important 10 - Critical
Importance of roadway for access to municipal assets	Utility access, boat ramps, shellfishing, beach parking, etc. *Please explain.*	1 – Non-Critical 5 – Somewhat Important 8 – Important 10 - Critical
Concerns relative to Sea Level Rise (SLR) (daily flooding)	Projected out from present-day, 2030, 2050, 2070, site-specific concerns, etc. *Please explain.*	1 – Low Concern 5 – Low-Medium Concern 8 – High Concern 10 – Very High Concern
Projected usable life of roadway relative to (SLR)	From Town's perspective, how long until SLR impacts render section of roadway impassible or unusable (relative to MA-DOT guidelines). *Please explain.*	1 – Long-Term 5 – Medium-Term 8 – Short-Term 10 – Very Short-Term
Concerns relative to storm surge	Projected out from present-day, 2030, 2050, 2070. *Please Explain.*	1 – Low Concern 5 – Low-Medium Concern 8 – High Concern 10 – Very High Concern
Projected tipping point of storm surge risk	At what point do things become unattainable at each site? Present, 2030, 2050, 2070? Town tolerance for inundation, asset loss, depth, frequency, duration, etc. *Please explain.*	1 – Beyond 2070 5 – 2050-2070 8 – 2050 10 – 2030-2050

Table 7. Consequence scoring matrix for low-lying roadways in the Town of Eastham.

	Smith Lane	Dyer Prince Road	Bridge Road	Samoset Road
Importance of Roadway for Evacuation	Low	Moderate	High	Moderate
Primary, Secondary, Non-Critical, etc.	Low	Moderate	High	Moderate
	Mod-High	Mod-High	Mod-High	Mod-High
	Mod-High	Mod-High	High	Mod-High
Importance of Roadway for Emergency Response	Low	Moderate	High	Moderate
Number of Homes, Vulnerable Populations, etc.	Moderate	Mod-High	High	Mod-High
	Mod-High	Mod-High	High	Mod-High
	Low	Mod-High	High	Mod-High
Importance of Roadway for Access to Municipal Assets	Low	High	High	High
Utility access, boat ramps, shellfishing, beach parking, etc.	Moderate	High	Mod-High	High
	Low	Mod-High	High	Mod-High
	Low	Mod-High	Mod-High	High
Concern Relative to Sea Level Rise (Daily Flooding)	Low	Moderate	High	Moderate
Projected out from present-day, 2030, 2050, 2070, site-specific concerns, etc.	Low	Mod-High	High	Mod-High
	Low	High	High	Moderate
	Low	Mod-High	High	Mod-High
Concerns Relative to Usable Life of Roadway	Low	Low	Mod-High	High
From Town's perspective, how long until sea level rise impacts render section of roadway impassible / unusable.	Moderate	Mod-High	High	Mod-High
Concerns Relative to Storm Surge Risk	High	High	High	High
Projected out from present-day, 2030, 2050, 2070.	Mod-High	High	High	Mod-High
	Low	High	High	High
	Low	High		High
Projected Tipping Point of Storm Surge Risk	2050	2030-2050	2030-2050	2030-2050
At what point do things become unattainable at each site? Present, 2030, 2050, 2070? Town tolerance for inundation, asset loss, depth, frequency, duration, etc.	2050-2070	2030-2050	2050	2030-2050
	2050-2070	2050	2030-2050	2050
Overall Score	**Low**	**Mod-High**	**High**	**High**
When Adaptation Needed	**2050-2070**	**2030-2050**	**Near-Term**	**Near-Term**

Scoring Rubric	
Low	Low
Moderate	Moderate
Mod-High	Mod-High
High	High

3.4 ASSESSMENT OF EXISTING INFRASTRUCTURE

Early in the project, the municipal project team and Woods Hole Group identified a series of municipal asset categories. During the site survey, a total of 242 individual assets across all asset categories were surveyed. Point data collected during the site survey was compared to MC-FRM flood risk probabilities calculated for each site to generate risk profiles for municipal assets located along each low-lying roadway. The risk profiles for each roadway illustrate the probability that individual assets along each road will be inundated by coastal storm surge from the present day though the 2030, 2050, and 2070 planning horizons. These data allowed the municipal project team to better understand the risk posed by storm surge to assets located along each road, empowering the Town to make informed decisions to improve the resilience of specific assets.

Risk profiles for assets located along each low-lying roadway are included in Tables 8-11. The tables include the survey point location for each asset, the coordinates and elevation of the asset, and the present day, 2030, 2050, and 2070 risk, presented as the probability the asset will be inundated during a given year. Risk levels are color-ramped to track changes in risk level through each planning horizon with red indicating the highest risk level. The MC-FRM flood risk probability tables used to generate the asset risk data are included in Appendix H.

- The assets at highest risk (100% annual probability of inundation) during present day conditions were primarily components of existing culverts (inverts, flapper gates, headwalls, etc.), commonly inundated during higher high tide event and storms. These frequently inundated assets account for approximately 11% of the total assets surveyed.
- Projected out to the 2030 planning horizon, utility infrastructure (water gates, utility poles, etc.) along the lowest-lying sections roadway become more at-risk, putting 18% of the total assets at risk.
- Projected out to the 2050 planning horizon, a greater diversity of utility infrastructure including fire hydrant bases and spindles, telephone boxes become impacted, putting approximately 35% of total assets at risk.
- Like the supporting inundation maps and figures, there is a tipping point in the asset risk maps between the 2050 and 2070 planning horizons. Between 2050 and 2070, 67% of total assets become at risk of inundation annually.

It is important to note that not all assets that become inundated will be damaged, require repair, or replacement. For instance, culverts, water gates supporting below-grade utility infrastructure, and fire hydrants may be able to stand up to more frequent inundation than utility poles along eroding banks, exposed gas valves, and telephone boxes. This analysis provides the Town with the foundation necessary to identify and adapt, retrofit, or relocate its most vulnerable assets and make informed decisions to improve the resilience of each low-lying roadway and associated infrastructure.

Table 8. Storm surge risk profile for assets located along Smith Lane, presented as annual probability of inundation.

Smith Lane								
Point	Northing	Easting	Elevation	Description	Present Day	2030 Risk	2050 Risk	2070 Risk
1147	2756028.699	1069592.647	0.38	Culvert Invert	100	100	100	100
1162	2756046.644	1069624.899	1.00	Culvert Invert	100	100	100	100
9738	2755599.577	1069209.678	1.15	Culvert Invert	100	100	100	100
9739	2755599.59	1069209.686	1.23	Culvert Invert	100	100	100	100
1148	2756029.146	1069593.102	3.06	Top of Culvert	100	100	100	100
1161	2756046.324	1069624.445	3.77	Top of Culvert	100	100	100	100
9741	2755651.137	1069169.518	4.45	Top of Culvert Flapper	100	100	100	100
9740	2755651.114	1069169.496	4.46	Top of Culvert Flapper	100	100	100	100
9735	2755650.732	1069169.684	5.10	Culvert Headwall	100	100	100	100
9737	2755600.495	1069208.437	5.89	Culvert Headwall	100	100	100	100
9736	2755600.413	1069208.473	5.93	Culvert Headwall	100	100	100	100
1139	2755969.669	1069606.512	6.05	Water Gate	100	100	100	100
1140	2755969.679	1069606.487	6.05	Water Gate	100	100	100	100
1143	2755991.1	1069622.941	6.40	Water Gate	100	100	100	100
1141	2755964.351	1069609.045	6.57	Fire Hydrant Base	100	100	100	100
1216	2755911.794	1069496.316	6.91	Utility Pole	>50	>50	100	100
1248	2755766.861	1069382.405	7.86	Fire Hydrant Base	>0.2	>0.2	100	100
1234	2755653.947	1069331.706	7.95	Catch Basin	>0.1	>0.1	100	100
1231	2755781.782	1069343.076	8.05	Utility Pole	<0.1	<0.1	100	100
1172	2755772.918	1069377.3	8.05	Water Gate	<0.1	<0.1	100	100
1173	2755771.25	1069373.621	8.11	Water Gate	<0.1	<0.1	100	100
1200	2755679.266	1069233.06	8.88	Catch Basin	<0.1	<0.1	>50	100
1142	2755964.748	1069609.628	9.02	Fire Hydrant Spindle	<0.1	<0.1	>50	100
1176	2755662.642	1069247.199	9.23	Catch Basin	<0.1	<0.1	>50	100
1230	2755651.221	1069193.492	9.61	Utility Pole	<0.1	<0.1	>50	100
1189	2755304.854	1068833.12	11.13	Fire Hydrant Spindle	<0.1	<0.1	>2	>50
1229	2755518.924	1069039.005	11.71	Utility Pole	<0.1	<0.1	>1	>30
1228	2755388.324	1068888.016	11.87	Utility Pole	<0.1	<0.1	>0.5	>30

Table 9. Storm surge risk profile for assets located along Samoset Road. Presented as annual probability of inundation.

Dyer Prince Road								
Point	Northing	Easting	Elevation	Description	Present Day	2030 Risk	2050 Risk	2070 Risk
1147	2756028.699	1069592.647	0.38	Culvert Invert	100	100	100	100
1162	2756046.644	1069624.899	1.00	Culvert Invert	100	100	100	100
9738	2755599.577	1069209.678	1.15	Culvert Invert	100	100	100	100
1148	2756029.146	1069593.102	3.06	Culvert Top	100	100	100	100
1161	2756046.324	1069624.445	3.77	Culvert Top	100	100	100	100
9740	2755651.114	1069169.496	4.46	Culvert Flapper	100	100	100	100
9735	2755650.732	1069169.684	5.10	Culvert Headwall	100	100	100	100
9736	2755600.413	1069208.473	5.93	Culvert Headwall	100	100	100	100
1139	2755969.669	1069606.512	6.05	Water Gate	>50	100	100	100
1140	2755969.679	1069606.487	6.05	Water Gate	>50	100	100	100
1145	2755964.426	1069662.488	6.28	Utility Pole	>50	100	100	100
1143	2755991.1	1069622.941	6.40	Water Gate	>50	100	100	100
1141	2755964.351	1069609.045	6.57	Fire Hydrant Base	>50	100	100	100
1144	2755956.989	1069638.816	6.58	Utility Pole	>50	100	100	100
1455	2756222.985	1065370.328	6.80	Utility Pole	>50	100	100	100
1216	2755911.794	1069496.316	6.91	Utility Pole	>50	100	100	100
1582	2756222.429	1065369.911	6.95	Utility Pole	>50	100	100	100
1423	2756206.824	1065400.358	6.99	Fire Hydrant Base	>50	100	100	100
1560	2756206.736	1065400.681	7.02	Fire Hydrant Base	>50	100	100	100
1421	2756197.514	1065394.69	7.04	Water Gate	>50	100	100	100
1422	2756197.696	1065391.621	7.05	Water Gate	>50	100	100	100
9726	2756502.517	1063539.102	7.23	Fire Hydrant Base	>30	>50	100	100
1265	2756491.63	1063543.707	7.31	Water Gate	>30	>50	100	100
1267	2756503.611	1063539.399	7.53	Fire Hydrant Base	>30	>50	100	100
1146	2756102.221	1069594.295	7.66	Utility Pole	>30	>50	100	100
1326	2756616.301	1064140.752	7.71	Water Gate	>30	>50	100	100
1327	2756616.275	1064137.03	7.73	Water Gate	>30	>50	100	100
1325	2756613.688	1064143.908	7.74	Water Gate	>25	>50	100	100
1248	2755766.861	1069382.405	7.86	Fire Hydrant Base	>25	>50	100	100
1346	2756596.703	1064131.804	7.87	Utility Pole	>25	>50	100	100
1432	2756166.832	1065407.6	7.92	Utility Pole	>20	>50	100	100
1263	2756512.39	1063576.935	7.95	Utility Pole	>20	>50	100	100
1234	2755653.947	1069331.706	7.95	Catch Basin	>20	>50	100	100
1559	2756166.632	1065407.372	7.97	Utility Pole	>20	>50	100	100
1231	2755781.782	1069343.076	8.05	Utility Pole	>20	>50	100	100
1172	2755772.918	1069377.3	8.05	Water Gate	>20	>50	100	100
1173	2755771.25	1069373.621	8.11	Water Gate	>10	>50	100	100
1236	2755645.265	1069336.819	8.26	Manhole	>10	>50	>50	100
1328	2756627.372	1064144.958	8.31	Fire Hydrant Base	>10	>50	>50	100
1343	2756490.62	1064453.13	8.48	Utility Pole	>10	>30	>50	100
10520	2756416.85	1064704.532	8.54	Water Gate	>10	>30	>50	100
10519	2756416.804	1064704.438	8.56	Water Gate	>10	>30	>50	100
1911	2756467.236	1064641.382	8.57	Fire Hydrant Base	>10	>30	>50	100
8002	2756545.917	1064289.98	8.60	Bell Phone	>5	>30	>50	100
1344	2756543.972	1064294.201	8.64	Utility Pole	>5	>30	>50	100
1345	2756584.911	1064282.727	8.70	Utility Pole	>5	>30	>50	100
1910	2756458.886	1064639.937	8.74	Water Gate	>5	>30	>50	100
8001	2756577.117	1064283.233	8.86	Bell Phone	>5	>30	>50	100
1200	2755679.266	1069233.06	8.88	Catch Basin	>5	>30	>50	100
1893	2756429.391	1064683.951	8.92	Utility Pole	>5	>30	>50	100
1142	2755964.748	1069609.628	9.02	Fire Hydrant Spindle	>5	>25	>50	100
8003	2756447.933	1064759.192	9.06	Bell Phone	>5	>25	>50	100
1892	2756436.681	1064624.72	9.09	Utility Pole	>2	>25	>50	100
1895	2756413.714	1064752.11	9.17	Utility Box	>2	>20	>50	100
1370	2756421.222	1064618.324	9.17	Utility Pole	>2	>20	>50	100
9730	2756314.379	1063224.838	9.22	Fire Hydrant Base	>2	>20	>50	100
1176	2755662.642	1069247.199	9.23	Catch Basin	>2	>20	>50	100

Dyer Prince Road Cont'd								
Point	Northing	Easting	Elevation	Description	Present Day	2030 Risk	2050 Risk	2070 Risk
9732	2756313.626	1063225.431	9.41	Fire Hydrant Base	>2	>10	>50	100
1509	2755956.545	1065938.383	9.42	Utility Pole	>2	>10	>50	100
1566	2756277.074	1065194.477	9.56	Utility Pole	>2	>10	>50	100
1230	2755651.221	1069193.492	9.61	Utility Pole	>2	>10	>50	100
1438	2756277.697	1065195.021	9.64	Utility Pole	>2	>10	>50	100
1439	2756279.149	1065193.009	9.67	Utility Box	>2	>10	>50	100
1366	2756362.92	1063203.435	9.74	Utility Pole	>1	>10	>30	100
1474	2755863.985	1066361.901	9.80	Fire Hydrant Base	>1	>10	>30	100
1506	2756013.491	1065776.8	9.82	Utility Pole	>1	>10	>30	100
1519	2755808.001	1066437.973	9.85	Utility Pole	>1	>5	>30	100
1473	2755855.093	1066359.152	9.87	Water Gate	>1	>5	>30	100
1462	2755998.872	1065873.516	9.92	Water Gate	>1	>5	>30	100
1472	2755854.602	1066356.168	9.94	Water Gate	>1	>5	>30	100
1906	2756434.745	1064824.537	9.96	Utility Box	>1	>5	>30	100
1525	2755704.85	1066761.747	9.99	Utility Pole	>1	>5	>30	100
1415	2756304.214	1065183.932	10.00	Water Gate	>1	>5	>30	100
1567	2756304.062	1065184.023	10.00	Water Gate	>1	>5	>30	100
1513	2755896.603	1066137.736	10.01	Utility Pole	>1	>5	>30	>50
1568	2756306.754	1065182.014	10.10	Water Gate	>1	>5	>30	>50
9728	2756503.279	1063538.693	10.12	Fire Hydrant Spindle	>1	>5	>30	>50
1414	2756306.897	1065181.964	10.12	Water Gate	>1	>5	>30	>50
1268	2756503.655	1063539.445	10.32	Fire Hydrant Spindle	>0.5	>5	>30	>50
1272	2756441.124	1063387.69	10.34	Utility Pole	>0.5	>2	>30	>50
8000	2756620.568	1063994.941	10.40	Bell Phone	>0.5	>2	>30	>50
1516	2755852.877	1066283.022	10.41	Utility Pole	>0.5	>2	>30	>50
1463	2756007.695	1065877.121	10.49	Fire Hydrant Base	>0.5	>2	>25	>50
1482	2755714.188	1066823.607	10.54	Fire Hydrant Base	>0.5	>2	>25	>50
1483	2755707.014	1066820.7	10.63	Water Gate	>0.2	>2	>25	>50
1569	2756316.717	1065157.751	10.70	Water Gate	>0.2	>2	>20	>50
1554	2756061.28	1065645.916	10.80	Utility Pole	>0.2	>2	>20	>50
1502	2755609.711	1067087.235	10.90	Utility Pole	>0.2	>2	>10	>50
1570	2756324.331	1065149.702	10.95	Water Gate	>0.2	>2	>10	>50
1410	2756324.632	1065149.264	10.97	Water Gate	>0.2	>2	>10	>50
1329	2756627.168	1064144.935	10.98	Fire Hydrant Spindle	>0.2	>1	>10	>50
1571	2756324.878	1065146.239	11.02	Water Gate	>0.2	>1	>10	>50
1411	2756324.972	1065146.169	11.04	Water Gate	>0.2	>1	>10	>50
1189	2755304.854	1068833.12	11.13	Fire Hydrant Base	>0.2	>1	>10	>50
1522	2755758.805	1066595.319	11.15	Utility Pole	>0.2	>1	>10	>50
1412	2756334.926	1065154.767	11.20	Fire Hydrant Base	>0.1	>1	>10	>50
1572	2756334.544	1065154.831	11.22	Fire Hydrant Base	>0.1	>1	>10	>50
1912	2756467.064	1064641.465	11.50	Fire Hydrant Spindle	>0.1	>0.5	>10	>50
1229	2755518.924	1069039.005	11.71	Utility Pole	<0.1	>0.5	>5	>30
1228	2755388.324	1068888.016	11.87	Utility Pole	<0.1	>0.5	>5	>30
1260	2756562.056	1063711.962	11.91	Utility Pole	<0.1	>0.2	>5	>30
1102	2756484.321	1068726.266	12.21	Utility Pole	<0.1	>0.2	>2	>30
1258	2756592.159	1063754.768	12.23	Catch Basin	<0.1	>0.2	>2	>30
9733	2756313.555	1063224.625	12.31	Fire Hydrant Spindle	<0.1	>0.2	>2	>25
1353	2756598.186	1063772.844	12.48	Catch Basin	<0.1	>0.2	>2	>20
1103	2756481.922	1068740.113	12.49	Utility Pole	<0.1	>0.2	>2	>20
1257	2756582.754	1063746.214	12.77	Manhole	<0.1	>0.1	>2	>10
1347	2756651.798	1063959.996	12.78	Utility Pole	<0.1	>0.1	>2	>10
1255	2756583.724	1063786.868	12.83	Water Gate	<0.1	>0.1	>2	>10
1355	2756583.746	1063786.881	12.84	Water Gate	<0.1	>0.1	>2	>10
1253	2756604.496	1063822.336	13.25	Utility Pole	<0.1	<0.1	>1	>10
1354	2756608.133	1063790.717	13.31	Manhole	<0.1	<0.1	>1	>10

Table 10. Storm surge risk profile for assets located along Bridge Road. Presented as annual probability of inundation.

Bridge Road								
Point	Northing	Easting	Elevation	Description	Present Day	2030 Risk	2050 Risk	2070 Risk
8004	2757449.068	1066631.806	2.74	Top of Culvert	100	100	100	100
1785	2757371.925	1066649.649	3.83	Culvert Invert	100	100	100	100
8005	2757448.424	1066632.017	3.87	Culvert Invert	100	100	100	100
1784	2757372.634	1066650.376	5.67	Top of Culvert	100	100	100	100
1788	2757415.817	1066598.366	6.92	Water Gate	>50	100	100	100
1787	2757415.423	1066602.91	6.98	Water Gate	>50	100	100	100
1789	2757430.091	1066565.634	7.07	Water Gate	>50	100	100	100
1791	2757422.792	1066563.419	7.10	Fire Hydrant Base	>50	>50	100	100
1790	2757433.066	1066563.072	7.21	Water Gate	>30	>50	100	100
1803	2757379.851	1066696.232	7.69	Utility Pole	>30	>50	100	100
1722	2757805.148	1065778.748	7.82	Water Gate	>25	>50	100	100
1657	2758563.059	1066268.436	7.86	Bridge Armor	>25	>50	100	100
1723	2757810.933	1065778.023	7.93	Water Gate	>20	>50	100	100
1800	2757440.929	1066602.421	7.94	Utility Pole	>20	>50	100	100
1718	2757821.502	1065750.28	8.06	Water Gate	>10	>50	100	100
1662	2758476.478	1066308.21	8.07	Bottom Watermain	>10	>50	100	100
1765	2756932.739	1066964.971	8.08	Utility Pole	>10	>50	100	100
1717	2757824.826	1065747.562	8.16	Water Gate	>10	>50	>50	100
1778	2757146.034	1066811.157	8.29	Fire Hydrant Base	>10	>50	>50	100
1726	2757755.735	1065832.954	8.30	Utility Pole	>10	>50	>50	100
1658	2758502.177	1066308.291	8.34	Bridge Armor	>10	>50	>50	100
1721	2757813.115	1065748.685	8.34	Utility Pole	>10	>50	>50	100
1700	2758476.615	1066260.673	8.36	Gas Valve	>10	>50	>50	100
1753	2757295.481	1066764.438	8.37	Utility Pole	>10	>50	>50	100
1699	2758476.717	1066260.649	8.37	Gas Valve	>10	>50	>50	100
1684	2758354.585	1066312.036	8.40	Water Gate	>10	>30	>50	100
1777	2757151.453	1066820.081	8.41	Water Gate	>10	>30	>50	100
1719	2757815.686	1065745.8	8.45	Fire Hydrant Base	>10	>30	>50	100
1760	2757081.266	1066882.646	8.45	Utility Pole	>10	>30	>50	100
1761	2757080.895	1066881.91	8.48	Utility Pole	>10	>30	>50	100
1756	2757194.963	1066819.709	8.52	Utility Pole	>10	>30	>50	100
1661	2758478.894	1066307.755	9.00	Top Watermain	>5	>25	>50	100
1660	2758476.712	1066304.655	9.06	Base Bridge Utility	>2	>25	>50	100
1795	2757475.035	1066498.517	9.12	Utility Pole	>2	>25	>50	100
1707	2758139.919	1066030.826	9.17	Water Gate	>2	>20	>50	100
1705	2758167.731	1066038.069	9.20	Utility Pole	>2	>20	>50	100
1659	2758477.851	1066304.908	9.29	Base Bridge Utility	>2	>20	>50	100
1599	2758916.574	1066347.259	9.40	Manhole	>2	>10	>50	100
1670	2758396.427	1066305.59	9.41	Base Bridge Utility	>2	>10	>50	100
1654	2758821.639	1066294.015	9.43	Water Gate	>2	>10	>50	100
1688	2758400.277	1066263.447	9.49	Bridge Abutment	>2	>10	>50	100
1641	2758521.833	1066279.746	9.55	Electrical Gate	>2	>10	>50	100
1642	2758521.748	1066279.851	9.55	Water Gate	>2	>10	>50	100
1770	2756815.976	1066999.296	9.62	Utility Pole	>1	>10	>50	100
1598	2758925.35	1066351.249	9.72	Manhole	>1	>10	>50	100
1671	2758394.282	1066308.785	9.76	Base Watermain	>1	>10	>30	100
1655	2758823.697	1066282.917	9.82	Fire Hydrant Base	>1	>10	>30	100
1708	2758149.195	1066022.324	9.87	Fire Hydrant Base	>1	>10	>30	100
1680	2758376.153	1066308.123	10.01	Bridge Armor	>1	>5	>30	100
1669	2758396.39	1066305.245	10.05	Base Bridge Utility	>0.5	>5	>30	>50
1595	2758962.322	1066376.16	10.28	Utility Pole	>0.5	>5	>30	>50
1685	2758311.458	1066254.071	10.30	Bridge Armor	>0.5	>5	>30	>50
1681	2758353.675	1066305.438	10.77	Water Gate	>0.2	>2	>20	>50
1678	2758471.877	1066302.65	10.79	Bridge Abutment	>0.2	>2	>20	>50
1694	2758471.695	1066263.249	10.83	Bridge Abutment	>0.2	>2	>20	>50
1632	2758339.167	1066272.346	10.89	Water Gate	>0.2	>2	>20	>50
1720	2757815.874	1065746.189	11.03	Fire Hydrant Spindle	>0.2	>2	>10	>50

Bridge Road Cont'd								
Point	Northing	Easting	Elevation	Description	Present Day	2030 Risk	2050 Risk	2070 Risk
1679	2758400.32	1066302.791	11.06	Bridge Abutment	>0.1	>2	>10	>50
1695	2758471.626	1066262.783	11.10	bot ut 8in	>0.1	>1	>10	>50
1675	2758433.866	1066304.485	11.19	Bottom of Bridge Utility	>0.1	>1	>10	>50
1674	2758433.773	1066304.394	12.04	Top of Bridge Utility Bra	<0.1	>0.5	>5	>30
1656	2758823.428	1066282.939	12.57	Fire Hydrant Spindle	<0.1	>0.2	>2	>20
1664	2758470.152	1066303.417	13.18	Bottom Watermain	<0.1	<0.1	>1	>10
1592	2759049.325	1066387.018	13.90	Utility Pole	<0.1	<0.1	>0.5	>5
1663	2758470.175	1066303.369	14.78	Top Watermain	<0.1	<0.1	>0.2	>1
1665	2758443.947	1066303.454	14.94	Top Watermain	<0.1	<0.1	>0.2	>1

Table 11. Storm surge risk profile for assets located along Samoset Road. Presented as annual probability of inundation.

Samoset Road								
Point	Northing	Easting	Elevation	Description	Present Risk	2030 Risk	2050 Risk	2070 Risk
1825	2764330.778	1064482.539	6.563	Utility Pole	>50	100	100	100
1837	2764424.282	1064492.626	7.6885	Water Gate	>30	>50	100	100
1864	2763680.794	1064238.172	7.8406	Fire Hydrant Base	>25	>50	100	100
1958	2765066.478	1065515.08	7.9057	Catch Basin	>25	>50	100	100
1962	2765039.879	1065433.225	7.9276	Water Gate	>25	>50	100	100
1963	2765037.745	1065430.167	7.9286	Water Gate	>25	>50	100	100
1933	2765090.526	1065505.553	7.9509	Catch Basin	>20	>50	100	100
1964	2765027.376	1065434.052	7.9819	Fire Hydrant Base	>20	>50	100	100
1959	2765055.252	1065505.62	8.0422	Utility Pole	>20	>50	100	100
1838	2764427.929	1064483.806	8.4736	Fire Hydrant Base	>10	>50	>50	100
1843	2764291.228	1064446.796	8.6988	Water Gate	>5	>30	>50	100
1862	2763734.88	1064268.018	8.7642	Utility Box	>5	>30	>50	100
1966	2765015.286	1065371.03	9.1304	Water Gate	>2	>25	>50	100
1967	2765012.751	1065368.285	9.2225	Water Gate	>2	>20	>50	100
1968	2765004.334	1065381.287	9.4092	Utility Pole	>2	>10	>50	100
1950	2765154.781	1065753.377	9.4453	Utility Pole	>2	>10	>50	100
1884	2764671.033	1064662.852	10.4167	Water Gate	>0.2	>2	>30	>50
1883	2764673.988	1064664.672	10.6152	Water Gate	>0.2	>2	>25	>50
1882	2764675.626	1064668.212	10.7534	Water Gate	>0.2	>2	>20	>50
1947	2765215.301	1065880.782	10.7745	Catch Basin	>0.2	>2	>20	>50
1940	2765239.844	1065870.528	10.9212	Catch Basin	>0.2	>2	>20	>50
1852	2764026.378	1064372.827	11.1395	Water Gate	>0.1	>1	>10	>50
1853	2764028.838	1064364.038	11.5794	Fire Hydrant Spindle	<0.1	>0.5	>10	>50
1945	2765220.476	1065911.075	11.6854	Utility Pole	<0.1	>0.5	>5	>30
1927	2764975.737	1065222.69	12.0165	Catch Basin	<0.1	>0.2	>5	>30
1974	2764950.478	1065232.208	12.1024	Catch Basin	<0.1	>0.2	>5	>30
1973	2764953.035	1065256.549	12.8156	Utility Pole	<0.1	>0.1	>1	>10
1979	2764878.977	1065081.062	15.2169	Utility Pole	<0.1	<0.1	>0.1	>1
1981	2764855.379	1065011.734	16.2652	Catch Basin	<0.1	<0.1	<0.1	>0.2
1989	2764793.561	1064869.291	16.2934	Fire Hydrant Base	<0.1	<0.1	<0.1	>0.2
1875	2764797.701	1064801.108	16.4428	Utility Pole	<0.1	<0.1	<0.1	>0.2
1988	2764802.163	1064864.234	16.5534	Water Gate	<0.1	<0.1	<0.1	>0.2
1983	2764851.722	1065002.101	16.6955	Utility Pole	<0.1	<0.1	<0.1	>0.1
1985	2764838.895	1064941.39	17.0359	Water Gate	<0.1	<0.1	<0.1	>0.1
1982	2764851.426	1065000.126	17.0604	Gas Valve	<0.1	<0.1	<0.1	>0.1
1990	2764793.616	1064868.814	19.0154	Fire Hydrant Spindle	<0.1	<0.1	<0.1	<0.1

3.5 PUBLIC MEETING AND STAKEHOLDER FEEDBACK

To solicit direct feedback from stakeholders, Town officials advertised the first of 2 public meetings to the 300+ direct and indirect abutters along the low-lying roadways. Due to restrictions placed on municipal meeting and public gatherings due to COVID-19, the meeting was held remotely through Zoom, recorded, and aired on public access Channel 18 to ensure that the greatest number of individuals were able to attend. The meeting included a presentation of inundation maps and figures. Significant time was also allocated to address public questions and comments. After the public meeting, additional written questions and comments were submitted directly to the Conservation Administrator. A record of public feedback was recorded and submitted to the Town is included in Appendix I. The public meeting poster is included in Figure 45. Specific feedback from the meeting is included below, which helped to guide the development of conceptual design alternatives presented in the next section of the report.

- *"While all these roads are vulnerable, Bridge Road is the most essential of the roads under consideration."*
- *"The Town can't raise every road – consider what is practical. Why would Town spend funds investing in roads that can't be saved?"*
- *"Before one raises the road, consider the dam it creates – if you block water flow it can create other problems."*
- *"Forcing flooding elsewhere or redirecting storm surge elsewhere may be problematic."*
- *"Flooding of adjacent private parcels should be a major consideration. Are there ways that the projections can lend themselves to private abutters?"*

LOW-LYING ROADS

A Vulnerability Assessment of Bridge Rd, Dyer Prince Rd, Samoset Rd and Smith Lane.

Wednesday, May 27, 2020 | TIME: 6:00PM ZOOM LINK:
https://us02web.zoom.us/j/88613975067?pwd=NFJzRTRZNWNTS2puSDhGaklla3VzUT09

MEETING ID: 886 1397 5067, PASSWORD: 290214

Please join the Conservation Department, Woods Hole Group, and public safety officials to learn about the results from assessing flooding a sea level rise impacts to several main roads in Eastham. Provide your experiences, and thoughts on various adaptive solutions for these roadways.

Shana Brogan
Eastham Conservation Department
555 Old Orchard Road, Eastham, MA
508-240-5971
conservation@eastham-ma.gov

❖ *This project has been funded by the Massachusetts Office of Coastal Zone Management's Coastal Resiliency Grant program.*

Figure 45. Town of Eastham CZM Resiliency Grant Project public meeting poster.

4.0 ADAPTATION ALTERNATIVES

To provide the Town of Eastham with a full suite of alternatives to improve the resilience of low-lying roadways, the Woods Hole Group considered green, living-shorelines approaches, hybrid alternatives, and grey-hardened solutions for the roadway side slopes. Consideration was given to the Massachusetts CZM Storm Smart Coasts manual when evaluating and developing the conceptual designs. Given the diversity and site-specific characteristics of each low-lying roadway, it is likely that a combination of alternatives (rather than a single, preferred alternative) will be necessary at each site to help the Town achieve its goal of reducing risk and improving the resilience of low-lying roadways. The suite of alternatives considered is included in Figure 46. In addition to the alternatives outlined in Figure 46, the Town also considered a more limited option: *Maintain Existing Infrastructure*, to shore up roadways at risk of imminent failure and a more drastic option: *Phased Retreat-Roadway Relocation* which would involve siting alternative routes through Town and retreating from the most vulnerable sections of roadway.

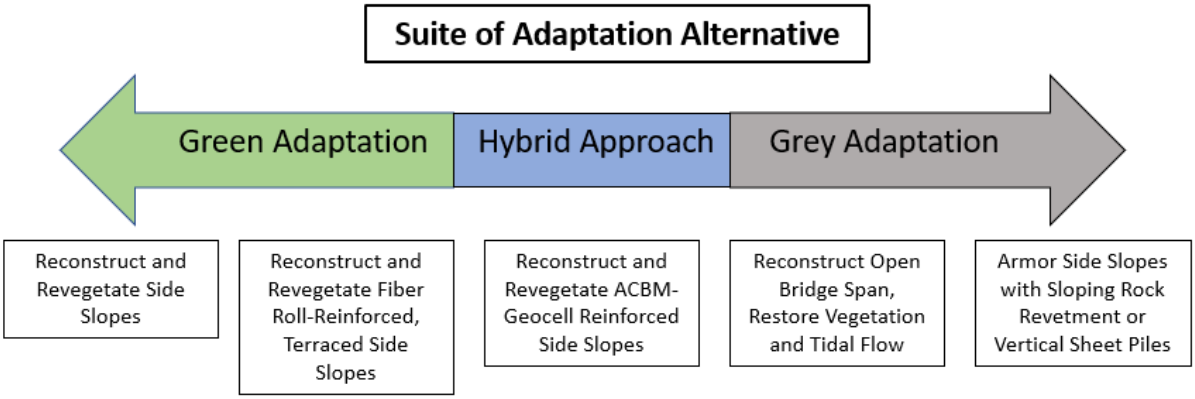


Figure 46. Suite of Adaptation Alternatives developed for the Town of Eastham

Each alternative assumes that the targeted roadway will be raised to a predetermined elevation before reconstructing the side slopes. During the design phase of the project, a wind-wave and overtopping analysis will be conducted to establish design criteria (appropriate roadway height, side slope width, need for slope reinforcement, etc.) for each site. The analysis will include modeling the system(s) relative to existing and future tidal regimes as well as coastal storm scenarios. Once design criteria are established, a 2D hydrodynamic model will be developed to evaluate potential adverse impacts (exacerbated flooding, impacts to adjacent properties, end effect erosion, etc.) associated with the preferred design alternative(s). For the purposes of this project, it was anticipated that the roadways will be raised to a level equal to or greater than the projected 2070 MHW-MHHW levels (approximately elevation 9.0-9.5 NAVD88) developed for each site to mitigate, at a minimum, nuisance flooding impacts over the anticipated 50-year design life of a municipal public works project.

Descriptions of each alternative with accompanying conceptual design imagery are presented in the following sections.

- Each conceptual design image includes a range of existing roadway elevations, corresponding to the range of the lowest points surveyed along each of the low-lying roadways.

- Each conceptual design image includes a range of MHW, MHHW water levels, corresponding to the range of present day and future MHW and MHHW levels calculated for each site.

Ranges rather than site-specific data points were included so that each conceptual design image could be considered across multiple low-lying roadway sites.

Maintain Existing Infrastructure

In addition to more resilient conceptual design alternatives, the project team also considered taking a more limited approach, aimed at maintaining existing infrastructure. This alternative involves maintaining existing municipal infrastructure: repairing undermined roads, shoring up culverts, and regrading side slopes, etc. on an as-needed basis across all low-lying roadway sites. Maintaining existing infrastructure would require no further engineering, site assessment, or analysis to implement, would require limited permitting, and would be the least expensive of the alternatives considered.

Without considering site-specific present day and future tidal conditions, it is likely that infrastructure maintained in-kind would be subject to repetitive loss, causing the Town to incur repetitive annual and post-storm maintenance costs until a more resilient alternative could be designed and implemented. Simply repairing existing infrastructure would not allow the Town to further its long-term goal of improving access to public and private property, access to municipal resources, evacuation during a storm event, and improved emergency response. Therefore, repairing existing infrastructure should not be considered a viable long-term adaptation strategy for the Town of Eastham, but could be used to shore up existing infrastructure at risk of imminent failure until a more suitable, long-term alternative can be implemented.

Reconstruct and Revegetate Roadway Embankments (1.5:1; 2:1; or 3:1 Slopes)

The raise, reconstruct, and revegetate alternative involves raising the low-lying roadway to a predetermined design (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Once the roadway surface has been raised, this alternative involves reconstructing the roadway embankments at either a 1.5:1, 2:1, or 3:1 slope extending seaward from the roadway surface (Figures 47-49). The 1.5:1 side slope alternative maintains a steep grade that may be more subject to erosion, scour, and wave refraction during a storm event. At the same time, the

steeper side slope minimizes the square footage of impact to the adjacent coastal resource areas. The 2:1 approach extends the side slope seaward, improving slope stability while subsequently increasing the area of impact to the adjacent resource areas. The 3:1 side slope alternative involves reconstructing much wider side slopes, offering the greatest stability while allowing for wave run-up and maintaining the ability to erode under storm conditions without undermining the roadway. The 3:1 side slope approach would have the greatest impact on the adjacent coastal resource areas.

Reconstructed roadway embankments would be seeded with a native coastal salt tolerant grass seed mix and blanketed with 100% biodegradable erosion control matting (ECS-2B, or similar), and overlain with 900g weight coir matting, staked and tied at 36" on-center with 36" hardwood stakes. Once the erosion control blankets were installed, the reconstructed side slopes would be planted with a combination of native woody and perennial species. Care would be taken to ensure the planting mix incorporated a diverse set of site-specific native plantings, drawing on the species composition of the adjacent landscape.

The reconstructed roadway embankments, blanketed, and revegetated would offer greater stability and resilience to the roadway. The reconstructed embankments would still be able to erode during a significant coastal storm event, contributing sediment to the adjacent coastal resource areas. Material costs for this alternative are relatively low, allowing reconstruction and/or repairs to occur promptly should significant damage occur.

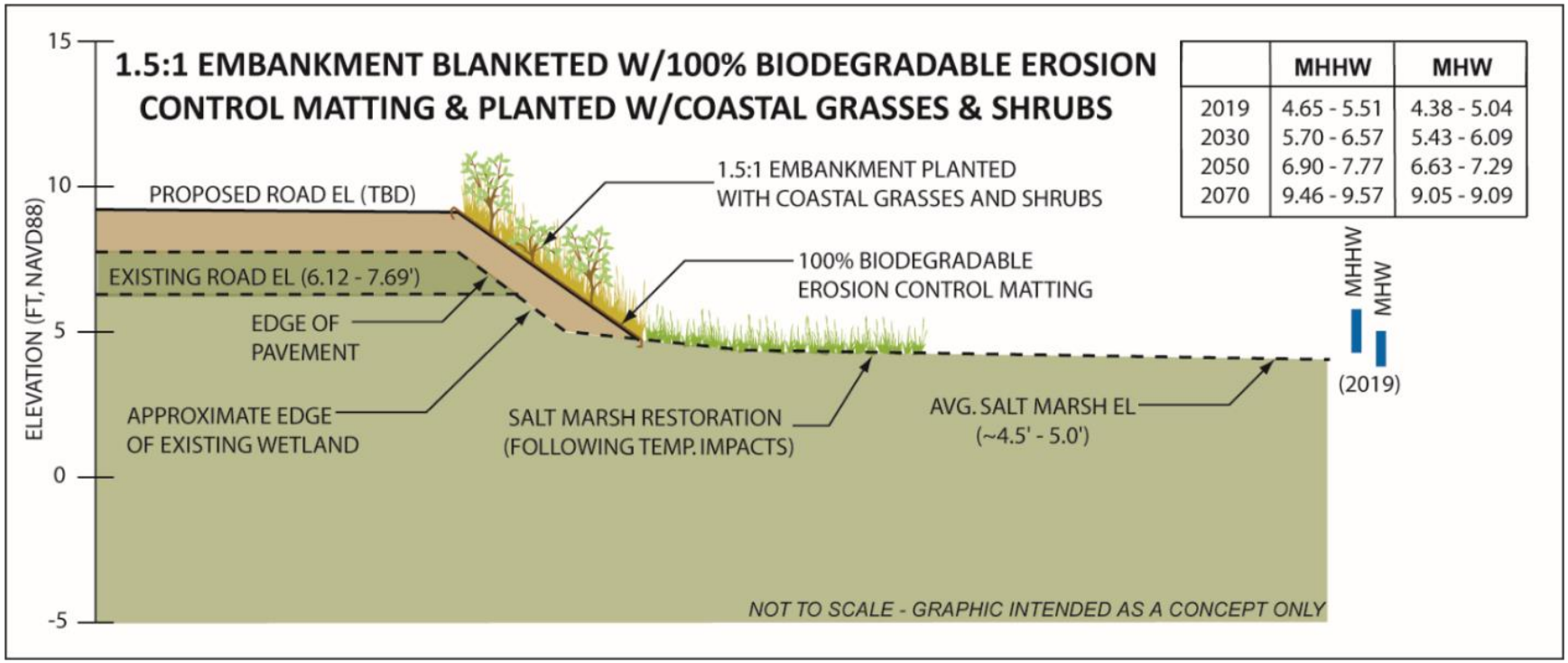


Figure 47. Raised roadway and reconstructed embankment alternative at 1.5:1 slope.

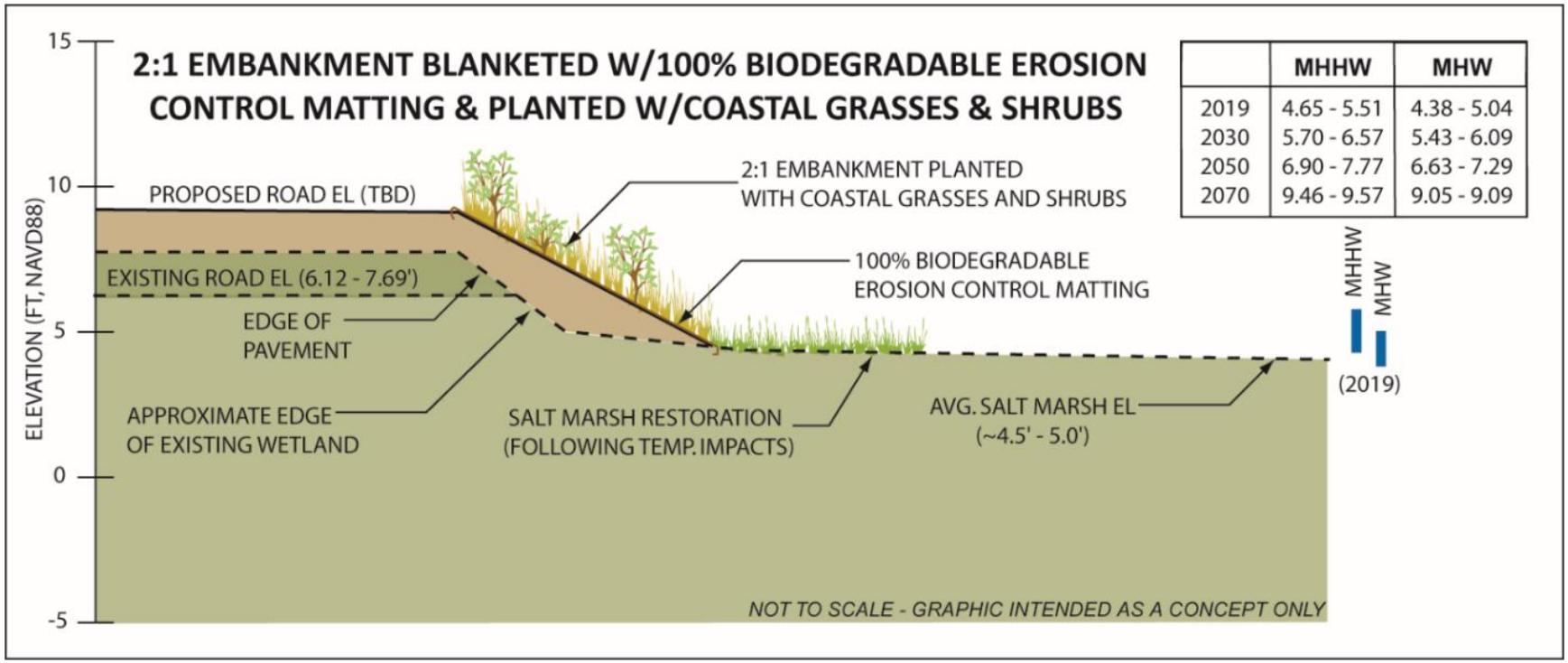


Figure 48. Raised roadway and reconstructed embankment alternative at 2:1 slope.

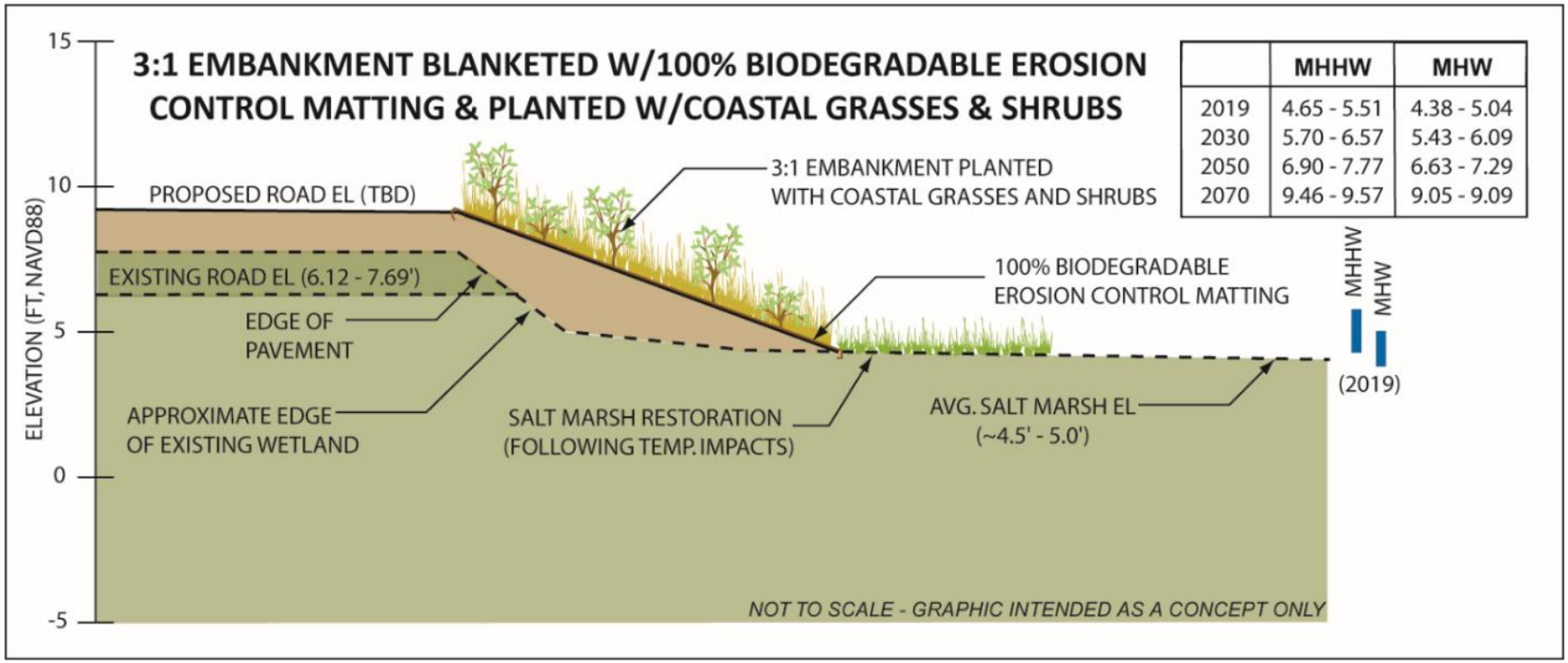


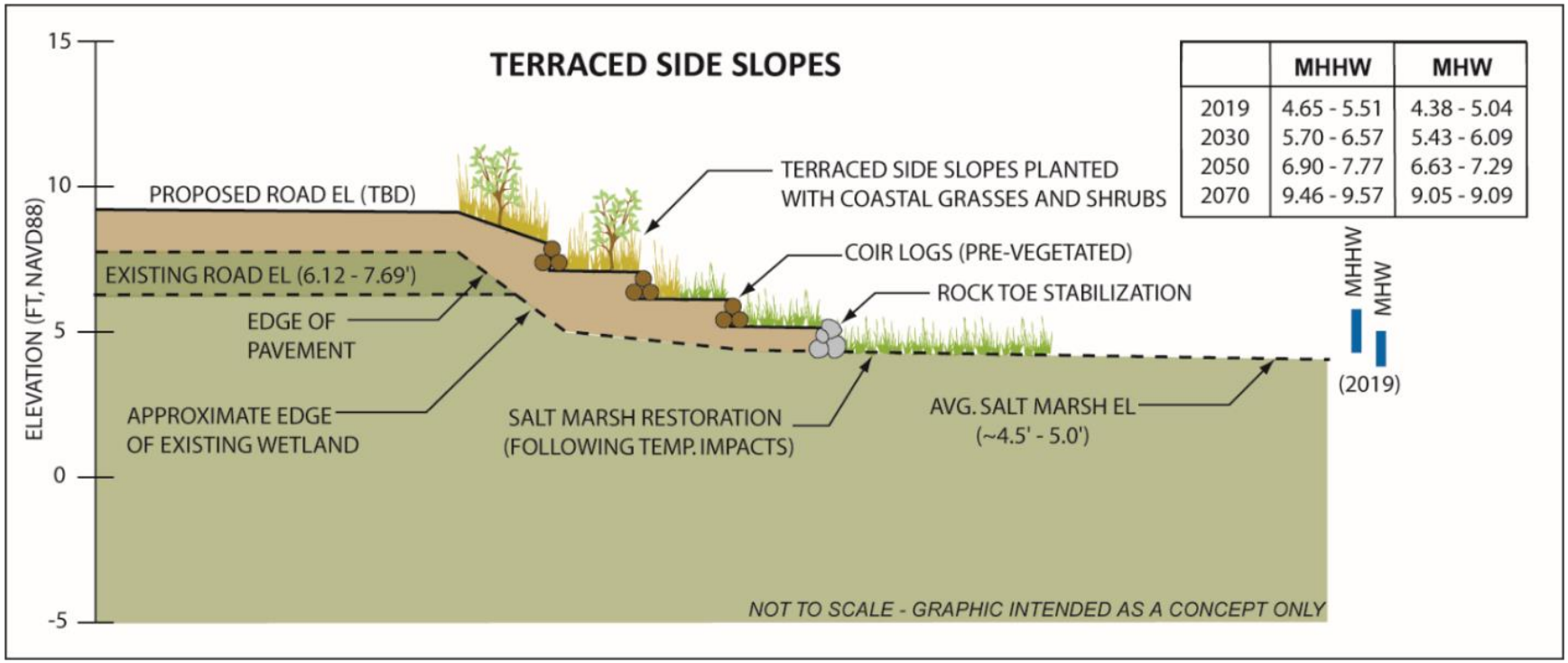
Figure 49. Raised roadway and reconstructed embankment alternative at 3:1 slope.

Reconstruct and Revegetate Reinforced, Terraced Side Slopes

Terraced side slopes were also considered as an alternative to improve the resilience of low-lying roadways (Figure 50). The terraced alternative would involve raising the low-lying roadway to a predetermined elevation (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Once the roadway had been raised, the side slopes would be reconstructed and reinforced. At the seaward edge of the terraced side slope, a stone toe would be installed along the shore to anchor and buffer the system. Moving landward from the toe, a series of fiber roll reinforced soil lifts would be installed to gain the elevation needed to meet the roadway side slope. Each of the salt marsh lifts would be blanketed with 100% biodegradable erosion control matting (ECS-2B, or similar), and overlain with 900g weight coir matting, staked and tied at 36" on-center with 36" hardwood stakes to retain the soil media. The remaining slope above the final fiber roll lift would be blanketed with 100% biodegradable erosion control matting (ECS-2B, or similar), and overlain with 900g weight coir matting, staked and tied at 36" on-center with 36" hardwood stakes.

The terraced side slope approach would have a larger footprint and therefore a greater impact on the adjacent coastal resource areas than many of the other alternatives that were considered. However, sections of the array below mean high water could be backfilled with engineered, salt marsh compatible soils to restore impacts. Further, reinforced lifts could be designed to mirror the adjacent topography to promote growth of salt marsh and/or costal salt tolerant upland vegetation, restoring impacted areas. Terraces constructed above mean high water would be seeded with a coastal salt tolerant seed mix. Once all sections of the array had been stabilized, each terrace would be planted with a combination of native woody and perennial species. Care would be taken to ensure that the planting mix incorporated a diverse set of site-specific native species, drawing on the plant composition of the adjacent landscape.

While the terraced approach might offer greater stability and nature-based buffering capacity than the reconstructed roadway embankment alternative, the materials used to construct the terraces would be designed to fail under storm conditions, allowing the system to contribute sediment to the near shore area. Unlike the reconstructed roadway embankment alternative, the terraced approach would be more costly to construct and more costly to maintain in the long-term.



	MHHW	MHW
2019	4.65 - 5.51	4.38 - 5.04
2030	5.70 - 6.57	5.43 - 6.09
2050	6.90 - 7.77	6.63 - 7.29
2070	9.46 - 9.57	9.05 - 9.09

Figure 50. Raised roadway and terraced side slope alternative.

Reconstruct and Revegetate Articulating Concrete Block Matting (ACBM) or Geocell Reinforced Side Slopes (1:1, 2:1, or 3:1 slopes)

The ACBM or geocell alternative would involve raising the low-lying roadway to a predetermined elevation (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Articulating concrete block matting (ACBM) is a series open-cell concrete blocks that are cabled together internally to form large pads that articulate to match the grade of the substrate. Installed side-by-side, the pads take on a honeycomb-like appearance, with all open cells aligned vertically. Once installed an anchored, the ACBM can be backfilled and vegetated. Geocell is like ACBM but is made of a heavy-duty open-cell synthetic material that can be applied to steep slopes, backfilled, and stabilized.

Prior to installing the ACBM or geocell, a structural geotextile would be installed along the slope to provide added structural stability. Once the structural geotextile had been installed, either ACBM or geocell would be applied to the slope, anchored, and backfilled at either a 1:1, 2:1, or 3:1 slope (Figure 51-53). The toe of the ACBM or geocell installation would be anchored using a row of vertical sheet piles. To soften the transition from the vertical sheet piles to the reinforced slope, a single row of pre-vegetated fiber rolls would be installed and anchored to promote the establishment of native coastal salt tolerant vegetation.

Like the unarmored *Reconstruct and Revegetate Roadway Embankments* alternative, the 1:1 ACBM or geocell side slope alternative maintains a steep grade, minimizing the square footage of impact to the adjacent coastal resource areas. The 2:1 ACBM or geocell approach extends the side slope seaward, improving slope stability while subsequently increasing the area of impact to the adjacent resource areas. The 3:1 ACBM or geocell approach involves reconstructing much wider side slopes, offering the greatest stability while allowing for wave run-up during a storm event. Understandably, the 3:1 side slope approach would extend further from the roadway surface and have the greatest impact on the adjacent coastal resource areas.

Once installed and backfilled, the ACMB or geocell would be seeded with a coastal salt tolerant grass seed mix blended into a (Filtrexx, or similar) compost mulch erosion control blanket. The compost mulch erosion control blanket is applied in a similar manner to hydroseed, offering biodegradable erosion control while providing a medium for seed germination. Along quiescent sections of low-lying roadways, 100% biodegradable erosion control blankets (ECS-2B, or similar) could be installed over the compost mulch blanket to for added stability. Once vegetation has fully established, the ACBM or geocell would appear as a fully vegetated slope.

The ACBM or geocell side slope alternative adds significantly more structural stability to the roadway side slopes than the unarmored alternatives. The ACBM or geocell would not readily erode during a storm event, preventing compatible material from entering the near shore area. However, the ACBM or geocell may be susceptible to damage during coastal storms, especially if applied along sections of roadway exposed to significant wave heights, open ocean exposure, frequent overtopping, winter pack ice impacts, etc. Damage to the ACBM or geocell array would

likely require reconstruction of significant linear footage of the side slope, increasing the long-term maintenance costs associated with the alternative.

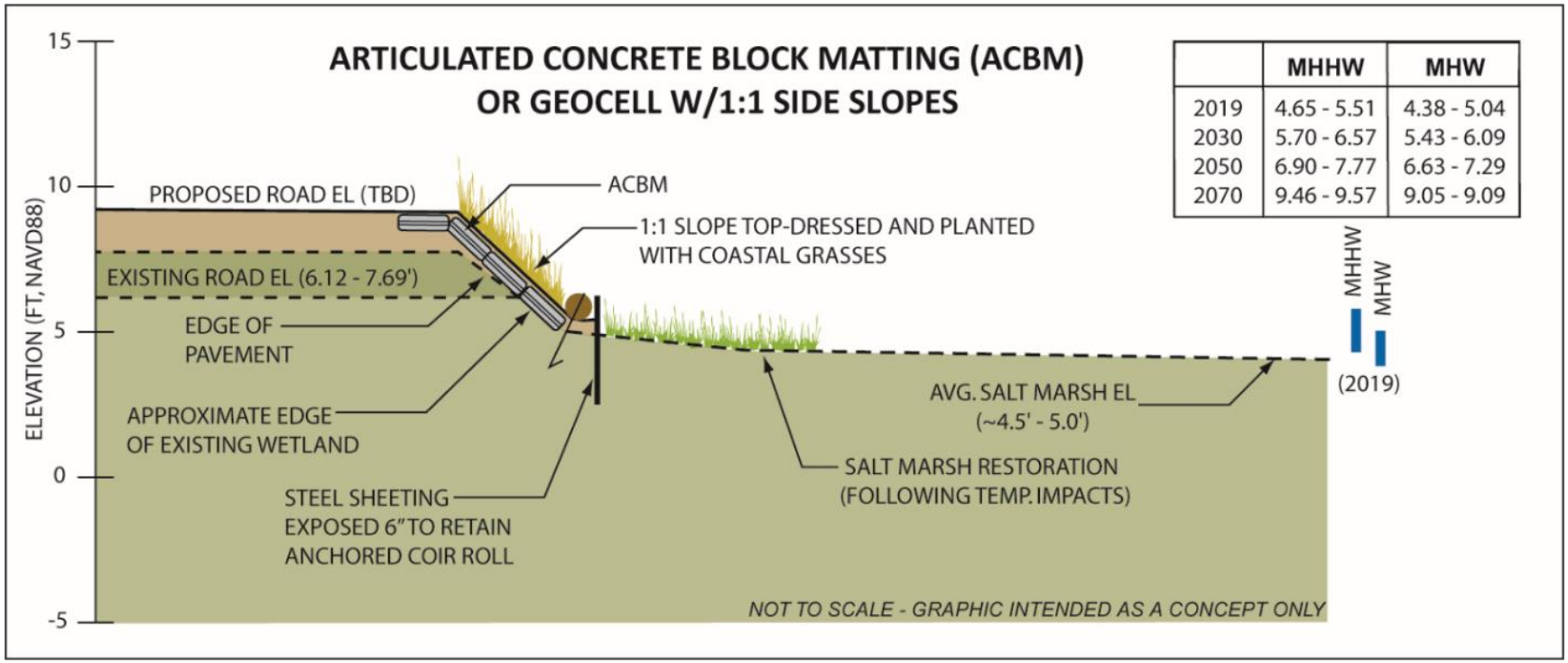


Figure 51. Raised roadway and ACBM-geocell alternative installed at 1:1.

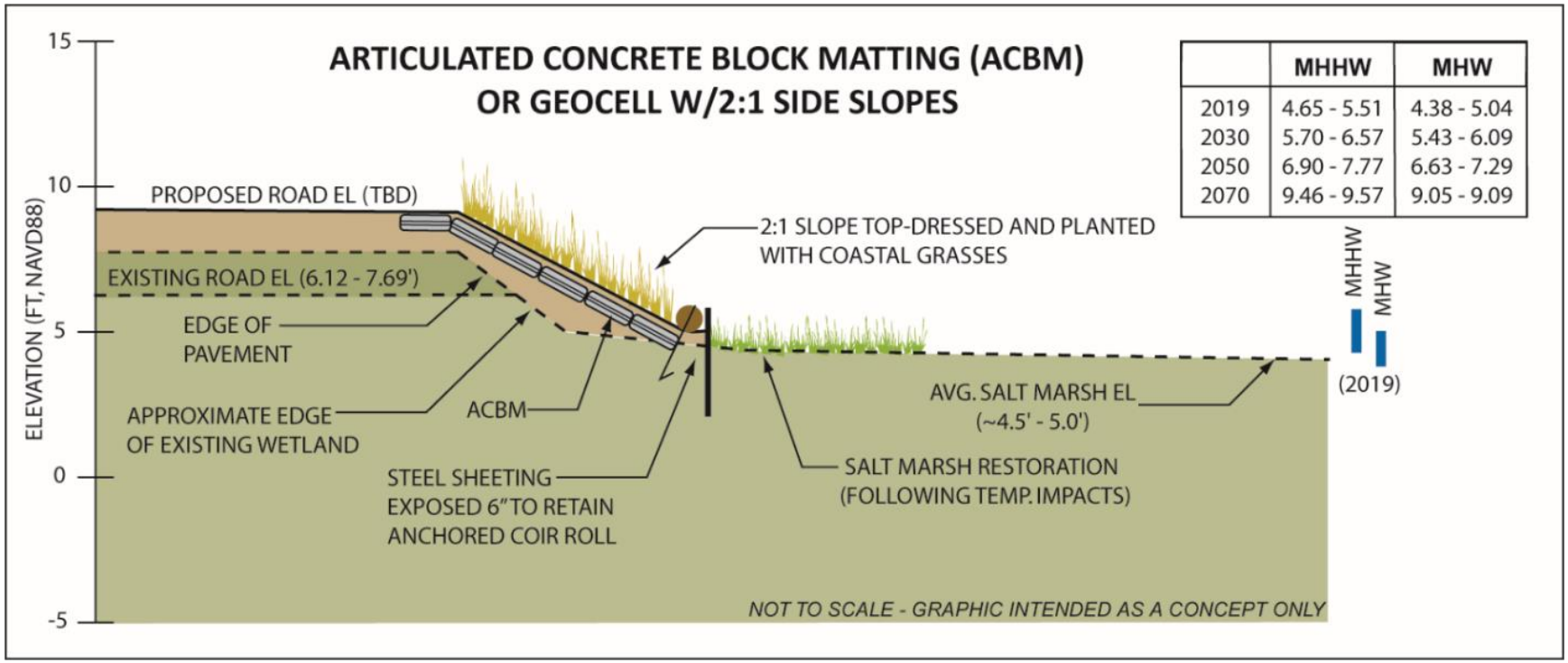


Figure 52. Raised roadway and ACBM-geocell alternative installed at 2:1.

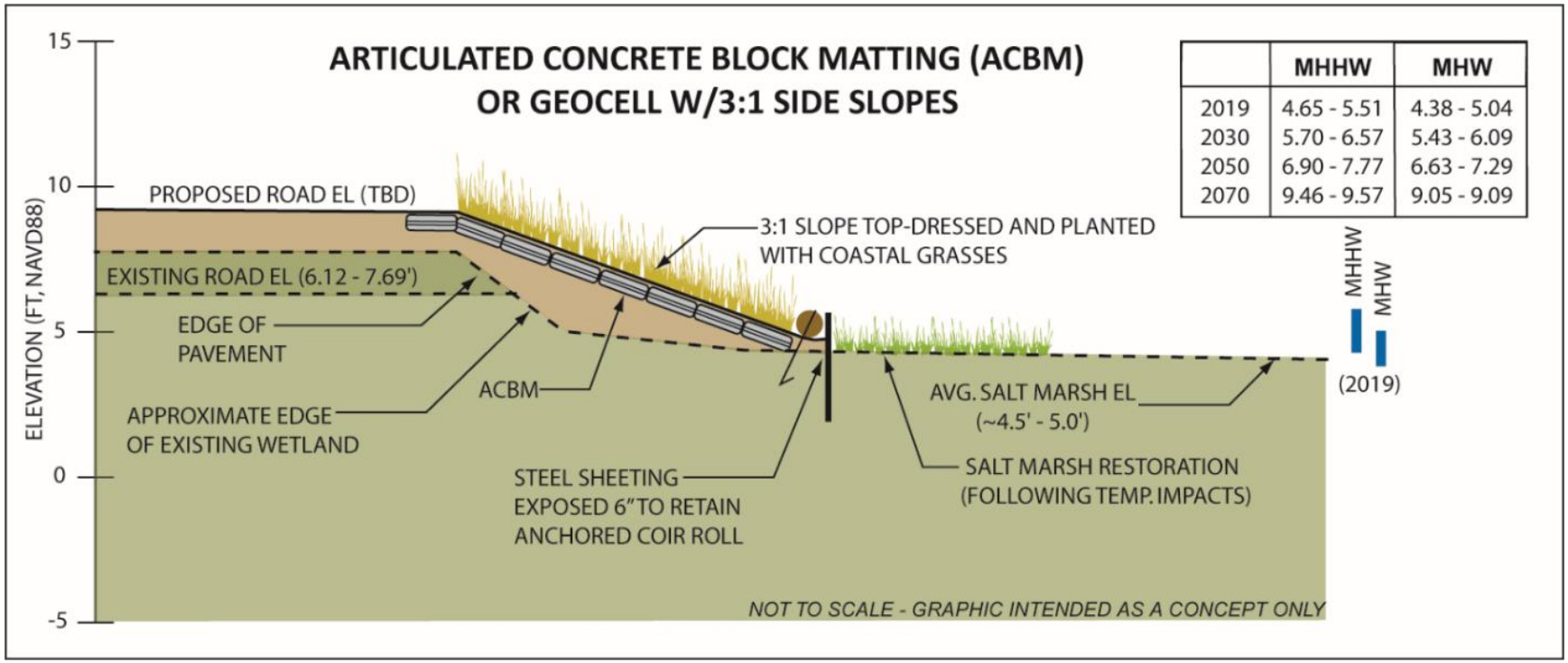


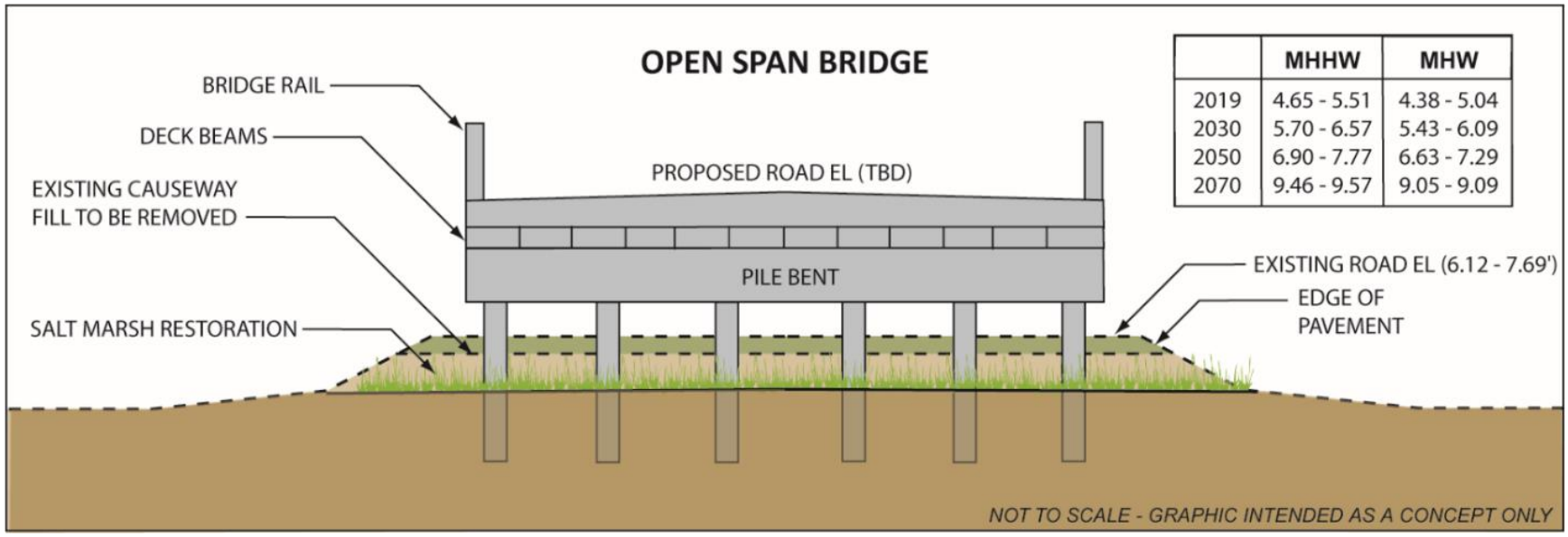
Figure 53. Raised roadway and ACBM-geocell alternative installed at 3:1.

Open Bridge Span

An open bridge span alternative would involve removing the existing roadway surface and side slopes to replace the low-lying roadway with an open span bridge (Figure 54). The elevation of the bridge decking surface would be raised to a pre-determined elevation (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Depending on the desired length of the span, it may be possible to implement prefabricated designs, providing a net cost savings.

It is possible that the removal of the roadway surface and side slopes would improve tidal flow to and drainage from any upstream areas. Restoration and revegetation may also be possible beneath the open span. While a bridge span may present a longer-term alternative, there would likely be a longer design, permitting, and construction lead time than the other side slope-centric alternatives. Further, construction would likely cause disruptions to traffic patterns and the costs incurred by taxpayers would be significant compared to other alternatives. Lastly, ensuring long-term access to abutting parcels may prove challenging, depending on the extent of the open span.

The open bridge span would allow the Town to improve the resilience of select sections of low-lying roadway. Design-engineering, permitting, and construction lead times would need to be carefully considered as well as the tax burden on residents.



	MHHW	MHW
2019	4.65 - 5.51	4.38 - 5.04
2030	5.70 - 6.57	5.43 - 6.09
2050	6.90 - 7.77	6.63 - 7.29
2070	9.46 - 9.57	9.05 - 9.09

Figure 54. Raised open bridge span alternative.

Sloping Rock Revetment

Hard engineering solutions were also considered to improve the resilience of low-lying roadways. The first hardened alternative considered was a sloping rock revetment. The sloping rock revetment alternative would involve raising the low-lying roadway to a predetermined elevation (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Once the roadway had been raised, the side slopes would be armored with a sloping rock revetment (Figure 55). Prior to construction, the side slopes would be regraded, and geotextile fabric installed to improve the stability of the stone structure. Bedding stone layer(s) would then be installed to support the armor stones.

The sloping rock revetment alternative would allow the roadway side slopes to remain relatively steep, preventing the footprint of the alternative from extending into adjacent coastal resource areas. However, the structure would also deprive the near shore area from sediment eroding from the side slopes and may cause wave refraction, erosion, and scour along the toe of the structure during coastal storm events. As with all hardened structures, the potential for end effect erosion and impacts to adjacent parcels and resource areas would need to be carefully considered. Once installed, areas immediately seaward of the structure could be nourished with compatible sediment and restored with coastal salt tolerant and/or salt marsh plantings.

The sloping rock revetment alternative would provide the reconstructed roadway and associated infrastructure with enhanced stability for the duration of the design life of the structure, especially in higher energy environments impacted by larger waves, open ocean exposure, winter pack ice impacts, etc. Impacts resulting from construction, future erosion or scour, or end effects would need to be carefully considered as they may prove difficult to restore.

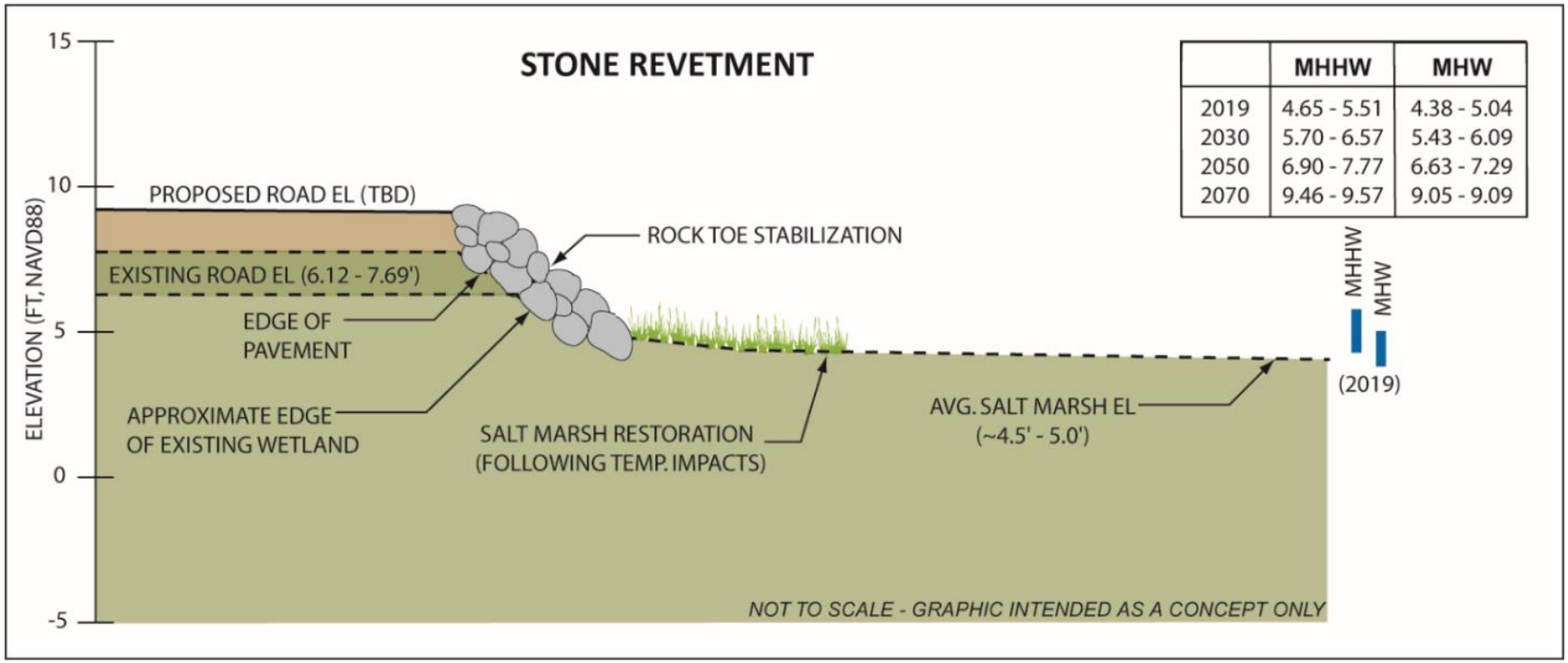


Figure 55. Raised roadway and sloping rock revetment alternative.

Vertical Sheet Piles

The vertical sheet pile alternative would involve raising the low-lying roadway to a predetermined elevation (TBD) based on a calculated wind, wave, and overtopping engineering analysis to establish appropriate design elevations relative to projected SLR and storm scenarios. Once the roadway had been raised, the side slopes would be armored and retained using driven vertical sheet piles (Figure 56). The sheet piles would be installed along the seaward edge of pavement, reducing the footprint of the alternative and subsequently, impacts to the adjacent coastal resource areas. Small amounts of compatible sediment or a single row of fiber rolls could be added seaward of the sheet piles to soften the structure and reduce erosion and scour along the toe of the sheeting.

The sheet pile alternative could help the Town to meet its goal of reducing the vulnerability low lying roadways in areas where the roadway surface directly abuts sensitive coastal resource areas that would be negatively impacted by other, wider side slope alternatives. Further, the sheet pile alternative could be used to improve the resilience of sections of roadway that are at imminent risk of failure or in a state of failure by shoring up the remaining infrastructure. Given that vertical structures tend to refract wave energy, the vertical sheet pile alternative would be most suitable along more quiescent sections of low-lying roadway without direct exposure to large waves, open ocean conditions, etc.

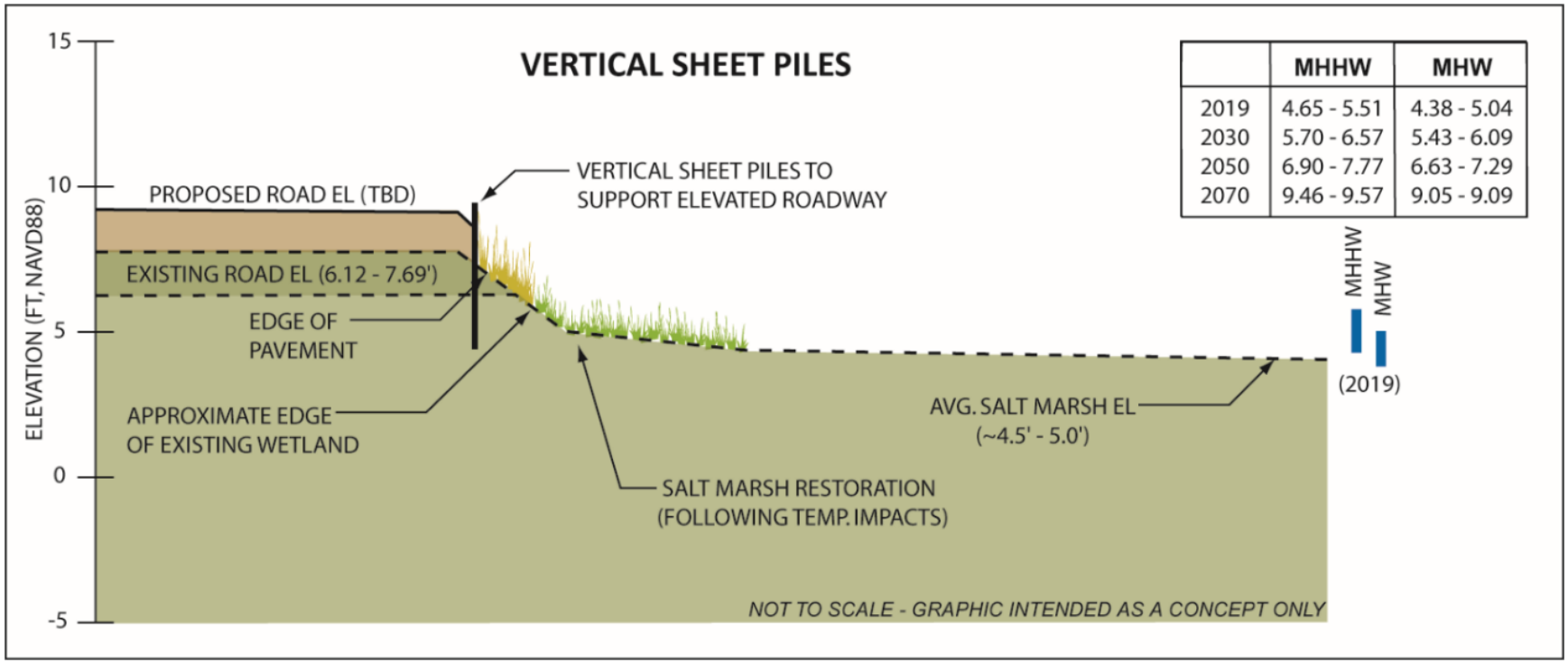


Figure 56. Raised roadway and vertical sheet pile alternative.

Phased Retreat – Roadway Relocation

A final alternative, phased retreat – roadway relocation was considered to improve the resilience of the Town's low-lying roadways. This alternative would not involve raising, maintaining, or reconstructing existing sections of vulnerable roadway. Instead, phased retreat would involve analyzing local traffic patterns and roadway layouts to determine if alternate, less vulnerable routes exist. If less vulnerable routes are identified, vulnerable sections of low-lying roadway could be abandoned and removed, allowing adjacent coastal resource areas to act as effective buffers for the adjacent uplands.

This alternative would allow the Town to meet is goal of improving the resilience of low-lying roadways if suitable alternate routes were readily available for each vulnerable roadway. The alternative would involve significant collaboration and coordination with abutters and local stakeholders to discuss potential disruptions and changes to historic traffic patterns. It should be noted that it is unlikely each low lying roadway has a suitable alternate route and if a suitable route is identified, it is possible that the alternative route may not be able to support the same volume of traffic.

4.1 REGARDING PRELIMINARY COSTS

To help the project team evaluate the various alternatives preliminary, planning-level cost estimates were developed for each of the roadway embankment alternatives. Cost estimates were presented as linear footage costs for paving and for side slope treatments, inclusive of labor. During this initial phase, cost estimates were not developed for site-specific project locations because the Town has yet to select a preferred alternative and develop design-engineering plans. The preliminary costs for each alternative presented above are included in Table 12.

Note that costs for improving the roadway surface and improving the side slopes are provided separately. Therefore, it will be necessary to calculate costs for roadway paving/raising and costs for side slope treatment separately. For example, if the Town proposes to raise 100 linear feet of roadway and reconstruct and revegetate the side slopes, the cost estimate for the work would be calculated in the following manner:

Linear Footage	Treatment	Cost per L.F.	Total Cost
100	Raise, Re-Mill and Repave	$947	$94,700
100	Reconstruct and Revegetate Side Slopes	$1,000	$100,000

Total Cost	$194,700

Table 12. Preliminary Linear Footage Cost Estimates for Roadway Adaptation Alternatives

Roadway Paving/Raising	Linear Footage Cost
Remilling and Repaving	$454.00
Remill, Raise, and Repave Roadway	$947.00
Side Slope Treatment	
Reconstruct and Revegetate	$1,000
Fiber Roll Reinforced / Terraced	$2,500
ACBM / Geocell Reinforced	$1,750
Pre-Fabricated Bridge Span	$26,000
Bridge Span New Construction	$1,500
Sloping Rock Revetment	$1,200
Vertical Sheet Piles	$1,500

4.2 REGARDING PERMITTING

As the Town evaluates the various alternatives to improve the resilience of low-lying roadways it will be important to consider the associated permitting requirements required to implement the proposed improvements. As previously discussed, steeper roadway side slope treatments may allow the Town to avoid impacts to adjacent coastal resource areas, limiting the number of permits that may be required. However, if more robust alternatives are preferred, or if the alternative is a hardened structure or bridge span, permitting requirements may be more extensive. As a starting point, it will be prudent for the Town to hold pre-application consultations with regulatory officials during the design and permitting phases of the project. In the meantime, it will be important for the Town to consider the implications of the following permits as it works towards selecting a preferred alternative.

ENF/EENF/EIR

MEPA review would be required if any of the review thresholds for wetlands, waterways, and tidelands (301 CMR 11.03 (3)), transportation (301 CMR 11.03(6)), or areas of critical environmental concern (301 CMR 11.03(11)) are exceeded.

Notice of Intent and Town Bylaw

Future proposed projects are likely to impact salt marsh, coastal bank, and/or land subject to coastal storm flowage. These areas are defined under the Massachusetts Wetland Protection Act (WPA) as Resource Areas and are therefore subject to the WPA regulations (310 CMR 10.00). The project will therefore require an Order of Conditions, from the Eastham Conservation Commission prior to construction. Improvements roadways are often categorized as limited projects. The road elevation component of the project, along with the associated side slope component is likely to fall under 310 CMR 10.24(7)(c)(1), which can allow for Limited Projects for maintenance and improvements of existing public roadways, including adding shoulders. Town bylaw relative to work conducted in an ACEC will also apply.

DEP Chapter 91 License

A MassDEP Chapter 91 Waterways License will be required for any work conducted on new and existing structures or fill below the mean high water line. Chapter 91 permitting will be required for the reconstruction of roadway side slopes, work in the salt marsh, and any required dredging as Chapter 91 (MA Public Waterfront Act) applies to filling activities in tidelands in Massachusetts.

DEP Water Quality Certification

A 401 Water Quality Certification will be required if the proposed project includes salt marsh restoration requiring fill placed in a salt marsh or if the proposed project requires limited amounts of dredging during construction.

US Army Corps of Engineers (USACE) Permit

Portions of any project that occur below the high tide line or have the potential to effect endangered or threatened species will require an Individual Permit employing Section 404 of the Federal Clean Water Act (33 U.S.C. 1344).

MA Coastal Zone Management Consistency

If the proposed project requires a Federal (USACE) permit, a statement of consistency will be requested from MA CZM.

4.3 PUBLIC FEEDBACK AND IMPLEMENTATION TIMELINE

The Town of Eastham and the Woods Hole Group hosted a second public meeting to solicit feedback regarding the conceptual design alternatives. Meeting minutes from the June Public Meeting are included in Appendix J. It is expected that public engagement will be a large component of future efforts to redesign and retrofit low-lying roadways. The municipal project team received the following feedback from members of the public:

- *"Concerns over hard-scape alternatives. Open span bridge may be most suitable alternative. Recognize costs, but most suitable long-term alternative."*
- *"Bridges do not address access to properties. Endless groups of bridges are not the solution. Harder solutions to shore up municipal infrastructure are of interest."*
- *"Diamondback terrapins are a concern, ACEC, NHESP concerns. Terraced side slopes may allow for turtle gardens."*
- *"Bridge is preferable as a long-term solution. Opens marsh for flood attenuation."*
- *"Bridge would impact many parcels. Islands of neighborhoods connected by roads may leave out some residents."*
- *"Likely that some combination of alternatives would be most suitable. May be possible to adapt and shore up existing infrastructure in the short-term while a longer-term alternative (such as a bridge) is designed, permitted, and funded. Public engagement will be a large component of any future scope."*

Based on this feedback and direct input from the municipal project team, the Woods Hole Group developed the following timeline for the implementation of adaptation strategies at each site and expected outcomes (Figure 57). The implementation framework identified immediately actionable, near-tern (2020-2030), mid-term (2030-2050), and long-term (2050-2070) steps that the Town can take to improve the resilience of low-lying roadways.

Implementation Framework

	Present Day	2020-2030	2030-2050	2050-2070
	Immediately Actionable Items	**Near-Term Actions**	**Mid-Term Actions**	**Long-Term Actions**
Activities	Review Targeted Vulnerability Assessment; Establish Steering Committee to Guide Implementation	Implement Bridge Road and Samoset Road Improvements	Design Improvements to Bridge Road (Phase II) (Bridge Superstructure)	Implement Bridge Road Phase II Improvements
	Design Improvements to Bridge Road (Raise Road, Reconstruct Side Slopes)	Dyer Prince Road Culvert Assessment	Design Improvements to Samoset Road (Phase II) (Raise Road, Reconstruct Side Slopes)	Implement Samoset Phase II Improvements
	Design Improvements to Samoset Road (Raise Road, Maintain Infrastructure)	Design Improvements to Dyer Prince Road (Raise Road, Reconstruct Side Slopes)	Explore Regional Partnerships to Address Long-Term Resilience of Bridge Road	Plan for Managed Retreat from Non-Critical and/or Repetitive-Loss Sections of Low-Lying Road
	Establish Permitting Framework(s) for Bridge Road and Samoset Road	Establish Permitting Framework(s) for Dyer Prince Road	Explore Alternative Evacuation Routes, Options to Relocate or Re-Route non-critical Low-Lying Roads	
	Identify Funding Mechanism(s) for Bridge Road and Samoset Road	Identify Funding Mechanism(s) for Dyer Prince Road		
	Identify Necessary Easements	Identify Necessary Easements		
	Public Outreach and Education			

	Immediately Actionable Outcomes	Near-Term Outcomes	Mid-Term Outcomes	Long-Term Outcomes
Outcomes	Engineering Design Plans for Highest Priority Sections of Low-Lying Roadway	Improved Resilience of Highest Priority Sections of Low-Lying Roadway	Improved Resilience of Med-High Priority Sections of Low-Lying Roadway	Improved Long-Term Resilience of Highest Priority Sections of Roadway
	Prepared to Begin Permitting Process	Improved Understanding of Tidal Dynamics along Dyer Prince Road	Prepared to Address and Adapt to Long-Range Impacts ti Bridge Road and Samoset Road	Prepared to Address Retreat from Non-Critical, Repetative Loss Infrastructure
	Funding Mechanisms Identified	Engineering Design Plans for Med-High Priority Sections of Low-Lying Roadway	Leverage Regional Partnerships to Fund Implementation of Bridge Road Phase II	
	Open Collaboration with Abutters	Prepared to Begin Permitting Process	Established Plan for Roadways that can no Longer be Maintained	
	Engaged, Informed, and Supportive Stakeholders	Funding Mechanisms Identified		
		Open Collaboration with Abutters		

Figure 57. Low-Lying Roadways Implementation Framework, Timeline, and Outcomes.

4.4 RECOMMENDATIONS AND NEXT STEPS

In the ***immediate term***, the framework identifies the need to review the results of the targeted vulnerability analysis in detail and establish a municipal steering committee to oversee subsequent redesign and retrofit, permitting, and implementation efforts. Based on the findings of this assessment and the feedback of the steering committee, the framework recommends initiating the process of developing a design to improve the resilience of the most vulnerable sections of Bridge Road and Samoset Road. Initial designs may focus on adapting and shoring up existing infrastructure in the short-term while longer-term alternatives (such as a new bridge span) are designed, permitted, and funded. In concert with the development of design-engineering plans, it will be important for the Town to establish a permitting framework and explore funding mechanisms to drive future implementation. These efforts will be aided by ongoing public education and outreach efforts and through collaboration with Town council to facilitate any required easements.

In the ***near-term*** it will be important to fund and implement Bridge Road and Samoset improvements to avoid anticipated SLR and storm surge impacts. While Bridge Road and Samoset Road improvements are constructed, the Town should take a proactive approach to continue the low-lying roadways design and permitting process for Dyer Prince Road, to ensure continued access to municipal assets at Rock Harbor and to private properties located along the road.

In the ***mid-term***, a second round of longer-term Phase II alternatives may be considered for Bridge Road and Samoset Road (depending on the performance of previous adaptation strategies). Given the importance of the Bridge Road bridge not only to the Town of Eastham, but to the entire Outer Cape region, it will be prudent to explore regional partnerships to address the long-term resilience of the bridge and to fund efforts to redesign or retrofit the existing bridge span. Given the projected impacts to low-lying roadways beyond 2050, it will also be important for the Town to explore alternatives to relocate and/or reroute other, non-critical low-lying roadways.

Long-term efforts include implementation of Phase II alternatives for roadways (including Bridge Road and Samoset Road) that cannot be relocated or rerouted. And active planning for managed retreat from non-critical and/or repetitive loss sections of low-lying roadway.

4.5 PUBLIC BENEFIT

These and other municipal efforts to improve the resilience of low-lying roadways are expected to provide the following site-specific benefits for Town residents:

Smith Lane

- Improved access to Wild Care, an Outer Cape wildlife rehabilitation facility.
- Improved access to several private homes.
- Parking and access to Upper Boat Meadow Conservation Area.

- Maintaining or improving tidal connectivity between two salt marsh resource areas.
- Improved resilience of water main infrastructure.

Dyer Prince Road

- Improved access to Rock Harbor and associated facilities.
  - Municipal revenues up to $60,000 from annual dockage.
  - Access to newly reconstructed State Boat ramp and municipal dock and pier.
  - Access to 700 Dyer Prince Road conservation lands, a $1.4M resident-approved purchase
- Access to a top viewing location for viewing Orleans' Rock Harbor fireworks display.
- Parking for beachgoers and dog walkers.
- Access to open mooring fields.
- Access to potential shellfish grant development areas.
- Access to open tidal flats for shellfishing.
- Improved resilience of water main infrastructure.

Bridge Road

- Maintenance of the only evacuation route for the Outer Cape aside from Route 6, critical for maintaining the safety of all four Outer Cape towns during storm events.
- Opportunities to improve and restore sections of degraded salt marsh located within a designated Area of Critical Environmental Concern.
- Opportunities to improve Diamond-backed terrapin nesting and management.
- Access to salt marsh that is popular for birdwatching and kayaking.
- Improved resilience of water main infrastructure and other elevated utilities on bridge span.

Samoset Road

- Improved access to residential neighborhoods.
- Access to First Encounter Beach, the Town's largest beach parking area and beach facility, with restrooms. Providing beach sticker revenues to the Town each year.
- Preserving opportunities to host community events at the First Encounter Beach area, including yoga classes and fundraisers.
- Access to the town's 28-acre aquaculture development area, licensed to over 15 private growers to cultivate shellfish and open tidal flats for shellfishing.
- Access to mooring fields.
- Improved resilience of water main infrastructure.

For these financial, ecological, cultural, and most importantly public safety reasons, maintaining consistent open access of these roadways for the public is critically important. They all provide numerous values to residents and visitors, demonstrated by their support for funding infrastructure and conservation initiatives.

5.0 LITERATURE CITED

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APPENDIX A. ASSET ELEVATIONS & LOCATIONS

Smith Lane

Point	Northing	Easting	Elevation	Description
1139	2755969.669	1069606.512	6.0495	Water Gate
1140	2755969.679	1069606.487	6.0501	Water Gate
1141	2755964.351	1069609.045	6.5704	fire hydrant base
1142	2755964.748	1069609.628	9.0236	fire hydrant spindle
1143	2755991.1	1069622.941	6.3985	Water Gate
1147	2756028.699	1069592.647	0.3844	Culvert Invert
1148	2756029.146	1069593.102	3.0616	Top of Culvert
1161	2756046.324	1069624.445	3.7749	Top of Culvert
1162	2756046.644	1069624.899	0.9981	Culvert Invert
1172	2755772.918	1069377.3	8.052	Water Gate
1173	2755771.25	1069373.621	8.1088	Water Gate
1176	2755662.642	1069247.199	9.2338	Catch Basin
1189	2755304.854	1068833.12	11.1276	Hydrant Spindle
1200	2755679.266	1069233.06	8.8793	Catch Basin
1216	2755911.794	1069496.316	6.9051	Utility Pole
1228	2755388.324	1068888.016	11.8691	Utility Pole
1229	2755518.924	1069039.005	11.7102	Utility Pole
1230	2755651.221	1069193.492	9.607	Utility Pole
1231	2755781.782	1069343.076	8.0488	Utility Pole
1234	2755653.947	1069331.706	7.9484	Catch Basin
1248	2755766.861	1069382.405	7.8589	Fire Hydrant Base
9735	2755650.732	1069169.684	5.1	Culvert Headwall
9736	2755600.413	1069208.473	5.933	Culvert Headwall
9737	2755600.495	1069208.437	5.89	Culvert Headwall
9738	2755599.577	1069209.678	1.152	Culvert Invert
9739	2755599.59	1069209.686	1.225	Culvert Invert
9740	2755651.114	1069169.496	4.462	Top of Culvert Flapper
9741	2755651.137	1069169.518	4.445	Top of Culvert Flapper

Dyer Prince Road

Point	Northing	Easting	Elevation	Description
1102	2756484.321	1068726.266	12.2133	Utility Pole
1103	2756481.922	1068740.113	12.4915	Utility Pole
1139	2755969.669	1069606.512	6.0495	Water Gate
1140	2755969.679	1069606.487	6.0501	Water Gate
1141	2755964.351	1069609.045	6.5704	Fire Hydrant Base
1142	2755964.748	1069609.628	9.0236	Fire Hydrant Spindle
1143	2755991.1	1069622.941	6.3985	Water Gate
1144	2755956.989	1069638.816	6.5814	Utility Pole
1145	2755964.426	1069662.488	6.2771	Utility Pole
1146	2756102.221	1069594.295	7.6574	Utility Pole
1147	2756028.699	1069592.647	0.3844	Culvert Invert
1148	2756029.146	1069593.102	3.0616	Culvert Top
1161	2756046.324	1069624.445	3.7749	Culvert Top
1162	2756046.644	1069624.899	0.9981	Culvert Invert
1172	2755772.918	1069377.3	8.052	Water Gate
1173	2755771.25	1069373.621	8.1088	Water Gate
1176	2755662.642	1069247.199	9.2338	Catch Basin
1189	2755304.854	1068833.12	11.1276	Fire Hydrant Base
1200	2755679.266	1069233.06	8.8793	Catch Basin
1216	2755911.794	1069496.316	6.9051	Utility Pole
1228	2755388.324	1068888.016	11.8691	Utility Pole
1229	2755518.924	1069039.005	11.7102	Utility Pole
1230	2755651.221	1069193.492	9.607	Utility Pole
1231	2755781.782	1069343.076	8.0488	Utility Pole
1234	2755653.947	1069331.706	7.9484	Catch Basin
1236	2755645.265	1069336.819	8.2605	Manhole
1248	2755766.861	1069382.405	7.8589	Fire Hydrant Base
1253	2756604.496	1063822.336	13.2506	Utility Pole
1255	2756583.724	1063786.868	12.8336	Water Gate
1257	2756582.754	1063746.214	12.7709	Manhole
1258	2756592.159	1063754.768	12.2266	Catch Basin
1260	2756562.056	1063711.962	11.9079	Utility Pole
1263	2756512.39	1063576.935	7.9463	Utility Pole
1265	2756491.63	1063543.707	7.3143	Water Gate
1267	2756503.611	1063539.399	7.525	Fire Hydrant Base
1268	2756503.655	1063539.445	10.3245	Fire Hydrant Spindle
1272	2756441.124	1063387.69	10.3409	Utility Pole
1325	2756613.688	1064143.908	7.742	Water Gate
1326	2756616.301	1064140.752	7.7142	Water Gate
1327	2756616.275	1064137.03	7.7325	Water Gate
1328	2756627.372	1064144.958	8.3149	Fire Hydrant Base
1329	2756627.168	1064144.935	10.9816	Fire Hydrant Spindle
1343	2756490.62	1064453.13	8.4784	Utility Pole
1344	2756543.972	1064294.201	8.6373	Utility Pole
1345	2756584.911	1064282.727	8.7042	Utility Pole

1346	2756596.703	1064131.804	7.8705	Utility Pole
1347	2756651.798	1063959.996	12.7761	Utility Pole
1353	2756598.186	1063772.844	12.4796	Catch Basin
1354	2756608.133	1063790.717	13.3053	Manhole
1355	2756583.746	1063786.881	12.8367	Water Gate
1366	2756362.92	1063203.435	9.737	Utility Pole
1370	2756421.222	1064618.324	9.1709	Utility Pole
1410	2756324.632	1065149.264	10.9691	Water Gate
1411	2756324.972	1065146.169	11.0374	Water Gate
1412	2756334.926	1065154.767	11.2017	Fire Hydrant Base
1414	2756306.897	1065181.964	10.1195	Water Gate
1415	2756304.214	1065183.932	9.9995	Water Gate
1421	2756197.514	1065394.69	7.0427	Water Gate
1422	2756197.696	1065391.621	7.0528	Water Gate
1423	2756206.824	1065400.358	6.9906	Fire Hydrant Base
1432	2756166.832	1065407.6	7.9189	Utility Pole
1438	2756277.697	1065195.021	9.6439	Utility Pole
1439	2756279.149	1065193.009	9.6721	Utility Box
1455	2756222.985	1065370.328	6.8048	Utility Pole
1462	2755998.872	1065873.516	9.9244	Water Gate
1463	2756007.695	1065877.121	10.4899	Fire Hydrant Base
1472	2755854.602	1066356.168	9.9408	Water Gate
1473	2755855.093	1066359.152	9.8659	Water Gate
1474	2755863.985	1066361.901	9.7961	Fire Hydrant Base
1482	2755714.188	1066823.607	10.5426	Fire Hydrant Base
1483	2755707.014	1066820.7	10.63	Water Gate
1502	2755609.711	1067087.235	10.9014	Utility Pole
1506	2756013.491	1065776.8	9.8247	Utility Pole
1509	2755956.545	1065938.383	9.4232	Utility Pole
1513	2755896.603	1066137.736	10.0069	Utility Pole
1516	2755852.877	1066283.022	10.4103	Utility Pole
1519	2755808.001	1066437.973	9.851	Utility Pole
1522	2755758.805	1066595.319	11.1468	Utility Pole
1525	2755704.85	1066761.747	9.9868	Utility Pole
1554	2756061.28	1065645.916	10.8045	Utility Pole
1559	2756166.632	1065407.372	7.9698	Utility Pole
1560	2756206.736	1065400.681	7.0167	Fire Hydrant Base
1566	2756277.074	1065194.477	9.5644	Utility Pole
1567	2756304.062	1065184.023	10.0011	Water Gate
1568	2756306.754	1065182.014	10.1023	Water Gate
1569	2756316.717	1065157.751	10.7019	Water Gate
1570	2756324.331	1065149.702	10.9461	Water Gate
1571	2756324.878	1065146.239	11.0182	Water Gate
1572	2756334.544	1065154.831	11.2152	Fire Hydrant Base
1582	2756222.429	1065369.911	6.9468	Utility Pole
1892	2756436.681	1064624.72	9.0902	Utility Pole
1893	2756429.391	1064683.951	8.9182	Utility Pole

1895	2756413.714	1064752.11	9.169	Utility Box
1906	2756434.745	1064824.537	9.9639	Utility Box
1910	2756458.886	1064639.937	8.7377	Water Gate
1911	2756467.236	1064641.382	8.5733	Fire Hydrant Base
1912	2756467.064	1064641.465	11.5019	Fire Hydrant Spindle
8000	2756620.568	1063994.941	10.395	Bell Phone
8001	2756577.117	1064283.233	8.858	Bell Phone
8002	2756545.917	1064289.98	8.598	Bell Phone
8003	2756447.933	1064759.192	9.063	Bell Phone
9726	2756502.517	1063539.102	7.227	Fire Hydrant Base
9728	2756503.279	1063538.693	10.116	Fire Hydrant Spindle
9730	2756314.379	1063224.838	9.22	Fire Hydrant Base
9732	2756313.626	1063225.431	9.41	Fire Hydrant Base
9733	2756313.555	1063224.625	12.314	Fire Hydrant Spindle
9735	2755650.732	1069169.684	5.1	Culvert Headwall
9736	2755600.413	1069208.473	5.933	Culvert Headwall
9738	2755599.577	1069209.678	1.152	Culvert Invert
9740	2755651.114	1069169.496	4.462	Culvert Flapper
10519	2756416.804	1064704.438	8.56	Water Gate
10520	2756416.85	1064704.532	8.543	Water Gate

Bridge Road

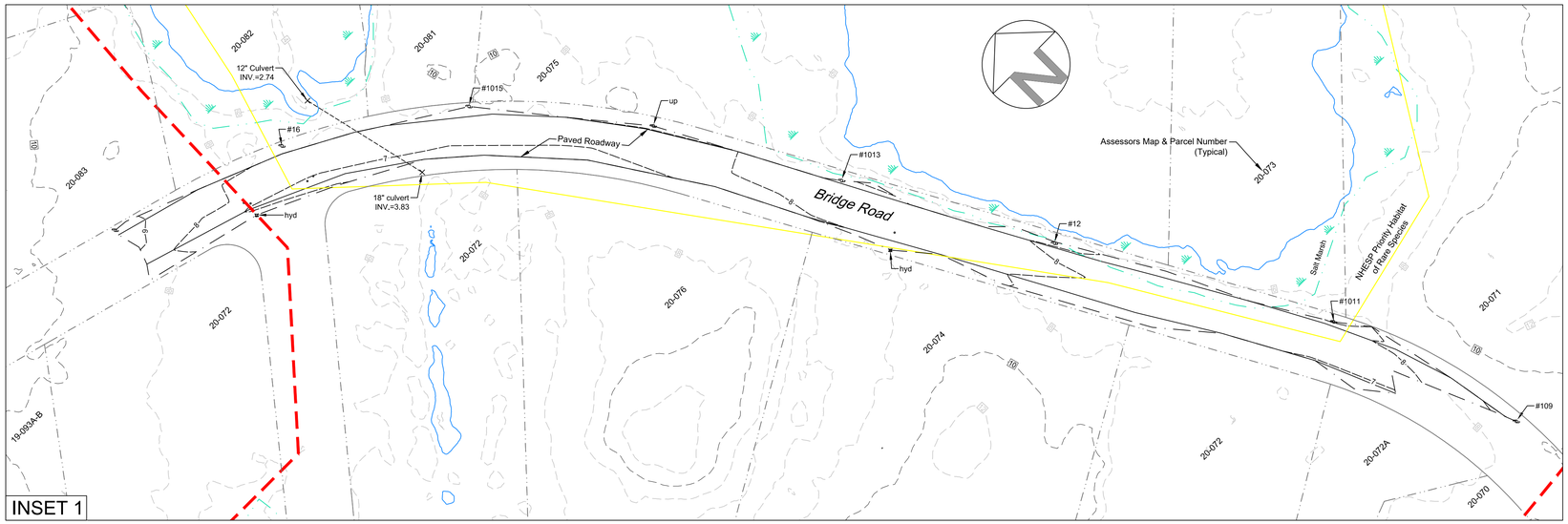
Point	Northing	Easting	Elevation	Description
1592	2759049.325	1066387.018	13.901	Utility Pole
1595	2758962.322	1066376.16	10.277	Utility Pole
1598	2758925.35	1066351.249	9.7194	Manhole
1599	2758916.574	1066347.259	9.3958	Manhole
1632	2758339.167	1066272.346	10.8906	Water Gate
1641	2758521.833	1066279.746	9.5509	Electrical Gate
1642	2758521.748	1066279.851	9.5538	Water Gate
1654	2758821.639	1066294.015	9.4276	Water Gate
1655	2758823.697	1066282.917	9.8187	Fire Hydrant Base
1656	2758823.428	1066282.939	12.5658	Fire Hydrant Spindle
1657	2758563.059	1066268.436	7.8609	Bridge Armor
1658	2758502.177	1066308.291	8.3387	Bridge Armor
1659	2758477.851	1066304.908	9.2884	Base Bridge Utility
1660	2758476.712	1066304.655	9.0589	Base Bridge Utility
1661	2758478.894	1066307.755	9.004	Top Watermain
1662	2758476.478	1066308.21	8.0693	Bottom Watermain
1663	2758470.175	1066303.369	14.783	Top Watermain
1664	2758470.152	1066303.417	13.1798	Bottom Watermain
1665	2758443.947	1066303.454	14.9377	Top Watermain
1669	2758396.39	1066305.245	10.0477	Base Bridge Utility
1670	2758396.427	1066305.59	9.4053	Base Bridge Utility
1671	2758394.282	1066308.785	9.7625	Base Watermain
1674	2758433.773	1066304.394	12.0403	Top of Bridge Utility Bracket
1675	2758433.866	1066304.485	11.1854	Bottom of Bridge Utility Bracket
1678	2758471.877	1066302.65	10.7886	Bridge Abutment
1679	2758400.32	1066302.791	11.0554	Bridge Abutment
1680	2758376.153	1066308.123	10.01	Bridge Armor
1681	2758353.675	1066305.438	10.7661	Water Gate
1684	2758354.585	1066312.036	8.3988	Water Gate
1685	2758311.458	1066254.071	10.2974	Bridge Armor
1688	2758400.277	1066263.447	9.4949	Bridge Abutment
1694	2758471.695	1066263.249	10.831	Bridge Abutment
1695	2758471.626	1066262.783	11.0994	bot ut 8in
1699	2758476.717	1066260.649	8.3684	Gas Valve
1700	2758476.615	1066260.673	8.361	Gas Valve
1705	2758167.731	1066038.069	9.2019	Utility Pole
1707	2758139.919	1066030.826	9.1692	Water Gate
1708	2758149.195	1066022.324	9.8656	Fire Hydrant Base
1717	2757824.826	1065747.562	8.1591	Water Gate
1718	2757821.502	1065750.28	8.0646	Water Gate
1719	2757815.686	1065745.8	8.4467	Fire Hydrant Base
1720	2757815.874	1065746.189	11.0284	Fire Hydrant Spindle
1721	2757813.115	1065748.685	8.3405	Utility Pole
1722	2757805.148	1065778.748	7.8217	Water Gate
1723	2757810.933	1065778.023	7.925	Water Gate

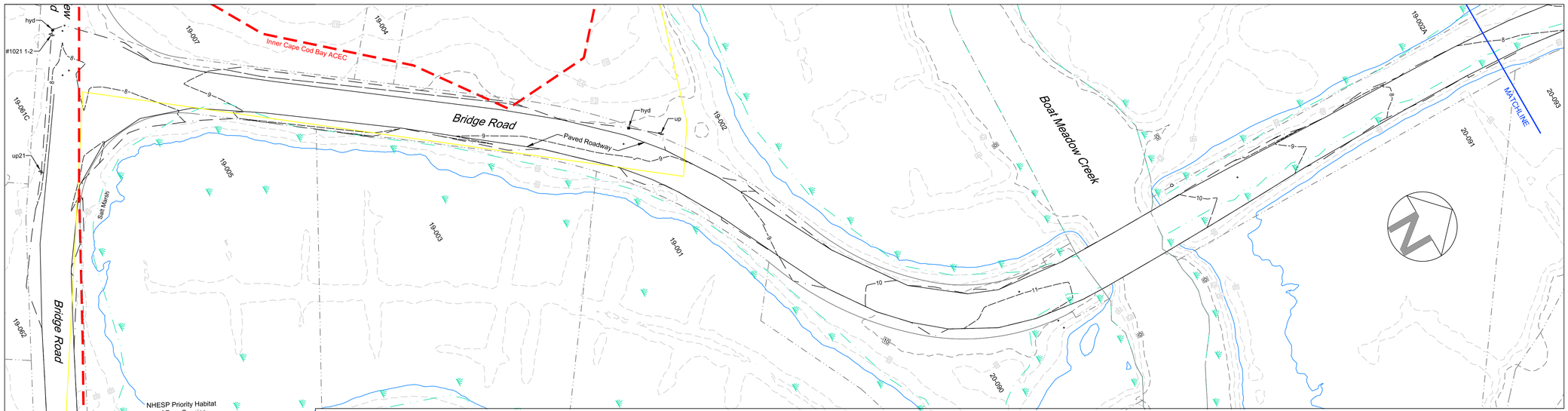
1726	2757755.735	1065832.954	8.3026	Utility Pole
1753	2757295.481	1066764.438	8.3671	Utility Pole
1756	2757194.963	1066819.709	8.5237	Utility Pole
1760	2757081.266	1066882.646	8.4533	Utility Pole
1761	2757080.895	1066881.91	8.4772	Utility Pole
1765	2756932.739	1066964.971	8.0828	Utility Pole
1770	2756815.976	1066999.296	9.6202	Utility Pole
1777	2757151.453	1066820.081	8.4137	Water Gate
1778	2757146.034	1066811.157	8.2943	Fire Hydrant Base
1784	2757372.634	1066650.376	5.6743	Top of Culvert
1785	2757371.925	1066649.649	3.829	Culvert Invert
1787	2757415.423	1066602.91	6.9829	Water Gate
1788	2757415.817	1066598.366	6.9234	Water Gate
1789	2757430.091	1066565.634	7.0685	Water Gate
1790	2757433.066	1066563.072	7.214	Water Gate
1791	2757422.792	1066563.419	7.0984	Fire Hydrant Base
1795	2757475.035	1066498.517	9.1216	Utility Pole
1800	2757440.929	1066602.421	7.939	Utility Pole
1803	2757379.851	1066696.232	7.6871	Utility Pole
8004	2757449.068	1066631.806	2.735	Top of Culvert
8005	2757448.424	1066632.017	3.865	Culvert Invert

Samoset Road

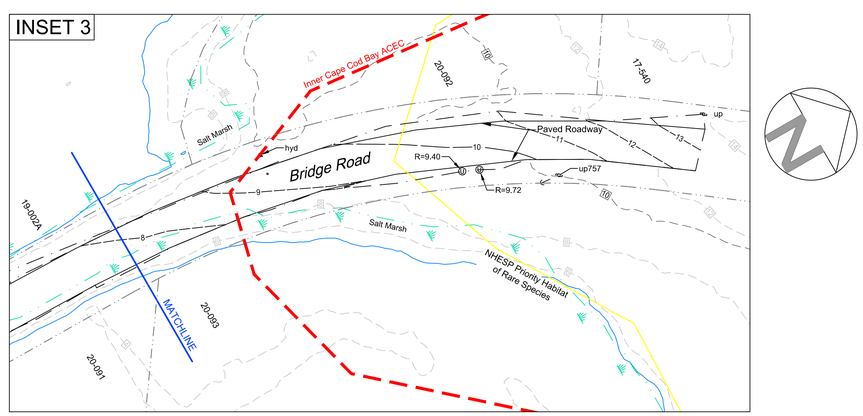
Point	Northing	Easting	Elevation	Description
1825	2764330.778	1064482.539	6.563	Utility Pole
1837	2764424.282	1064492.626	7.6885	Water Gate
1838	2764427.929	1064483.806	8.4736	Fire Hydrant Base
1843	2764291.228	1064446.796	8.6988	Water Gate
1852	2764026.378	1064372.827	11.1395	Water Gate
1853	2764028.838	1064364.038	11.5794	Fire Hydrant Spindle
1862	2763734.88	1064268.018	8.7642	Utility Box
1864	2763680.794	1064238.172	7.8406	Fire Hydrant Base
1875	2764797.701	1064801.108	16.4428	Utility Pole
1882	2764675.626	1064668.212	10.7534	Water Gate
1883	2764673.988	1064664.672	10.6152	Water Gate
1884	2764671.033	1064662.852	10.4167	Water Gate
1927	2764975.737	1065222.69	12.0165	Catch Basin
1933	2765090.526	1065505.553	7.9509	Catch Basin
1940	2765239.844	1065870.528	10.9212	Catch Basin
1945	2765220.476	1065911.075	11.6854	Utility Pole
1947	2765215.301	1065880.782	10.7745	Catch Basin
1950	2765154.781	1065753.377	9.4453	Utility Pole
1958	2765066.478	1065515.08	7.9057	Catch Basin
1959	2765055.252	1065505.62	8.0422	Utility Pole
1962	2765039.879	1065433.225	7.9276	Water Gate
1963	2765037.745	1065430.167	7.9286	Water Gate
1964	2765027.376	1065434.052	7.9819	Fire Hydrant Base
1966	2765015.286	1065371.03	9.1304	Water Gate
1967	2765012.751	1065368.285	9.2225	Water Gate
1968	2765004.334	1065381.287	9.4092	Utility Pole
1973	2764953.035	1065256.549	12.8156	Utility Pole
1974	2764950.478	1065232.208	12.1024	Catch Basin
1979	2764878.977	1065081.062	15.2169	Utility Pole
1981	2764855.379	1065011.734	16.2652	Catch Basin
1982	2764851.426	1065000.126	17.0604	Gas Valve
1983	2764851.722	1065002.101	16.6955	Utility Pole
1985	2764838.895	1064941.39	17.0359	Water Gate
1988	2764802.163	1064864.234	16.5534	Water Gate
1989	2764793.561	1064869.291	16.2934	Fire Hydrant Base
1990	2764793.616	1064868.814	19.0154	Fire Hydrant Spindle

APPENDIX B. EXISTING CONDITIONS PLANS





KEY MAP
SCALE: 1" = 2,000'



Graphic Scale

40 20 0 40 120

1" = 40'

	ELEVATION NAVD88 (FT)
HTL	---
MHW	5.04
NAVD88	0
MTL	---
MLW	-2.91

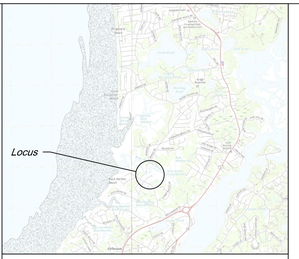
Mean High Water
Mean Low Water
Mass GIS Parcel Lines
Flood Zone Line
Mass GIS - MA DEP Wetlands
NHESP Priority Habitat Boundary
Area of Critical Environmental Concern (ACEC)
Edge of Pavement
Boundary of Field Survey & 2016 Lidar Topography
8 Field Survey Contour (NAVD88)
2016 USGS Lidar Contour
up Utility Pole
hyd Fire Hydrant
cbsn Catch Basin

Survey Notes:

Topographic survey conducted in January 2020 by Woods Hole Group.
Compiled topobathymetric data and 2016 orthophotograph provided by USGS.
Additional planimetric details provided by the Mass GIS.

Datum Notes:

Elevations are referenced to NAVD88 datum.
MHW Elevation = 5.04 ft
MLW Elevation = -2.91 ft



Location Map Not to Scale

WOODS HOLE GROUP
A CLS COMPANY
107 WATERHOUSE ROAD, BOURNE, MA 02532
TELEPHONE: (508) 540-8080 FAX: (508) 540-1001

Revisions | Date

1. 2. 3. 4. 5. 6. 7.

Surveyed By:
Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

Title:
Existing Conditions Plan - Bridge Road
Prepared For:
Town of Eastham
Eastham, MA

Project Number: 2019-0111
Dwg File: 2019-0111_SP
Scale: 1" = 40'
Date: June 3, 2020
Approved:
Drawn: JRK

	ELEVATION NAVD88 (FT)
HTL	---
MHW	5.04
NAVD88	0
MTL	---
MLW	-2.91

Mean High Water

Mean Low Water

Mass GIS Parcel Lines

Flood Zone Line

Mass GIS - MA DEP Wetlands

NHESP Priority Habitat Boundary

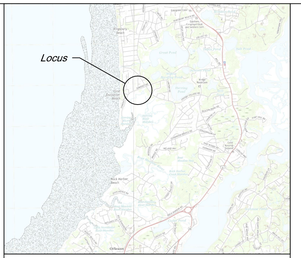
Area of Critical Environmental Concern (ACEC)

Edge of Pavement

Boundary of Field Survey & 2016 Lidar Topography

Field Survey Contour (NAVD88)

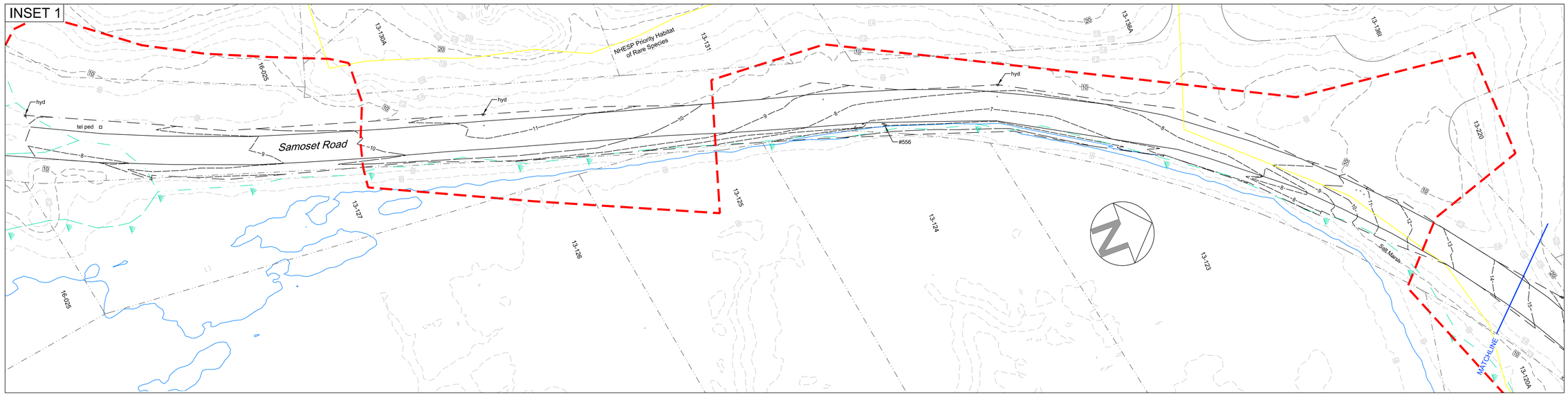
2016 USGS Lidar Contour



Location Map Not to Scale

WOODS HOLE GROUP
A CLS COMPANY
107 WATERHOUSE ROAD, BOURNE, MA 02532
TELEPHONE: (508) 540-8080 FAX: (508) 540-1001

INSET 1



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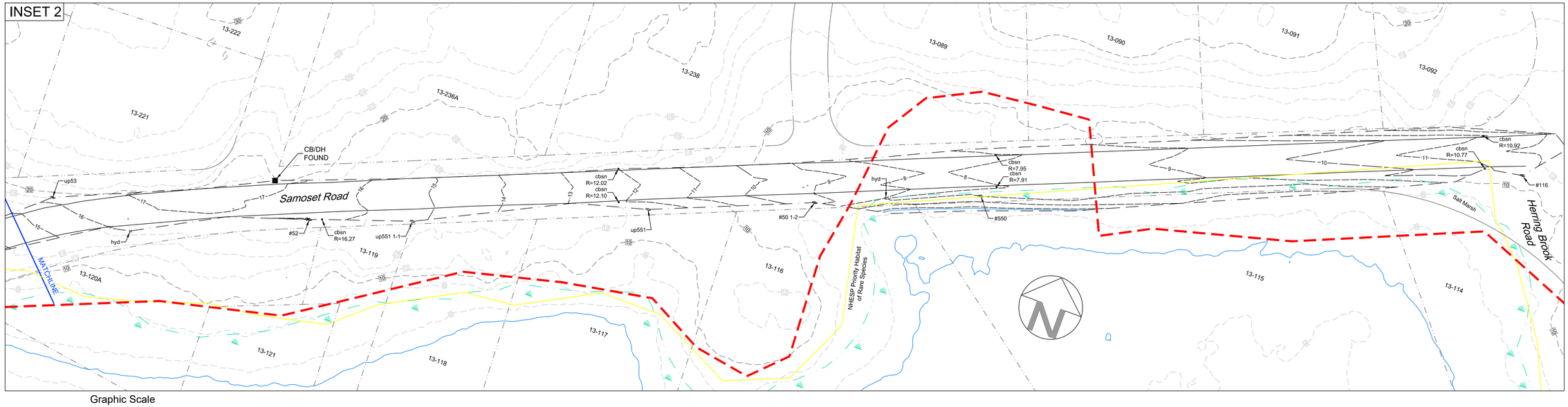

Graphic Scale

40 20 0 40 120

1" = 40'

Date	Revisions
	1.
	2.
	3.
	4.
	5.
	6.
	7.

Surveyed By:

Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

Title:

Existing Conditions Plan - Samoset Road
Prepared For:
Town of Eastham
Eastham, MA

Project Number: 2019-0111
Dwg File: 2019-0111_SP
Scale: 1" = 40'
Date: June 3, 2020
Approved:
Drawn: JRK

	ELEVATION NAVD88 (FT)
HTL	---
MHW	5.04
NAVD88	0
MTL	---
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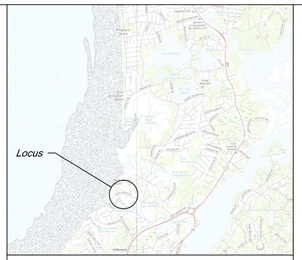

Location Map Not to Scale

Graphic Scale

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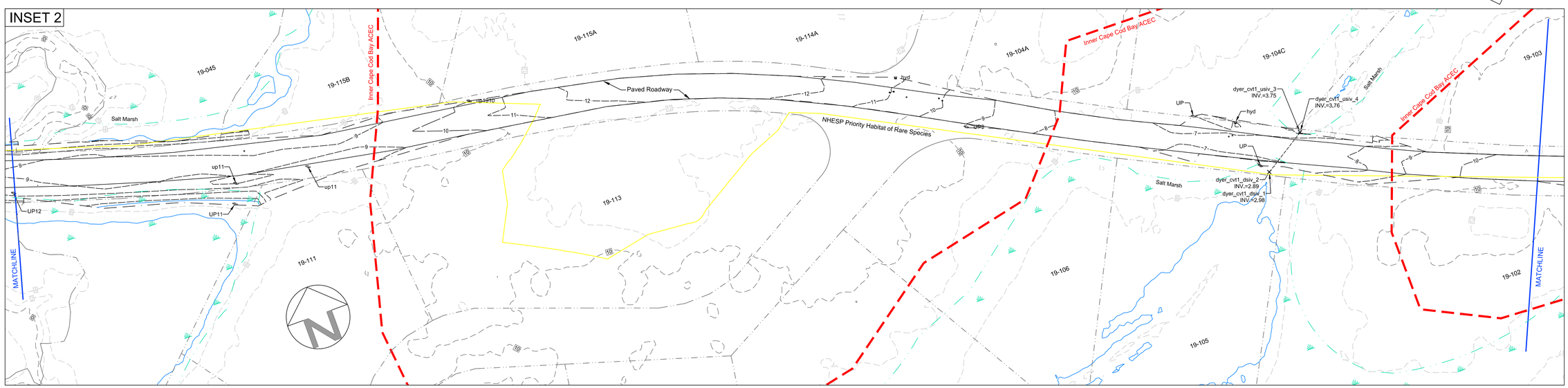
1" = 40'



WOODS HOLE GROUP
A CLS COMPANY
107 WATERHOUSE ROAD, BOURNE, MA 02532
TELEPHONE: (508) 540-8080 FAX: (508) 540-1001

Date

Revisions

1.
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4.
5.
6.
7.

Surveyed By:
Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

Title:
Existing Conditions Plan - Dyer Prince Road
Prepared For:
Town of Eastham
Eastham, MA

Project Number: 2019-0111
Dwg File: 2019-0111_SP
Scale: 1" = 40'
Date: June 3, 2020
Approved:
Drawn: JRK

	ELEVATION NAVD88 (FT)
HTL	---
MHW	5.04
NAVD88	0
MTL	---
MLW	-2.91

Mean High Water

Mean Low Water

Mass GIS Parcel Lines

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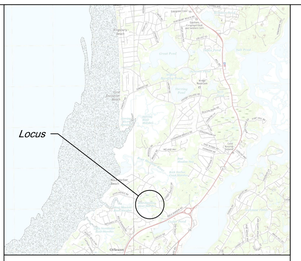
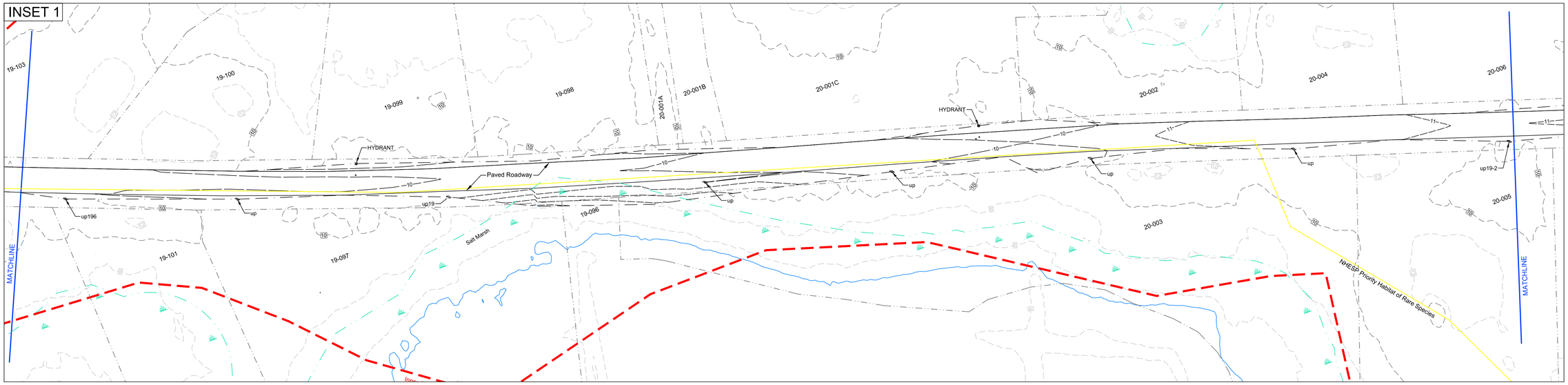
2016 USGS Lidar Contour



Location Map Not to Scale

WOODS HOLE GROUP
A CLS COMPANY
107 WATERHOUSE ROAD, BOURNE, MA 02532
TELEPHONE: (508) 540-8080 FAX: (508) 540-1001

INSET 1



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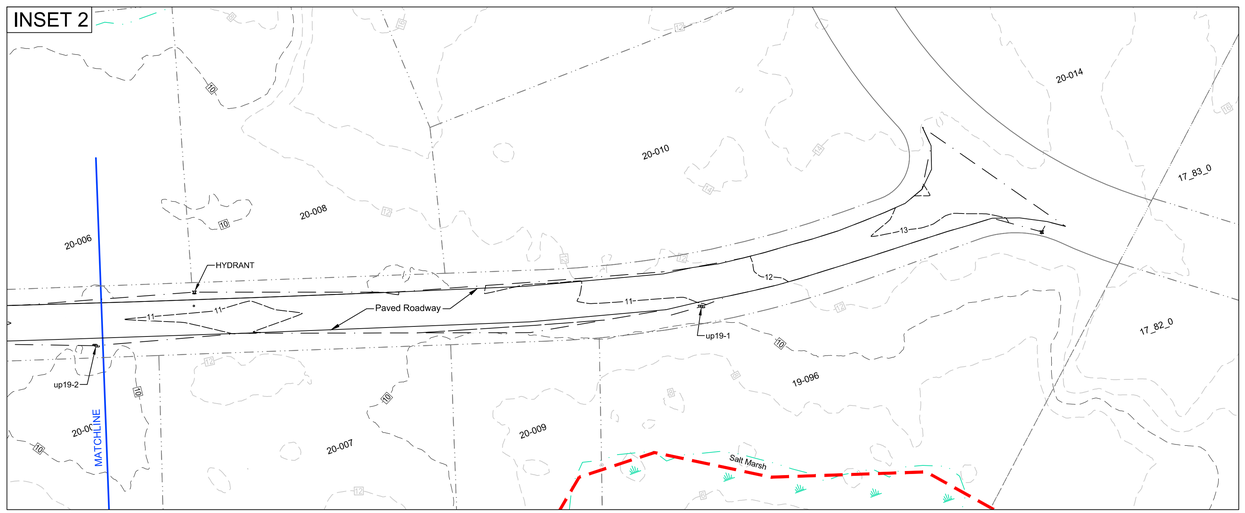

Graphic Scale

40 20 0 40 120

1" = 40'

Surveyed By:

Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

Revisions	Date
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Title:

Existing Conditions Plan - Dyer Prince Road
Prepared For:
Town of Eastham
Eastham, MA

Project Number: 2019-0111
Dwg File: 2019-0111_SP
Scale: 1" = 40'
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MHW	5.04
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Mean Low Water

Mass GIS Parcel Lines

Flood Zone Line

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NHESP Priority Habitat Boundary

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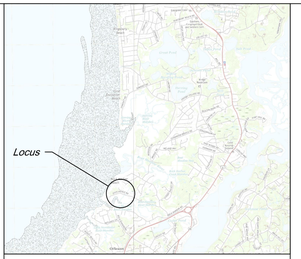
Field Survey Contour (NAVD88)

2016 USGS Lidar Contour



Location Map Not to Scale

WOODS HOLE GROUP
A CLS COMPANY
107 WATERHOUSE ROAD, BOURNE, MA 02532
TELEPHONE: (508) 540-8080 FAX: (508) 540-1001

INSET 1

INSET 2

Rock Harbor Road

Smith Lane

Paved Roadway

Paved Bike Path

Cape Cod Rail Trail

Inner Cape Cod Bay ACEC

Salt Marsh

Eastham

Orleans

SBLP FOUND - TOWN MONUMENT

SBDH FOUND

NHESP Priority Habitat of Rare Species

30" CULVERT INV.=0.38

30" CULVERT INV.=1.00

culvert INV.=1.15

box culvert w/ stops INV.=-0.92

4'x6' box culvert INV.=-1.10

cbsn R=9.23

cbsn R=8.88

cbsn R=7.95

Entry to Eastham Rotary

Exit from Eastham Rotary

up168

up1682

up1681

up2052

up205

hyd

#165

#164

#164s

20-121B

20-124B

20-124A

20-120

20-125A

20-122

20-123

20-125

10_1_0

10_2_0

10_3_0

18_19_0

18_20_0

18_18_0

Graphic Scale

40 20 0 40 120

1" = 40'

	Date
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Revisions

Surveyed By:

Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

Title:

Existing Conditions Plan - Smith Lane & Bike Path
Prepared For:
Town of Eastham
Eastham, MA

Project Number: 2019-0111
Dwg File: 2019-0111_SP
Scale: 1" = 40'
Date: June 3, 2020
Approved:
Drawn: JRK

APPENDIX C. PARCEL OWNERSHIP

Abutter ID	Abutter Owner	Abutter Owner 2	Abutter Address	Abutter Town	Abutter State	Abutter Zip	Abutter Bookpage	Abutter Location
19-108	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	N/A / N/A	15 DYER PRINCE LN
19-109	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	N/A / N/A	5 DYER PRINCE LN
20-90	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	N/A / N/A	0 BRIDGE RD
20-72A	WHITE DAVID L & EUGENIE M		385 BRIDGE RD	EASTHAM	MA	02642	1443 / 625	485 BRIDGE RD
20-12A	GRIFFIN DOUGLAS TTEE	BEARD ELIZABETH L TTEE	85 BRIDGE RD	EASTHAM	MA	02642	DOC / N/A	85 BRIDGE RD
19-93A	ZIMMERMAN DORIANNE P	JAMES S PAWLYK	219 PARK STREET APT#2	MONTCLAIR	NJ	07042	26863 / 152	657 BRIDGE RD
19-93B	KING REBEKAH S		14 BONAYA RD	EASTHAM	MA	02642	32098 / 26	659 BRIDGE RD
19-50A	RUYFFELAERT MICHAEL A & PAULA		66 COLTON PL	LONGMEADOW	MA	01106	26483 / 252	185 SUNSET AVE
13-182A	WHEELER GATRIA B &	DE LA CANAL SHIRLEY	PO BOX 679	EASTHAM	MA	02642	31918 / 303	11 BEACH PLUM LN
19-43D	SALOMONS HOWARD & JENNIFER		11 HARVEY LANE	N EASTON	MA	02366	CTF / 207927	580 DYER PRINCE RD
19-43E	DENERY FAMILY INVESTMENT TRUST	DENERY WESLEY & DONELLE TTEES	560 DYER PRINCE RD	EASTHAM	MA	02642	CTF / 218920	560 DYER PRINCE RD
20-1B	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	30228 / 182	52 DYER PRINCE RD A
20-1C	SCHOPP KENNETH C & REBECCA A		PO BOX 374	SHEFFIELD	MA	01257	31901 / 10	52 DYER PRINCE RD
19-43J	HARRIS CARL W JR & SUSAN M		5 MILES RD	HINGHAM	MA	02043	CTF / 202047	23 KEENE WAY
19-43F	CC SANDY TRUST	PATRICK & JENNIFER FAY TTEES	6 MARYKNOLL DRIVE	HINGHAM	MA	02043	CTF / 216075	8 KEENE WAY
19-43G	SCHOENER FAMILY IRREV TRUST	SCHOENER KATHLEEN & KAREN S	28 CONSTITUTION DR	SOUTHBORO	MA	01772	CTF / 201372	12 KEENE WAY
19-43H	SCHOENER KATHLEEN & ANTHONY TT	KATHLEEN M SCHOENER TRUST	28 CONSTITUTION DR	SOUTHBORO	MA	01772	CTF / 190211	16 KEENE WAY
19-43I	BIRKS JAMES M & REBECCA M		20401 BRIGHT WATER PL	STERLING	VA	20165	CTF / 203700	20 KEENE WAY
19-43K	SULKIN LISA & JEFFREY	SULKIN JANE & STEVE KOHALMI	181 AUBURN ST	AUBURNDALE	MA	02466	CTF / 211304	25 KEENE WAY
19-43L	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	CTF / 203922	700 DYER PRINCE RD
13-89	MURPHY BARRY M & GAIL S		10 PILGRIM'S PATH	EASTHAM	MA	02642	26473 / 285	10 PILGRIM'S PATH
13-90	CAMPBELL CATHERINE	DONALD C CAMPBELL	286 OAK LANE	GETTYSBURG	PA	17325	30335 / 2	1280 SAMOSET RD
13-91	BREVARD MARY E & MATHEW E		4054 AUGUSTA COURT	BLOOMFIELD	MI	48302	29557 / 138	1250 SAMOSET RD
13-92	WHITMORE BRUCE C		905 HERRING BROOK ROAD	EASTHAM	MA	02642	29221 / 340	905 HERRING BROOK RD
13-114	STANTON BARBARA H		895 HERRINGBROOK RD	EASTHAM	MA	02642	7682 / 012	895 HERRING BROOK RD
13-116	WATSON DAVID S		PO BOX 2804	ORLEANS	MA	02653	3526 / 219	1315 SAMOSET RD
13-117	NEIDEL FAMILY REALTY TRUST	WILLIAM NEIDEL TRUSTEE	6364 ROOKERY CIR	BRADENTON	FL	34203	6900 / 186	1355 SAMOSET RD
13-118	BUFFINGTON JOANNA LT	WILLIAM DEAN BROOK LT	c/o JAMES BUFFINGTON	EASTHAM	MA	02642	26140 / 114	1395 SAMOSET RD
13-119	WILLARD STEPHEN F		1405 SAMOSET RD	EASTHAM	MA	02642	18059 / 254	1405 SAMOSET RD
13-120A	DAIGLE DAVID VAHLTEICH	JILL L HOWARD DAIGLE	14 TWOMBLY DR	SUMMIT	NJ	07901	10710 / 094	1415 SAMOSET RD
13-130A	WELCH JOHN L & CHERYL B		79 ST BOTOLPH ST #1	BOSTON	MA	02116	CTF / 189615	1600 SAMOSET RD
13-131	ROWE ROBERT H & ROBIN M		1570 SAMOSET RD	EASTHAM	MA	02642	CTF / 202027	1570 SAMOSET RD
13-132A	WHYMAN JOHN S & FRAN L		16 SABRINA RD	WELLESLEY	MA	02482	CTF / 165545	30 SHERWOOD RD
13-133A	NOETZLI HANS C TTEE	SHERWOOD RD NOMINEE TRUST	4116 BEARD AVE SOUTH	MINNEAPOLIS	MN	55410	CTF / C307-A	20 SHERWOOD RD
13-133B	LINDA A ROSSETTI 2004 REVOC TR	LINDA A ROSSETTI TRUSTEE	6 WOLCOTT TERRACE	WINCHESTER	MA	01890	CTF / C307-B	18 SHERWOOD RD
13-133C	RIDLEY FAMILY TRUST	PETER T & ANN F RIDLEY TTEES	865 SANDCASTLE DR	CORONA DEL MAR	CA	92625	CTF / C307-C	16 SHERWOOD RD
13-133D	TRANTINA LIVING TRUST	GERALD G TRANTINA ET AL	2810 ESTERO BLVD UNIT 412	FORT MYERS BEACH	FL	33931	CTF / C307-D	14 SHERWOOD RD
13-133E	MILLER TED S	ABIGAIL S ADAMS	100 S BEDFORD RD SUITE 110	MT KISCO	NY	10549-3444	CTF / C307-E	12 SHERWOOD RD
13-134	COHEN DANIEL & FRIEDMAN SUSAN		39 VANTERVENTER AVENUE	PRINCETON	NJ	08542	CTF / 219768	10 SHERWOOD RD
13-135	GUDZAR FAMILY LLC	ZERLINA GUZDAR DUBOIS	4900 LAURELWOOD COURT	MASON	OH	45040	CTF / 217310	1540 SAMOSET RD
13-136A	BRAZA FAMILY TRUST	FRANK & LORRAINE L BRAZA TTEES	PO BOX 425	EASTHAM	MA	02642	30076 / 303	15 BAY SHORE LN
13-136B	MARTIN D CEPKAUSKAS LVG TRUST	MARIE A CEPKAUSKAS LVG TRUST	PO BOX 1164	EASTHAM	MA	02642	29515 / 102	25 BAY SHORE LN
13-136C	FRIEDMAN BETTY LUCAS		95 WHITCOMB AVE	BOSTON	MA	02130	9731 / 79	35 BAY SHORE LN
13-136D	FRIEDMAN BETTY LUCAS		95 WHITCOMB AVE	BOSTON	MA	02130-3436	7465 / 121	45 BAY SHORE LN
13-136E	PAZNIOKAS PAUL	PHYLLILS A MONDELLI	PO BOX 369	BROOKSIDE	NJ	07926	22416 / 192	50 BAY SHORE LN
13-136F	LYNNE BASSETT PERRY REV TRUST	LYNNE BASSETT PERRY TRUSTEE	163 SANFORD ROAD	SOUTHBURY	CT	06488	31068 / 301	40 BAY SHORE LN

13-136G	JULIE BARBARA KOENIG REVOC TR	JULIE BARBARA KOENIG TTEE	300 ELM ST	HOLLYWOOD	FL	33019	30129 / 237	30 BAY SHORE LN
13-136H	DONATO DANIEL F & ROBIN V		192 EUCLID AVE	WATERBURY	CT	06710	12934 / 199	20 BAY SHORE LN
13-136I	BARTH STEFANIE M		20 WEST 72ND ST APT 1110	NEW YORK	NY	10023	22407 / 183	10 BAY SHORE LN
13-138	LYNNE BASSETT PERRY REV TRUST	LYNNE BASSETT PERRY TRUSTEE	163 SANFORD ROAD	SOUTHBURY	CT	06488	31068 / 301	15 SUNSET LN
13-139	RICE BENJAMIN M & JUDITH M		117 WINTER ST	NORWELL	MA	02061-1409	9913 / 203	25 SUNSET LN
13-140	DONATO PASCONE REVOC TRUST	ANNE F PASCONE REVOC TRUST	PO BOX 1072	EASTHAM	MA	02642	13195 / 172	35 SUNSET LN
13-141	RICE BENJAMIN & JUDITH		34 TOMPSEN LN	MILTON	MA	02186	8889 / 266	45 SUNSET LN
13-142	HATCH FAMILY TRUST	STEPHEN PHIFER TRUSTEE	33 HOLLOW RD	BRIMFIELD	MA	01010	9726 / 062	55 SUNSET LN
13-143	BAY DREAM LLC		253 RIVER PARK DRIVE	JUPITER	FL	33477	30217 / 272	1 BAYBERRY LN
13-144	PALTEN DAVID H TRUSTEE	BAYBERRY LANE REALTY TRUST	9 FOXCROFT RD	WEST HARTFORD	CT	06119	15880 / 174	3 BAYBERRY LN
13-145	SLOSSAR CYNTHIA A & WILLIAM		23 GREENBRIAR ST	BERGENFIELD	NJ	07621	26897 / 39	5 BAYBERRY LN
13-146	HARRIS RICHARD & SHERROL TTEES	KATIE REALTY TRUST	270 SOUTH STREET	W BRIDGEWATER	MA	02379	21381 / 335	7 BAYBERRY LN
13-147	HARRIS RICHARD P & SHERROL		270 SOUTH STREET	W BRIDGEWATER	MA	02379	9456 / 295	9 BAYBERRY LN
13-148	MARTIN C ROSNER QUAL TRUST #2	ARLENE B ROSNER QUAL TRUST #2	234 VIVIEN COURT	PARAMUS	NJ	07652	10139 / 171	11 BAYBERRY LN
13-149	MCCARTHY KEVIN F & KAREN J		36 MINUTEMAN RD	MEDFIELD	MA	02052	25852 / 61	13 BAYBERRY LN
13-150	MCCARTHY KEVIN F & KAREN J		129 EDGEWATER DRIVE	NEEDHAM	MA	02492	25852 / 61	15 BAYBERRY LN
13-151	EAGAR KEVIN	PARAMESWARI ROYCHOUDHURY	14 RICE ST	NEWTON	MA	02459-1934	24398 / 179	19 BAYBERRY LN
13-152	ROYCHOUDHURY PARAMESWARI	KEVIN FRANCIS EAGAR	14 RICE ST	NEWTON	MA	02459	30129 / 156	21 BAYBERRY LN
13-153	ROSEN RICHARD S TRUSTEE	EBB TIDE REALTY TRUST	PO BX 128	WHITMAN	MA	02382	23013 / 330	23 BAYBERRY LN
13-154	JAY EMERSON DAVIS FAMILY TRUST	JAY E & ELIZABETH H DAVIS TTEE	360 LOS ALTOS AVE	LONG BEACH	CA	90814	20195 / 335	25 BAYBERRY LN
13-155	KIMLER BRADFORD J & LISA J		49 ALGONQUIAN DR	NATICK	MA	01760	20637 / 39	27 BAYBERRY LN
13-156	FUCCI W JOHN & DOLORES C		234 HAWKS CREST LANE	WEAVERVILLE	NC	28787	7954 / 213	29 BAYBERRY LN
13-157	SCOTT FAMILY 2010 IRREV TRUST	ROGER W HOBBY TRUSTEE	280 CONGRESS ST SUITE 1300	BOSTON	MA	02210	27927 / 168	31 BAYBERRY LN
13-158	PUKWUDGIE REALTY TRUST	DOROTHY E DANIELS TTEE	838 W ELKCAM CIR APT 403	MARCO ISLAND	FL	34145-2266	10493 / 239	33 BAYBERRY LN
13-159	RUSSO MARK J TRUSTEE	ROBERT J KOURY TRUSTEE	11807 WASHINGTON ST	KANSAS CITY	MO	64114	25324 / 199	35 BAYBERRY LN
13-160	PARRETT REALTY TRUST	RICHARD J PARRETT JR TRUSTEE	70 BONNIE BRIAR	OSTERVILLE	MA	02655	23347 / 40	36 BAYBERRY LN
13-161	FURGANG SAMUEL & SANDRA		19 SANDPIPER DR	WEST WARWICK	RI	02893	3976 / 064	34 BAYBERRY LN
13-162	KRAEMER MICHAEL F & ROSS S		200 EXCHANGE ST UNIT 1513	PROVIDENCE	RI	02903	7428 / 303	32 BAYBERRY LN
13-163	VAN SCHOUWEN MICHELLE M		4812 BENCHMARK COURT	SARASOTA	FL	34238	30191 / 325	30 BAYBERRY LN
13-164	DINNEEN JAMES M	ROBERT G DINNEEN ET AL	8 TOWNLINE RD	NORTH HAVEN	CT	06473	22294 / 51	28 BAYBERRY LN
13-165	JOYCE PATRICIA	LAUREEN KUNCHES	26 BAYBERRY LN	EASTHAM	MA	02642	14960 / 187	26 BAYBERRY LN
13-167A	CAMPBELL SYLVIA A TRUSTEE	SYLVIA A CAMPBELL NOM TRUST	PO BOX 656	BOCA GRANDE	FL	33921	9862 / 011	22 BAYBERRY LN
13-168	LINDBLOM WILLIAM & SUSAN	JOHN & MARYANNE RYAN	700 MORFORD AVE	LONG BRANCH	NJ	07740	29929 / 279	20 BAYBERRY LN
13-169	EAGAR KEVIN	PARAMESWARI ROYCHOUDHURY	14 RICE ST	NEWTON	MA	02459-1934	24398 / 179	18 BAYBERRY LN
13-170	SMITH JOANN & JENNIFER & JOANN	GUARDIAN FOR WILLIAM SMITH JR	33 OLD FIELD HILL RD UNIT 35	SOUTHBURY	CT	06488	7153 / 067	14 BAYBERRY LN
13-171	KAVAL DAVID J & ELLEN M		12 BAYBERRY LN	EASTHAM	MA	02642	18475 / 135	12 BAYBERRY LN
13-172	PHILIP SAMUEL DICKINSON REV TR	AYSIN OZKARAHAN DICKINSON TR	61 HEATHERBLOOM RD	WHITE PLAINS	NY	10605	29384 / 323	10 BAYBERRY LN
13-173	GREGG P PARTICELLI TRUST	LAURA F PARTICELLI TRUST	17 PARMENTER RD	FRAMINGHAM	MA	01701	30136 / 101	8 BAYBERRY LN
13-174	HUMBERT M OLIVEIRA TRUST	HUMBERT M OLIVEIRA TTEE	30 FENNER STREET	PROVIDENCE	RI	02903	31479 / 310	6 BAYBERRY LN
13-175	BACEWICZ JOHN C & LOIS R		PO BOX 708	N EASTHAM	MA	02651	31023 / 259	4 BAYBERRY LN
13-176	JOSEPH A MORCALDI FAMILY TRUST	HELEN J MORCALDI FAMILY TRUST	1990 HARTFORD TURNPIKE	NORTH HAVEN	CT	06473	9968 / 016	50 SUNSET LN
13-177	JOSEPH A MORCALDI FAMILY TRUST	HELEN MORCALDI FAMILY TRUST	1990 HARTFORD TURNPIKE	NORTH HAVEN	CT	06473	9968 / 018	40 SUNSET LN
13-178	JOSEPH A MORCALDI FAMILY TRUST	HELEN J MORCALDI FAMILY TRUST	1990 HARTFORD TURNPIKE	NORTH HAVEN	CT	06473	9968 / 018	3 BEACH PLUM LN
13-179	DREESSEN MARK F	SARA J SAYIGH	5405 SO INGLESIDE AVE	CHICAGO	IL	60615	7247 / 226	5 BEACH PLUM LN
13-180	FOLGER FAMILY TRUST	STEPHEN & SUSAN FOLGER TTEES	7 BEACH PLUM LANE	EASTHAM	MA	02642	26697 / 280	7 BEACH PLUM LN
13-183	WILCOX JONATHAN L & ALISON B		84 HANSCOM AVE	READING	MA	01867	27270 / 269	13 BEACH PLUM LN
13-184	WOLK KEVIN J & SARA J		4534 EQUESTRIAN DRIVE	HUDSONVILLE	MA	49426	26449 / 145	15 BEACH PLUM LN

13-185	BAMFORD JOYCE M TRUSTEE	JOYCE M BAMFORD REVOC TRUST	PO BOX 265	EASTHAM	MA	02642	20358 / 193	17 BEACH PLUM LN
13-186	OCONNELL DANIEL TTEE	OCONNELL FAMILY TRUST	PO BOX 1649	N EASTHAM	MA	02651	3469 / 180	19 BEACH PLUM LN
13-187	MEYER CHRISTINE SIEGWARTH		1 WOODCREST DRIVE	ARMONK	NY	10504	30952 / 236	21 BEACH PLUM LN
13-188	GAITA JAMES AND LEONA		241 W 97th ST APT 3M	NEW YORK	NY	10025	29128 / 64	23 BEACH PLUM LN
13-189	PRICE WALTER E & KATHLEEN	EMELIA E INGERSOLL	2 SYCAMORE LANE	AVON	CT	06001	29393 / 67	25 BEACH PLUM LN
13-190	SZEMREYLO STANLEY		152 GRANT HILL RD	TOLLAND	CT	06084	1306 / 674	27 BEACH PLUM LN
13-191	CAROLYN CLARKE ET AL		36 GARDEN ROAD	NEWTON	MA	02458	32061 / 89	29 BEACH PLUM LN
13-192	SKOLER CHARLOTTE TRUSTEE	CHARLOTTE SKOLER REALTY TRUST	539 NORTH AVE	BARRINGTON	IL	60010-3364	15449 / 101	31 BEACH PLUM LN
13-193	CARNEY JW JR	JOY B ROSEN	34 CHESTNUT TERR	NEWTON	MA	02459	28088 / 181	34 CRANBERRY LN
13-194	HILL ANN F, ALYSSA OMARA	AMY MUEHLBERGER	47 ELLISE RD	STORRS	CT	06268	22406 / 192	26 BEACH PLUM LN
13-195	TILLES DAN S		31 FIELDING STREET	CONCORD	MA	01742	17030 / 81	110 COBBETT LN
13-196	ATKINS VICTOR F & SUSAN C		1521 LITCHFIELD RD	WATERTOWN	CT	06795	21037 / 242	100 COBBETT LN
13-197	KRISCENSKI NANCE	ELIZABETH K KNOBLAUCH	16 AVALON PL	WETHERSFIELD	CT	06109	12391 / 209	90 COBBETT LN
13-198	SCHREIBER ALAN & JAMES		6507 PRINCETON DRIVE	ALEXANDRIA	VA	22307	32119 / 245	80 COBBETT LN
13-199	CERONE ROBERT A & LINDA A		74 TULANE RD	KENMORE	NY	14217	2399 / 195	70 COBBETT LN
13-200	SIXTY COBBETT LANE RLTY TRUST	JESSE PAUL JOHNSON ET AL TTEE	170 SEMINARY DRIVE	MENLO PARK	CA	94025	29197 / 270	60 COBBETT LN
13-201	J & F REALTY TRUST	FRANCES BROPHY TRUSTEE	PO BOX 1069	EASTHAM	MA	02642	8335 / 168	50 COBBETT LN
13-202	LALLI TRUST	SUSAN M & LEONARD LALLI TTEES	40 COBBETT LN	EASTHAM	MA	02642	28746 / 64	40 COBBETT LN
13-206A	OCONNELL FAMILY REVOC TRUST	SUSAN & GEORGE OCONNELL TTEES	22 BEACH PLUM LANE	EASTHAM	MA	02642	31132 / 222	22 BEACH PLUM LN
13-207	BENDER FAMILY NOMINEE TRUST	RICHARD & ANITA BENDER TTEES	90 TIMBER TRAIL	E HARTFORD	CT	06118	19795 / 56	20 BEACH PLUM LN
13-208	MCGARRY JAMES W & CAROLYN J		14 PUTNAM STREET	CHARLESTOWN	MA	02129-3816	29343 / 56	18 BEACH PLUM LN
13-209	HULME RICHARD F JR	KATHLEEN A THREADGOLD	12 SPRUCE ST	FRAMINGHAM	MA	01701	7866 / 134	16 BEACH PLUM LN
13-210	FANNON MARK C & DIANE M		14 BEACH PLUM LN	EASTHAM	MA	02651	11655 / 273	14 BEACH PLUM LN
13-211	BUCKLEY EDWARD JR	SHELLEY R MYERS-BUCKLEY	4 GURNEY PL	ROCHESTER	MA	02770	12277 / 116	12 BEACH PLUM LN
13-212	CRANE BRUCE & PATRICIA TTEES	CRANE NOMINEE TRUST 2012	180 MIDDLETOWN AVE	WETHERSFIELD	CT	06109	26236 / 320	10 BEACH PLUM LN
13-213	BARTOLOTTA DAVID V & MICHELLE		156 SPRING ST	MEDFIELD	MA	02052	27779 / 65	6 BEACH PLUM LN
13-214	SCHUSTER JOHN T & JEANETTE	JAMES H & SUSAN R SCHUSTER	151 CHITTENDEN RD	KILLINGWORTH	CT	06419	18920 / 65	4 BEACH PLUM LN
13-215	SURDAM WARREN B & VICTORINE M		3271 MARILYN ST	SCHENECTADY	NY	12303	7157 / 086	2 BEACH PLUM LN
13-216	TAYLOR JANE		1 BEACH PLUM LANE	EASTHAM	MA	02642	29033 / 284	1 BEACH PLUM LN
13-218	NORMA M DALEY 2018 REVOC TRUST	NORMA M DALEY TTEE	PO BOX 1303	EASTHAM	MA	02642	31161 / 339	30 SUNSET LN
13-219	ELIA A MOTTOLA IRREVOC TRUST	MARY S MOTTOLA IRREVOC TRUST	53 MARIAN DR	NO ANDOVER	MA	01845	22903 / 41	20 SUNSET LN
13-220	REARDON DAWN M		542 TURNPIKE ST	STOUGHTON	MA	02072	30694 / 73	10 SUNSET LN
13-221	WEBER ALICE TTEE	FREDERICK & ALICE WEBER REV TR	1420 SAMOSET RD	EASTHAM	MA	02642	24563 / 305	1420 SAMOSET RD
13-222	STEVEN E KLEINBERG REVOC TRUST	STEVEN KLEINBERG TTEE	15 CLAYTON RD	EASTHAM	MA	02642	30168 / 68	15 CLAYTON RD
13-223	KOTOWSKI WIESLAW & KATHLEEN P		24 CHICKATAWBUT ST	DORCHESTER	MA	02122	28735 / 320	25 CLAYTON RD
13-224	SLIWA DENISE T & EDWARD A TTEE	DTS REALTY TRUST	6616 WAKEFIELD DRIVE	FT MYERS	FL	33966	14311 / 316	35 CLAYTON RD
13-225	ZAZZARO JOHN A & JEAN M		45 CLAYTON RD	EASTHAM	MA	02642	27638 / 230	45 CLAYTON RD
13-226	FINK GERALD N & BARBARA		55 CLAYTON RD	EASTHAM	MA	02642	30424 / 49	55 CLAYTON RD
13-227	WARD JOANNE G		201 EKANA CIRCLE	DAYTONA BEACH	FL	32124	8277 / 278	65 CLAYTON RD
13-228	FIRST ENCOUNTER REALTY TRUST	LUCY M PETERSON, TTEE	67 STONE PATH LN	WEST SPRINGFIELD	MA	01089	31740 / 271	75 CLAYTON RD
13-229	LOOMIS ELIZABETH F		85 CLAYTON RD	EASTHAM	MA	02642	30335 / 21	85 CLAYTON RD
13-230	LLOYD DONALD G	RICHARD T / WAYNE PETER LLOYD	95 CLAYTON RD	EASTHAM	MA	02642	29068 / 183	95 CLAYTON RD
13-231	STEPHEN F DUARTE 2016 LVG TR	SUSAN Y WILLIAMS 2016 LVG TR	100 CLAYTON RD	EASTHAM	MA	02642	29492 / 336	100 CLAYTON RD
13-232	SMITH FAMILY NOMINEE TRUST	ELIZABETH J SMITH TRUSTEE	PO BOX 351	EASTHAM	MA	02642	20266 / 310	40 CLAYTON RD
13-234A	DUMAS ROGER L & EVELYN SUE		107 COLE RD	EASTHAM	MA	02642	7510 / 248	107 COLE RD
13-234B	COZ JOHN E		PO BOX 96	MARLBOROUGH	MA	01752	CTF / 213306	105 COLE RD
13-236A	SHIRE WILLOW B	SUMMER B ZEH	1380 SAMOSET RD	EASTHAM	MA	02642	17290 / 195	1380 SAMOSET RD

13-238	ERICKSON CHARLES D & JANICE G		18 OVAL RD	ESSEX FELLS	NJ	07021	2404 / 019	5 PILGRIM'S PATH
16-25	EASTHAM TOWN OF	FIRST ENCOUNTER BEACH	2500 STATE HWY	EASTHAM	MA	02642	1369 / 1091	1620 SAMOSET RD
19-1	NARDINI MARY J TTEE	MARY J NARDINI REVOC LVG TR	15 CHARLIE NOBLE WAY	EASTHAM	MA	02642	18954 / 105	15 CHARLIE NOBLE WAY
19-2	ARNOLD JAMES W TTEE	JAMES W ARNOLD REVOC TRUST	725 BRIDGE RD	EASTHAM	MA	02642	CTF / 173348	725 BRIDGE RD
19-3	FARDY GEORGE W & MARY E		160 ROCKLAND RD	CARLISLE	MA	01741	26759 / 2	13 CHARLIE NOBLE WAY
19-4	SHEEHAN JOHN P & ZOBEL SARA E		229 WEST 60TH STREET APT 5T	NEW YORK	NY	10023	CTF / 216812	715 BRIDGE RD
19-5	BRADY PAUL F JR & LAURA S		18 NORFOLK AVE	MEDWAY	MA	02053	31321 / 297	11 CHARLIE NOBLE WAY
19-6	WILLIAM E ROBBINS TRUST	MARTHA S ROBBINS TRUST	10 CHARLIE NOBLE WAY	EASTHAM	MA	02642	19103 / 272	10 CHARLIE NOBLE WAY
19-7	HANSON ANDREA L TTEE	ANDREA L HANSON REVOCABLE TR	15 BAY VIEW RD	EASTHAM	MA	02642	CTF / 182363	15 BAY VIEW RD
19-8	LAFOND THOMAS J & MONICA P		14 HIGHLAND ST	SHARON	MA	02067	CTF / 186753	10 BOAT MEADOW WAY
19-9	BISSON PAUL E & KRISTEN M		55 HIGHLAND AVENUE	SUDBURY	MA	01776-3318	CTF / 211928	12 BOAT MEADOW WAY
19-10	CLARK PHILLIP E & JOAN P		PO BOX 1011	ORLEANS	MA	02653	CTF / 136305	14 BOAT MEADOW WAY
19-11	BRADY PHILIP T & KAREN M		1 REDNER RD	MORRISTOWN	NJ	07960	CTF / 166894	16 BOAT MEADOW WAY
19-12	BOAT MEADOW WAY REALTY TRUST	JANET L TESTA TTEE	6 LONGFELLOW RD	WAYLAND	MA	01778	CTF / 176728	18 BOAT MEADOW WAY
19-13	LEKITES ROBERT L & EDIE A		20 BOAT MEADOW WAY	EASTHAM	MA	02642	CTF / 156996	20 BOAT MEADOW WAY
19-14	CARUSO PAUL J & KATHRYN TTEES	CARUSO REALTY TRUST	391 WASHINGTON ST	HOLLISTON	MA	01746	CTF / 183799	22 BOAT MEADOW WAY
19-15	CICERO FAMILY REALTY TRUST	JUDITH CICERO REALTY TRUST	45 BAYVIEW RD	EASTHAM	MA	02642	25505 / 297	45 BAY VIEW RD
19-16	ALEXANDER RICHARD B & KIMBERLY		37 STEPHANIE LANE	DARIEN	CT	06820	26802 / 80	50 BAY VIEW RD
19-17	CROSSMAN CAROLYN		40 BAY VIEW RD	EASTHAM	MA	02642	18525 / 280	40 BAY VIEW RD
19-18	DOBEK REVOC INDENTURE TRUST	MITCHELL L & LYDIA DOBEK TTEES	PO BOX 277	THREE RIVERS	MA	01080	20548 / 202	20 SUNSET AVE
19-19	SHANMUGARAJ MURUGESAN & MALINI		50 LIBERTY DRIVE APT 4A	BOSTON	MA	02210	23178 / 114	40 SUNSET AVE
19-20	DALBEY VERLINDEN REALTY TRUST		60 BAY VIEW RD	EASTHAM	MA	02642	32128 / 20	60 BAY VIEW RD
19-21	CACCIAPAGLIA DONALD C & ELLEN		95 STUYVESANT AVE	RYE	NY	10580	19991 / 221	70 BAY VIEW RD
19-22	SINGAL BRUCE	SYDNEY ALTMAN	79 WOODCHESTER DR	NEWTON	MA	02467	23994 / 83	80 SUNSET AVE
19-23	KOLBERT JUDITH A TTEE	KOLBERT ONE FAMILY TRUST	PO BOX 2049	ORLEANS	MA	02653	16000 / 97	90 SUNSET AVE
19-24A	THORLEY-LAWSON DAVID A	BRIGITTE T HUBER	175 GROVE STREET	CAMBRIDGE	MA	02138	30271 / 53	16 BEACH RD
19-25	WAUWINET DEVELOPMENT LLC		PO BOX 642	WINDHAM	NH	03087	25377 / 203	140 SUNSET AVE
19-26	CLARK MARTHA L TRUSTEE	MARTHA L CLARK FAMILY TRUST	10 BEACH RD	EASTHAM	MA	02642	16760 / 119	10 BEACH RD
19-27A	18 BEACH ROAD LLC		1010 BALDWIN AVE	NORFOLK	VA	23507	28610 / 278	18 BEACH RD
19-28A	BRETON MICHAEL & ELIZABETH		88 BLAIR RD	WILLINGTON	CT	06279	29954 / 244	20 BEACH RD
19-30	PHILLIPS RICHARD B & KATHRYN S		17 BEACH RD	EASTHAM	MA	02642	11159 / 318	19 BEACH RD
19-31	PHILLIPS KATHRYN S TTEE	KATHRYN S PHILLIPS REVOC TR	17 BEACH RD	EASTHAM	MA	02642	18994 / 205	17 BEACH RD
19-32	15 BEACH ROAD ASSOCIATES LLC	ATTN: JON BARNES	17 VIALLS DR	BARRINGTON	RI	02806	24179 / 183	15 BEACH RD
19-33	VALINSKI FAMILY NOMINEE TRUST	EDWARD/DOROTHY VALINSKI TTEES	170 SUNSET AVE	EASTHAM	MA	02642	11923 / 309	170 SUNSET AVE
19-34	SUNSET AVENUE REALTY TRUST	EVA & MICHAEL MILOFSKY TTEES	1010 WALTHAM ST APT 446	LEXINGTON	MA	02421	27199 / 311	180 SUNSET AVE
19-35	COPPI BRUNO & MARIE		30 PILGRIM DR	WINCHESTER	MA	01890	3120 / 149	10 ASPARAGUS LN
19-36	ROBERT G ROBINSON LVG TRUST	GRETCHEN P ROBINSON LVG TRUST	PO BOX 1275	ORLEANS	MA	02653	30134 / 230	18 ASPARAGUS LN
19-37	GEORGE S SWOPE JR LVG TRUST	MARGARET L ANDREWS LVG TRUST	PO BOX 2353	ORLEANS	MA	02653	27922 / 203	22 ASPARAGUS LN
19-38	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	26 ASPARAGUS LN
19-39A	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	35 ASPARAGUS LN
19-41	HOLLERAN NANCY O'NEIL		11 SHEFFIELD RD	WINCHESTER	MA	01890	N/A / N/A	210 SUNSET AVE
19-42	HOLLERAN JR EDWARD T		11 SHEFFIELD RD	WINCHESTER	MA	01890	28107 / 113	220 SUNSET AVE
19-43B	JO-ANN SHUBERT TRUST	JO-ANN SCHUBERT TTEE	PO BOX 1264	EASTHAM	MA	02642	CTF / 219883	520 DYER PRINCE RD
19-43C	LONG TIMOTHY E & CHERYL A		LISKENSTRAAT 2	3080 TERVUREN		BELGIUM	CTF / 204588	480 DYER PRINCE RD
19-44	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	3964 / 252	400 DYER PRINCE RD
19-45	EASTHAM TOWN OF		2500 STATE HIGHWAY	EASTHAM	MA	02642	1411 / 870	0 DYER PRINCE RD
19-46	EASTHAM TOWN OF		2500 STATE HIGHWAY	EASTHAM	MA	02642	1411 / 870	0 DYER PRINCE RD

19-47	EASTHAM TOWN OF		2500 STATE HIGHWAY	EASTHAM	MA	02642	4413 / 301	0 DYER PRINCE RD
19-48	HOLLERAN JR EDWARD T		11 SHEFFIELD RD	WINCHESTER	MA	01890	28107 / 113	225 SUNSET AVE
19-49	193 SUNSET LLC		14822 CASTLE PARK TERRACE	LAKEWOOD RANCH	FL	34202	30999 / 178	193 SUNSET AVE
19-52	NALLY THOMAS J & SUSAN B		17 CUSHING RD	BROOKLINE	MA	02146	6498 / 193	169 SUNSET AVE
19-53	LEO KLEVENS REVOCABLE TRUST	ELAINE KLEVENS REVOCABLE TRUST	147 SUNSET AVE	EASTHAM	MA	02642	24667 / 215	147 SUNSET AVE
19-54	GREGORY DANIEL R & BLANCHE M		PO BOX 1195	ORLEANS	MA	02653	7406 / 130	115 SUNSET AVE
19-55	CARL G BECHGAARD LIVING TRUST	CANDACE BECHGAARD LIVING TRUST	PO BX 295	ORLEANS	MA	02653	26151 / 122	93 SUNSET AVE
19-56	BEGIN MARJORIE R		1065 PAPER STREET	SUFFIELD	CT	06078	31744 / 49	81 SUNSET AVE
19-57	SALMESTRELLI JEROME R & DEBORA		PO BOX 1080	ORLEANS	MA	02653	12586 / 131	69 SUNSET AVE
19-58	GATES JOHN C & LAURA H LT	F MICHAEL & DIANE FLASAR	800 GRAVES RD	CONWAY	MA	01341	29966 / 252	47 SUNSET AVE
19-59	DWYER MARY F		BX 2343	ORLEANS	MA	02653	25463 / 5	25 SUNSET AVE
19-60	BRUCKNER ANDREW W & ROBIN J		1318 EXCALIBER LN	SANDY SPRING	MD	20860	28120 / 121	20 BAY VIEW RD
19-61A	QUATTLEBAUM EDWIN G & RUTH F		9 LEXINGTON ST	CHARLESTOWN	MA	02129	7184 / 080	18 BAY VIEW RD
19-61B	OCONNOR RICHARD C & ANNE M		16 ROCKLEDGE DR	AVON	CT	06001	22337 / 2	16 BAY VIEW RD
19-61C	PRENTISS SHARYN M		PO BOX 1038	ORLEANS	MA	02653	9760 / 058	10 BAY VIEW RD
19-62	NICKERSON ANNETTE LIFE TENANT		685 BRIDGE RD	EASTHAM	MA	02642	CTF / 199599	685 BRIDGE RD
19-63	TAURAS FAMILY NOMINEE TRUST	JAMES A & ANGELA A TAURAS TTEE	6 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 147574	6 WINDJAMMER LN
19-64	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	CTF / 132237	10 WINDJAMMER LN
19-65	HURLEY JOHN J		PO BOX 1126	ORLEANS	MA	02653	CTF / 147699	385 WINDJAMMER LN
19-66	HURLEY JOHN J		PO BOX 1126	ORLEANS	MA	02653	CTF / 147699	95 WINDJAMMER LN
19-67	NICKERSON ANNETTE LIFE TENANT		685 BRIDGE ROAD	EASTHAM	MA	02642	CTF / 199599	112 WINDJAMMER LN
19-68A	LIBERATORE WILLIAM M & SHARON		36 WESTFIELD DR	N ATTLEBORO	MA	02760	1489 / 089	110 WINDJAMMER LN OFF
19-68B	NIQUETTE FAMILY TRUST	ELIZABETH FULLER TRUSTEE	156 GLENDALE RD	ATTLEBORO	MA	02703	27243 / 74	120 WINDJAMMER LN OFF
19-68C	LIBERATORE WILLIAM M & SHARON		36 WESTFIELD DR	N ATTLEBORO	MA	02760	1489 / 089	124 WINDJAMMER LN
19-69	SCIBINICO KAREN	EDWARD R EQUI	111 APPLEWOOD LN	CLINTON	MA	01510	24915 / 273	130 WINDJAMMER LN
19-70A	ROGER TUCKER THURSTON TRUST	CAROL H THURSTON TRUST	115 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 155318	115 WINDJAMMER LN
19-71	WILLIAM H ALLAN LIVING TRUST	WILLIAM H ALLAN TRUSTEE	160 WINDJAMMER LANE	EASTHAM	MA	02642	29309 / 104	160 WINDJAMMER LN
19-73	COOPER ERIC J	CAROL NUMRICH	1924 LONG RIDGE RD	STAMFORD	CT	06903	29322 / 261	190 WINDJAMMER LN
19-74	WINDJAMMER LANE REALTY TRUST	JOSEPHINE C GRAVALLESE ET AL	39 SUNSET ROCK ROAD	ANDOVER	MA	01810	CTF / 219731	210 WINDJAMMER LN
19-76	HOLLEY MARTIN M & SUSAN T		BX 279	RED HOOK	NY	12571-0279	CTF / 184927	215 WINDJAMMER LN
19-77	HOLLEY MARTIN M & SUSAN T		PO BX 279	RED HOOK	NY	12571-0279	CTF / 184927	225 WINDJAMMER LN
19-78	AYOUB GRETCHEN		20 MARTIN ST	WEST ROXBURY	MA	02132	CTF / 197214	250 WINDJAMMER LN
19-79	TOMANEY WILLIAM J	JESSE M HOROWITZ	280 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 206301	280 WINDJAMMER LN
19-80	SCRIBNER SUSAN R		290 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 133792	290 WINDJAMMER LN
19-81	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	3990 / 263	0 WINDJAMMER LN
19-82	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	3990 / 263	0 WINDJAMMER LN
19-83	WILLIAM T DUVALL LVG TRUST	JOANNA K ANDERSON LVG TRUST	310 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 211872	310 WINDJAMMER LN
19-84	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	3990 / 263	0 WINDJAMMER LN
19-85	GOLDSTEIN ROBERT B TRUSTEE	340 WINDJAMMER LN NOMINEE TR	340 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 166560	340 WINDJAMMER LN
19-86	RYAN EILEEN		275 WINDJAMMER LANE	EASTHAM	MA	02642	CTF / 210421	275 WINDJAMMER LN
19-87	SHANLEY-KOEBER MARY E		355 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 169313	355 WINDJAMMER LN
19-88	ARAGONA MICHAEL	MARI MCDADE	109 BRINKER RD	BARRINGTON HILLS	IL	60010	CTF / 183454	360 WINDJAMMER LN
19-89	HOLBACK KATHLEEN H		73 FURNACE BROOK DR	CORTLANDT MANOR	NY	10567	CTF / 170958	390 WINDJAMMER LN
19-91	GIBSON FAMILY TRUST	WILLIAM GIBSON TTEE ET AL	44 SUNSET RIDGE LANE	BOLTON	MA	01740	CTF / 185056	375 WINDJAMMER LN
19-92	RICHARDSON DOROTHY		410 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 180265	410 WINDJAMMER LN
19-94	KILGROW DAVID	DEBORAH J LEONE	440 WINDJAMMER LN	EASTHAM	MA	02642	CTF / 144562	440 WINDJAMMER LN
19-95	CORLISS FAMILY IRREVOC TRUST	MICHAEL JEREMIAH CORLISS TTEE	151 HILLSIDE ST	MILTON	MA	02186	CTF / 214567	665 BRIDGE RD

19-96	LEACACOS GEORGE J	CAROLYN O BROTHERTON	33 NORTH LAKE DR	HAMDEN	CT	06517	10671 / 017	53 DYER PRINCE RD
19-97	DYER PRINCE 73 NOMINEE RLTY TR	CHRISTOPHER R TAPSCOTT TRUSTEE	49 CRAIN SQUARE BLVD	HOUSTON	TX	77025	28100 / 306	73 DYER PRINCE RD
19-98	PEIRCE LORRAINE		163 MAYFAIR DR	WESTWOOD	MA	02090	7288 / 183	60 DYER PRINCE RD
19-99	PEIRCE LORRAINE		163 MAYFAIR DR	WESTWOOD	MA	02090	7404 / 183	70 DYER PRINCE RD
19-100	HOFFMAN GAIL		80 DYER PRINCE RD	EASTHAM	MA	02642	5885 / 326	80 DYER PRINCE RD
19-101	DYER PRINCE 73 NOMINEE RLTY TR	SUSAN S TAPSCOTT TRUSTEE	49 CRAIN SQUARE BLVD	HOUSTON	TX	77025	28100 / 306	81 DYER PRINCE RD
19-102	DEBS NICHOLAS A		101 DYER PRINCE RD	EASTHAM	MA	02642	28083 / 46	101 DYER PRINCE RD
19-103	KOPLEY KENNETH P		100 DYER PRINCE RD	EASTHAM	MA	02642	20194 / 87	100 DYER PRINCE RD
19-104A	MARTIN RICHARD A LIFE TENANT	DIANE L MARTIN LIFE TENANT	320 MCWHORTER DR	ATHENS	GA	30606	22216 / 11	120 DYER PRINCE RD
19-104B	MCKENZIE ROGER C	DONNA I CARY	284 WINDJAMMER LN	EASTHAM	MA	02642	11078 / 292	284 WINDJAMMER LN
19-104C	GOODALE BEVERLY K		195 CRESCENT ST	W BOYLSTON	MA	01583	29442 / 326	110 DYER PRINCE RD
19-106	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	CTF / 125339	119 DYER PRINCE RD
19-110	FELDMAN GLEN		3 CHAMBERLAIN ST	HOPKINTON	MA	01748-2417	CTF / 181478	2 DYER PRINCE LN
19-111	CAPE HOLDEN REALTY TRUST	CHRISTOPHER M HOLDEN TRUSTEE	25 UPLAND AVE	LUNENBURG	MA	01462	CTF / 201455	339 DYER PRINCE RD
19-113	ZAGLIO PETER	CAROL JOHNSON ZAGLIO	510 E 23RD ST APT 5C	NEW YORK	NY	10010	CTF / 188410	227 DYER PRINCE RD
19-114A	BUTERA ROBT J JR & GWYNETH		2783 CRAIGIE AVENUE	DECATUR	GA	30030-3926	31954 / 126	220 DYER PRINCE RD
19-114B	BUTERA ROBT J JR & GWYNETH O		2783 CRAIGIE AVENUE	DECATUR	GA	30030-3926	31954 / 126	25 SIMS WAY
19-114C	COMPACT OF CC CONSERV TR INC		PO BOX 443	BARNSTABLE	MA	02630	31939 / 334	20 SIMS WAY
19-114D	COMPACT OF CC CONSERV TR INC		PO BOX 443	BARNSTABLE	MA	02630	31939 / 334	10 SIMS WAY
19-115A	PEDLOW JOSEPH M & LAURA J		330 DYER PRINCE RD	EASTHAM	MA	02642	22294 / 49	270 DYER PRINCE RD
19-115B	PEDLOW JOSEPH M & LAURA J		330 DYER PRINCE RD	EASTHAM	MA	02642	21524 / 68	330 DYER PRINCE RD
19-115C	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	330 DYER PRINCE RD RR
19-115D	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	270 DYER PRINCE RD RR
19-116	ERICKSON ROBERT J		2736 BAYVIEW DR	NAPLES	FL	34112	21993 / 131	371 DYER PRINCE RD
19-117	ERICKSON ROBERT J		2736 BAYVIEW DR	NAPLES	FL	34112	21993 / 131	381 DYER PRINCE RD
19-118	SCHOENER FAMILY IRREV TRUST	KATHLEEN/KAREN SCHOENER TTEES	28 CONSTITUTION DR	SOUTHBOROUGH	MA	01772	CTF / 201372	531 DYER PRINCE RD
19-119	WATERON FARM REALTY TRUST	VICTOR SANTIAGO, TTEE	50 IVY CIRCLE	BRIDGEWATER	MA	02324	31579 / 350	431 DYER PRINCE RD
19-120	EASTHAM TOWN OF	ROCK HARBOR BEACH	2500 STATE HIGHWAY	EASTHAM	MA	02642	CTF / 24690	631 DYER PRINCE RD
20-1A	HEDLUND RICHARD R & LORRAINE A		P O BOX 702	EASTHAM	MA	02642	4194 / 219	54 DYER PRINCE RD
20-2	ROGERS PHILIP		8 SILVER COURT	BEVERLY	MA	01915	CTF / 203475	50 DYER PRINCE RD
20-3	BENKER MARILYN R		119 EAST BACON ST	PLAINVILLE	MA	02762	8626 / 178	47 DYER PRINCE RD
20-4	LESLIE-ANN MORSE		PO BOX 482	ORLEANS	MA	02653	CTF / 216215	42 DYER PRINCE RD
20-5	BENKER MARILYN R		119 EAST BACON ST	PLAINVILLE	MA	02762	8626 / 178	41 DYER PRINCE RD
20-6	JENNIFER E. VECCHI, TTEE	2018 HOLBROOK TRUST	PO BOX 323	YARMOUTH PORT	MA	02675	CTF / 21673	0 DYER PRINCE RD
20-6A	VECCHI JENNIFER E TRUSTEE	2018 HOLBROOK TRUST	PO BOX 323	YARMOUTHPORT	MA	02675	CTF / 216173	40 DYER PRINCE RD-OFF
20-7	KATE J WALLACE REVOC TRUST	RICHARD W WALLACE REVOC TRUST	89 ROCKVIEW ST	JAMAICA PLAIN	MA	02130	10998 / 93	31 DYER PRINCE RD
20-8	MORSE ANNA M		PO BOX 482	ORLEANS	MA	02653	CTF / 53727	30 DYER PRINCE RD
20-9	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	21 DYER PRINCE RD
20-10	DOMKE GUIDO	DANA A PARADIS	10 DYER PRINCE RD	EASTHAM	MA	02642	26707 / 295	10 DYER PRINCE RD
20-11	AUDETTE ARMAND & LISA ANN		PO BOX 937	S WELLFLEET	MA	02663	CTF / 207040	25 BRIDGE RD
20-14	JOSEPH L PUTNAM TRUST OF 1984	JEAN W PUTNAM TRUST OF 1984	20 BRIDGE RD	EASTHAM	MA	02642	10672 / 225	20 BRIDGE RD
20-15A	DALY CHRISTOPHER J		70 BRIDGE RD	EASTHAM	MA	02642	32016 / 262	70 BRIDGE RD
20-17	JESTUDE JAMES J		1649 WHEELER ST	N DIGHTON	MA	02764	26912 / 268	80 GOODY HALLETT DR
20-18	VENTIMIGLIA KENNETH & KIMBERLY		130 GOODY HALLETT DR	EASTHAM	MA	02642	26457 / 42	130 GOODY HALLETT DR
20-19	SUCHECKI PHILLIP P & JUDITH J		150 GOODY HALLETT DR	EASTHAM	MA	02642	30965 / 216	150 GOODY HALLETT DR
20-20	PIERSON REVOC LIVING TRUST	DOUGLAS R PIERSON TRUSTEE	1823 ASHWOOD RUN	THE VILLAGES	FL	32162	30502 / 326	190 GOODY HALLETT DR
20-21	WELLES TIMOTHY W	PATRICIA A MCDONALD	230 GOODY HALLETT DR	EASTHAM	MA	02642	29346 / 241	230 GOODY HALLETT DR

20-22	GRIECO RALPH M & JAYNE M		117 FRAMINGHAM RD	SOUTHBOROUGH	MA	01772	25089 / 42	290 GOODY HALLETT DR
20-23	MURRAY JAN E	JEAN E KILGORE	PO BOX 1159	EASTHAM	MA	02642	28790 / 130	300 GOODY HALLETT DR
20-24	KURT & KIMBERLY GOTTSCHALL		11 MAPLE DRIVE	EAST LYME	CT	06333	31382 / 71	330 GOODY HALLETT DR
20-26	FULLER CAROL A		8 BROOKVIEW CIRCLE	TYNGSBORO	MA	01879	31563 / 140	370 GOODY HALLETT DR
20-27	BRITTON BARBARA R		555 BROADWAY APT 3I	HASTINGS ON HUDSON	NY	10706	26552 / 298	390 GOODY HALLETT DR
20-31	HAGG PETER A & LINDA H		400 GOODY HALLETT DR	EASTHAM	MA	02642	2084 / 109	400 GOODY HALLETT DR
20-33A	SANDLER HOPE ELIZABETH	JOHN HOWARD SANDLER	PO BOX 324	EASTHAM	MA	02642	30037 / 176	385 GOODY HALLETT DR
20-34	BOAT MEADOW MARSH LLC		PO BOX 453	GUILFORD	CT	06437	24176 / 288	325 GOODY HALLETT DR
20-35	KELLEHER TIMOTHY P	LYNNDA LEE KELLEHER	1963 SOUTH LEYDEN ST	DENVER	CO	80224	30426 / 247	225 GOODY HALLETT DR
20-36	HEEG EDNA P		20 JOHN THOMAS RD	EASTHAM	MA	02642	2720 / 068	20 JOHN THOMAS RD
20-37	YOUNG ANDREW S & JOANNE E		PO BOX 137	WOODVILLE	MA	01784	30592 / 265	60 JOHN THOMAS RD
20-38	VAETH J STUART & ANN G		81 POND ST	WINCHESTER	MA	01890	10484 / 343	90 JOHN THOMAS RD
20-39	ALIMANESTIANU KATHERINE		120 JOHN THOMAS RD	EASTHAM	MA	02642	11129 / 317	120 JOHN THOMAS RD
20-40	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	13895 / 178	150 JOHN THOMAS RD
20-41	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	13177 / 197	0 JOHN THOMAS RD OFF
20-44	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	13478 / 39	135 JOHN THOMAS RD
20-45	KOENINGER ALICE & EDWARD LT	c/o JULIE KOENINGER	2 WILSON ST	WELLESLEY	MA	02482	24143 / 131	30 CAPT SHERMAN PL
20-46	KOENINGER ALICE & EDWARD LT	c/o JULIE KOENINGER	2 WILSON ST	WELLESLEY	MA	02482	24143 / 129	20 CAPT SHERMAN PL
20-47	MAHONEY EDWARD J & SHANNON E		95 JOHN THOMAS RD	EASTHAM	MA	02642	21124 / 78	95 JOHN THOMAS RD
20-48	PETERSON VIRGINIA R		7 WHITE PINES DR	EASTHAM	MA	02642	4482 / 210	85 JOHN THOMAS RD
20-49	SCHWORER DOUGLAS		20 JEREMIAHS LOOK	EASTHAM	MA	02642	23342 / 219	20 JEREMIAHS LOOK
20-50	FREEMAN ROBERT J & LAURA A		30 JEREMIAHS LOOK	EASTHAM	MA	02642	13050 / 054	30 JEREMIAHS LOOK
20-51	FEDERAL NATIONAL MORTGAGE ASSO		14221 DALLAS PKWY #1000	DALLAS	TX	75254	32034 / 170	75 JOHN THOMAS RD
20-52	VELLELA JOHN	KASIA B MALKIEWICZ	55 JOHN THOMAS RD	EASTHAM	MA	02642	28534 / 218	55 JOHN THOMAS RD
20-53	AJA CAPE PROPERTIES LLC		337 STOWE HILL RD	WILMINGTON	VT	05363	27985 / 106	25 JOHN THOMAS RD
20-54	RUTH J ONEILL LIVING TRUST	RUTH J ONEILL TRUSTEE	195 GOODY HALLETT DR	EASTHAM	MA	02642	27872 / 115	195 GOODY HALLETT DR
20-55	HALLISEY SHEILA & JOSEPH ET AL	THOMAS & MARGARET HALLISEY	138 LOWDEN ST	PAWTUCKET	RI	02860	27614 / 302	185 GOODY HALLETT DR
20-56	UNDERHILL MICHAEL B		2741 GULF VIEW DRIVE	NAPLES	FL	33962	5511 / 050	147 GOODY HALLETT DR
20-57	BISHOP MAHALA BUSSELLE TRUSTEE	MAHALA BUSSELLE BISHOP TRUST	PO BOX 283	BROOKSVILLE	ME	04617	24598 / 293	145 GOODY HALLETT DR
20-60	JANAVEY LAURA		90 BLUE HERON RD	WELLFLEET	MA	02667	CTF / 190890	105 BRIDGE RD
20-61	LANGE GERALD W		155 BRIDGE RD	EASTHAM	MA	02642	CTF / 192602	155 BRIDGE RD
20-62	TANDEM RIDE LLC		220 BRIDGE ROAD	EASTHAM	MA	02642	31228 / 259	220 BRIDGE RD
20-63	DONOVAN WILLIAM E & JOYCE A		45 EAST CIRCLE DR	E LONGMEADOW	MA	01028	CTF / 140090	225 BRIDGE RD
20-64	DAVIS DANIEL B & DIANE M		255 BRIDGE RD	EASTHAM	MA	02642	CTF / 210932	255 BRIDGE RD
20-65	SALTWATER REVOCABLE TRUST	MICHAEL JOSEPH MCCARTHY TTEE	PO BOX 351	ORLEANS	MA	02653	CTF / 179488	30 ELISABETH DR
20-66	MCCARTHY MICHAEL	BARBARA A EHLE	PO BOX 351	ORLEANS	MA	02653	CTF / 125690	20 ELISABETH DR
20-67	ADELBERG MARLENE		19 DOLPHIN COVE QUAY	STAMFORD	CT	06902	CTF / 179697	10 ELISABETH DR
20-68	MCCANN CHARLES E LIFE TENANT	THERESA MCCANN LIFE TENANT	15 WALTHAM ST B-503	BOSTON	MA	02118	23537 / 318	280 BRIDGE RD
20-70	WHITE DAVID L & EUGENIE M		385 BRIDGE RD	EASTHAM	MA	02642	1443 / 625	385 BRIDGE RD
20-71	CORMIER CHRISTOPHER T & MARY R		4 BEVERLY RD	MADISON	NJ	07940	25739 / 122	420 BRIDGE RD
20-72	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	19053 / 250	635 BRIDGE RD
20-73	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	13177 / 198	470 BRIDGE RD
20-74	PERKINS JOHN E S		92 EVANS DR	STOUGHTON	MA	02072	15528 / 222	585 BRIDGE RD
20-75	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	29341 / 300	600 BRIDGE RD
20-76	WADE FAMILY REALTY TRUST	PETER & DALE WADE TTEES	PO BOX 1192	ORLEANS	MA	02653	28003 / 89	625 BRIDGE RD
20-81	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	29341 / 300	630 BRIDGE RD
20-82	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	28707 / 150	640 BRIDGE RD

20-83	WATSON DONALD E & ROBBIO CAROL		650 BRIDGE RD	EASTHAM	MA	02642	32162 / 110	650 BRIDGE RD
20-84	EVANS BEVERLY DANIEL		146 CORNWALL HOLLOW RD	WEST CORNWALL	CT	06796	17604 / 126	14 CHARLIE NOBLE WAY
20-85	CUMMINGS STEPHEN J & KIMBERLY		12 CHARLIE NOBLE WAY	EASTHAM	MA	02642	17844 / 209	12 CHARLIE NOBLE WAY
20-86	CHARLES CARLSON JR REV LVG TR	CHARLES CARLSON JR TTEE	16 CHARLIE NOBLE WAY	EASTHAM	MA	02642	19597 / 35	16 CHARLIE NOBLE WAY
20-87	CALLOWAY DARRELL CRAIG & TAMMY		54 BAKERS POND ROAD	ORLEANS	MA	02653	32129 / 41	18 CHARLIE NOBLE WAY
20-88	STRZEPEK CHRISTINE N	DANIEL E GOSLEE	11712 PINE VALLEY CLUB DRIVE	CHARLOTTE	NC	28277	30725 / 218	22 CHARLIE NOBLE WAY
20-89	QUICK JEANINE F		223 FALLS BROOK RD	BRISTOL	CT	06010	28883 / 148	17 CHARLIE NOBLE WAY
20-120	HAYWARD JOHN D & UELIA		11 SMITH LN	EASTHAM	MA	02642	22783 / 127	11 SMITH LN
20-122A	EASTHAM TOWN OF		2500 STATE HIGHWAY	EASTHAM	MA	02642	5858 / 084	55 SMITH LN
20-123	SULLIVAN WILLIAM & LAURA TTEES	SULLIVAN REALTY TRUST	30 SMITH LN	EASTHAM	MA	02642	26509 / 14	30 SMITH LN
20-124A	EASTHAM TOWN OF		2500 STATE HGWY	EASTHAM	MA	02642	CTF / 163915	40 SMITH LN
20-124B	ASCHETTINO PAULA & MICHAEL M		21 SMITH LN	EASTHAM	MA	02642	CTF / 150137	13 SMITH LN
20-59A	THOMAS CHRISTOPHER	PATRICIA A GILL	385 CLINTON AVE	BROOKLYN	NY	11238	20868 / 235	120 BRIDGE RD
20-58A	EASTHAM CONSERVATION FNDTN		PO BOX 183	EASTHAM	MA	02642	24327 / 168	75 GOODY HALLETT DR
20-121A	ASCHETTINO MICHAEL & PAULA TTE	ASCHETTINO LIVING TRUST	21 SMITH LN	EASTHAM	MA	02642	CTF / 185112	21 SMITH LN
20-121B	EASTHAM TOWN OF	SMITH PROPERTY	2500 STATE HGWY	EASTHAM	MA	02642	CTF / 163915	22 SMITH LN
19-29	EASTHAM TOWN OF		2500 STATE HIGHWAY	EASTHAM	MA	02642	N/A / N/A	21 BEACH RD
19-105	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	N/A / N/A	109 DYER PRINCE RD
19-107	EASTHAM TOWN OF		2500 STATE HWY	EASTHAM	MA	02642	N/A / N/A	17 DYER PRINCE LN

APPENDIX D. MUNICIPAL BYLAWS AND REGULATIONS

Inventory of Town Bylaws and Local Permitting Requirements

The Town of Eastham Conservation Department, Department of Public Works, and Planning-Zoning Departments reviewed existing Town bylaws to determine if various conceptual roadway side slope alternatives would trigger Town-specific regulations and/or reviews.

Department of Public Works

The **Department of Public Works** reported that the implementation of any roadway project would require compliance with the Town's existing Stormwater Management Regulations, State of Massachusetts Department of Environmental Protection Stormwater Standards, and full compliance with the Town's EPA MS4 General Permit. The Town of Eastham DPW Director did not anticipate that the proposed roadway side slope alternatives would require any ancillary authorizations from the DPW beyond compliance with the stormwater standards. The DPW Director emphasized that comprehensive erosion and sediment control would play a large role in any future roadway-specific resiliency project and encouraged the project team to consider Section 3 of the Town of Eastham Stormwater Management Regulations – *Construction Erosion and Sediment Control and Post-Construction Stormwater Management*, when evaluating alternatives. Section 3 of the Town Stormwater Management Regulations is included below:

SECTION 3 – CONSTRUCTION EROSION AND SEDIMENT CONTROL, AND POST-CONSTRUCTION STORMWATER MANAGEMENT

3.1 Preamble

Construction site stormwater runoff and post-construction stormwater discharges can adversely affect public safety, public and private property, surface water, groundwater resources, drinking water supplies, recreation, aquatic habitats, fish and other aquatic life, property values and other uses of land and water. It is in the public interest to regulate construction site stormwater runoff and post-construction stormwater discharges in order to minimize the impacts identified above.

3.2 Purpose and Objectives

The purpose of these regulations is to establish minimum requirements and controls to protect and safeguard the environment, natural resources, general health, safety, and welfare of the public residing in the Town of Eastham from the adverse impacts of soil erosion, sedimentation, and stormwater runoff. This section seeks to meet that purpose through the following objectives:

1. *Eliminating or reducing the adverse effects of soil erosion and sedimentation;*
2. *Minimizing stormwater runoff from any development;*
3. *Minimizing nonpoint source pollution caused by stormwater runoff from development;*
4. *Providing for groundwater recharge where appropriate;*

5. *Ensuring controls are in place to respond to the aforementioned objectives and that these controls are properly operated and maintained.*
6. *Establishing provisions for the long-term responsibility for and maintenance of structural stormwater control facilities and nonstructural stormwater management practices to ensure that they continue to function as designed, are maintained, and pose no threat to public safety;*
7. *Encouraging the use of nonstructural stormwater management practices or "low-impact development" practices, i.e. grass swales, rain gardens and other BMPs; and*
8. *Establishing administrative procedures, fees and fines for violations for the submission, review, approval or disapproval of applications for stormwater management permits, and for the inspection of approved active projects, and long-term follow up.*
9. *Ensuring development adheres to MassDEP's Stormwater Handbook and Stormwater Standards*

3.3 Applicability and Exemptions

These regulations shall apply to all activities that result in:

1. *A land disturbance activity of one or more acres of land, or that will disturb less than one acre of land but are part of a larger common plan of development or sale that will ultimately disturb equal to or greater than one acre of land*
2. *No person shall perform any activity that results in a land disturbance activity of an acre or more of land without an approved soil erosion and sediment control plan and stormwater management plan*
3. *The following exemptions from these regulations apply:*
    - *(1) Any land disturbance of less than one acre of land;*
    - *(2) Normal maintenance and improvement of land in agricultural use as defined by the Wetlands Protection Act regulation, 310 CMR 10.04;*
    - *(3) In addition, as authorized in the Phase II Small MS4 General Permit for Massachusetts, stormwater discharges resulting from the above activities that are subject to jurisdiction under the Wetland Protection Act and demonstrate compliance with the Massachusetts Stormwater Management Standards as reflected in an order of conditions issued by the Town of Eastham Conservation Commission are deemed to be in compliance with these regulations*
    - *(4) Emergency activities necessary to protect public health or safety, so long as all necessary emergency permits or emergency certifications have been or will be obtained, including emergency repairs to roads or their drainage systems as per the Massachusetts Stormwater Handbook and Stormwater Standards;*
    - *(5) Normal maintenance and improvements of Town of Eastham publicly owned roads, including but not limited to asphalt resurfacing, road reclamation, regrading of existing gravel roads and any other minor activities as described by 310 CMR 10.02 (2)(b) 2;*
    - *(6) Any work or projects for which all necessary approvals and permits have been issued before the effective date of these regulations.*

3.4 Soil Erosion and Sediment Control

1. *An erosion and sedimentation control plan review is triggered by a site development plan and/or a building permit application or other activity that falls within the jurisdiction of these regulations.*
2. *Applicants shall be referred by the permit-issuing agency (Planning Board, Zoning Board of Appeals, Building Department, etc.) to the Department of Public Works to conduct the soil erosion and sediment control plan review.*
3. *Activities that fall within the jurisdiction of this bylaw that do not require a permit from any Town department are not exempt from this provision. In this situation, the applicant must seek a soil erosion and sediment control plan review directly from the Department of Public Works.*
4. *The Superintendent of Public Works may take any of the following actions as a result of their review: approval, approval with conditions, disapproval, or disapproval without prejudice.*
5. *The Building Commissioner shall administer, implement and enforce these regulations. Any powers granted to or duties imposed upon the Building Commissioner may be delegated by the Building Commissioner to his/ her designee, including but not limited to the DPW Superintendent.*
6. *The Erosion and Sediment Control Plan shall contain sufficient information to describe the nature and purpose of the proposed development, pertinent conditions of the site and the adjacent areas, and proposed erosion and sedimentation controls which include BMPs appropriate to site conditions, including efforts to minimize the areas of land disturbance. The plan shall also describe measures to control construction wastes including but not limited to construction materials, concrete truck wash out chemicals, litter, and sanitary waste.*
7. *Stormwater systems shall be designed to avoid disturbances of areas susceptible to erosion and sediment loss. This means avoiding to the greatest extent practicable: the damaging of large forest stands; building on steep slopes (15% or greater); and disturbing land in wetland buffer zones and floodplains.*

3.5 Post-Construction Stormwater Management

1. *A stormwater management plan review is triggered by a site development plan and/or a building permit application or other activity that falls within the jurisdiction of these regulations.*
2. *Applicants shall be referred by the permit-issuing agency (Planning Board, Zoning Board of Appeals, Building Department, etc.) to the Department of Public Works to conduct the stormwater management plan review*
3. *Activities that fall within the jurisdiction of this bylaw that do not require a permit from any Town department are not exempt from this provision. In this situation, the applicant must seek stormwater management plan review directly from the Director.*
4. *An operation and maintenance plan (O&M Plan) is required at the time of application for all projects. The maintenance plan shall be designed to ensure compliance with the permit in all seasons and throughout the life of the system.*
5. *The Superintendent of Public Works shall make the final decision of what maintenance option is appropriate in a given situation. The Superintendent will consider natural features,*

proximity of site to water bodies and wetlands, extent of impervious surfaces, size of the site, the types of stormwater management structures, and potential need for ongoing maintenance activities when making this decision.

6. *The O&M Plan shall identify and include all required documents, including, but not limited to, maintenance agreements and stormwater management easements. All documents may be submitted to Town Counsel for review*

7. *As-Builts. Permittees shall submit as-built plans prepared and certified by a Massachusetts Professional Land Surveyor no later than one year after completion of construction projects to be included with the Stormwater Management Plan. The As-Built plans must depict all on site structural and non-structural controls design to manage stormwater associated with the completed site. The plan set must include design specifications of all stormwater management controls prepared and certified by a Massachusetts Professional Engineer*

8. *The operation and maintenance plan shall remain on file with the Department of Public Works and shall be an ongoing requirement*

3.6 *Enforcement*

1. *The Building Commissioner and the Department of Public Works shall make inspections of all sites covered under these regulations within the Town and may, for these purposes, enter upon the premises where such operations are carried on at all reasonable times.*

2. *The Select Board, acting through the Building Commissioner, DPW Superintendent, or an authorized employee or agent, shall enforce these regulations, orders, violation notices, and enforcement orders, and may pursue all civil remedies for such violations.*

3. *Civil Relief. If a person violates the provisions of these regulations, permit, notice, or order issued thereunder, the Board may seek injunctive relief in a court of competent jurisdiction restraining the person from activities which would create further violations or compelling the person to perform abatement or remediation of the violation.*

4. *Orders. The Board or an authorized agent of the Board may issue a written order to enforce the provisions of these regulations, which may include:*

    (1) That practices, or operations, in defiance of these regulations shall cease and desist; and

    (2) Remediation of erosion, removal of sedimentation spilled beyond approved limits, in connection therewith;

    (3) Provision of maintenance to stormwater system in accordance with approved O&M plan

5. *Suspension of construction or site alteration activity. In the event that the activity at a site violates the conditions as stated or shown on the approved soil erosion and sediment control plan or stormwater management plan in such a manner as the enforcing agent determines to adversely affect the environment, public welfare/health and municipal facilities, then the agent may suspend work until the violation is corrected.*

6. *If the enforcing person determines that abatement or remediation of contamination is required, the order shall set forth a deadline by which such abatement or remediation must be completed. Said order shall further advise that, should the violator or property owner fail to abate or perform remediation within the specified deadline, the Town of Eastham may,*

at its option, undertake such work, and expenses thereof shall be charged to the violator.

7. *Within thirty (30) days after completing all measures necessary to abate the violation or to perform remediation, the violator and the property owner will be notified of the costs incurred by the Town of Eastham including administrative costs. The violator or property owner may file a written protest objecting to the amount or basis of costs with the Board within thirty (30) days of receipt of the notification of the costs incurred. If the amount due is not received by the expiration of the time in which to file a protest or within thirty (30) days following a decision of the Board affirming or reducing the costs, or from a final decision of a court of competent jurisdiction, the costs shall become a special assessment against the property owner and shall constitute a lien on the owner's property for the amount of said costs. Interest shall begin to accrue on any unpaid costs at the statutory rate provided in MGL c. 59, § 57, after the 31st day at which the costs first become due.*

8. *Civil Penalty. Any violation of any provision of these regulations, order or permit issued thereunder shall be punishable by a civil penalty of not more than $100 per violation. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.*

9. *Non-Criminal Disposition. As an alternative to criminal prosecution or civil action, the Town of Eastham may elect to utilize the non-criminal disposition procedure set forth in MGL c. 40, § 21D, and Chapter I, Article I, of the Town of Eastham Bylaws. The fine for the first violation shall be $100. The fine for the second violation shall be $200. The fine for the third and all subsequent violations shall be $300. Each day or part thereof that such violation(s) occurs or continues shall constitute a separate offense. The Town of Eastham may also impose additional penalties for reimbursement of labor and/or materials used to temporarily remedy the violation.*

10. *Entry to Perform Duties Under these regulations. To the extent permitted by state law, or if authorized by the owner or other party in control of the property, the Board, its agents, officers, and employees may enter upon privately owned property for the purpose of performing their duties under these regulations and may make or cause to be made such examinations, surveys or sampling as the Board deems reasonably necessary.*

11. *Appeals. The decisions or orders of the Board shall be final. Further relief shall be to a court of competent jurisdiction.*

12. *Remedies Not Exclusive. The remedies listed in these regulations are not exclusive of any other remedies available under any applicable federal, state or local law.*

3.7 *Severability*

The Town of Eastham Select Board shall adopt, and may periodically amend, rules and regulations relating to the terms, conditions, definitions, enforcement, fees (including application, inspection, and/or consultant fees), fines and penalties, application requirements, design standards, procedures and administration of these regulations, after conducting a public hearing to receive comments on any proposed rules and regulations, or revisions thereto. Failure by the Town of Eastham Select Board to promulgate such rules and regulations, or a legal declaration of their invalidity by a court, shall not act to suspend or invalidate the effect of these regulations

Planning / Zoning Department

The **Town Planning Department** provided feedback to the municipal project team regarding planning and/or zoning bylaws and/or reviews that may be required to facilitate the implementation of any future roadway resilience project. The Planning Department did not anticipate that any existing Town planning or zoning reviews would be required as part of a roadway project if the scope of work were limited to the existing roadway right-of-way. If the work included alterations to public or private property that required changes to any associated building(s), parking, or traffic movement, etc. then the Planning Board site plan review process would be required.

Conservation Department

The Town **Conservation Department** summarized the Town regulations that would govern the implementation of any future roadway resilience project. All projects would require review (Notice of Intent) by the Town Conservation Commission. Aside from Town-specific bylaws relative to the Inner Cape Cod Bay Area of Critical Environmental Concern (ACEC), all other applicable conservation regulations and restrictions are included in 310 CMR 10.00 the Massachusetts Wetlands Protection Act. Specifically, regulations relative to salt marshes, land containing shellfish, land subject to coastal storm flowage, coastal banks, priority habitat for rare and endangered wildlife (and subsequent time of year restrictions (TOYs)), and required mitigation for unavoidable impacts. Portions of all (4) low-lying roadways included in this study are located within or adjacent to the Inner Cape Cod Bay ACEC. Relevant Town regulations governing work within the ACEC are included below:

Relevant Eastham ACEC Regulations:

B. No dumping, filling, paving, removing of material, dredging or altering may be done, except that projects involving salt marsh creation, beach nourishment, dune stabilization, maintenance of anadromous fish runs, or aquaculture may be authorized by the Commission after the filing of a Notice of Intent.

C. Construction of any new road, bikeway or other way requiring paving, fill or other significant construction is prohibited. Repair and maintenance of any existing road, way, bikeway or trail within an ACEC may be permitted subject to the filing of a Notice of Intent. Any repair, maintenance, or improvements of such road, bikeways or other ways shall be in conformance with the requirements of MGL, Ch 131, sec. 40 and 40A and all other applicable laws, by-laws, and regulations.

Salt marsh creation, beach nourishment, dune stabilization, maintenance of anadromous fish runs, or aquaculture may be authorized in accordance with the performance standards under the Act and Bylaw.

C. 1. Projects shall be completed within six months of commencement unless the Commission grants an extension for due cause.

2. There shall be no increase in the volume of storm water runoff and no runoff from roads, bikeways, or trail projects shall be allowed to flow to resource areas. No degradation to water quality or wildlife habitats shall be permitted. 3. Any embankments to such roadways, bikeways and trails shall be re-vegetated and stabilized.

Where the presumption of significance has not been overcome, any work in an ACEC shall have no adverse effect on the wetlands values and interests described above.

Additional Considerations

In addition to compliance with existing local bylaws and regulations, the municipal project team acknowledges that any future roadway resilience project will require extensive permitting at the State and Federal level. However, specific requirements for a given alternative or project cannot be determined until a design has been drafted and thresholds of impact have been calculated. For planning purposes only, State and Federal permits may include but not be limited to:

- Massachusetts Environmental Policy Act (MEPA) Review (State)
- Chapter 91 License (State)
- Water Quality Certificate (State)
- Massachusetts Stormwater Regulations (State)
- Massachusetts Coastal Zone Management Federal Consistency (State)
- Army Corps of Engineers General Permit (Federal)

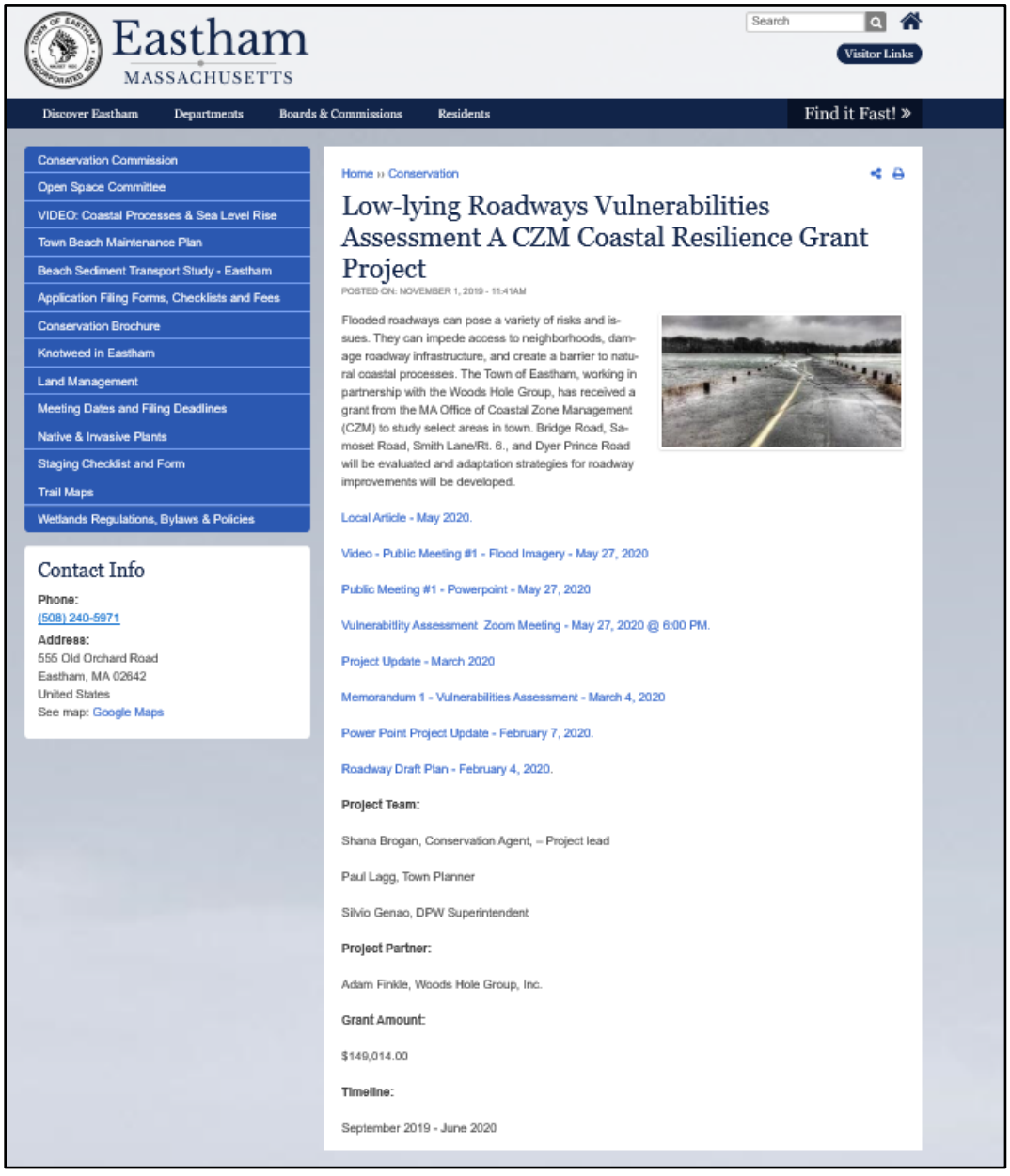
APPENDIX E. MUNICIPAL EDUCATION AND OUTREACH

Stakeholder Education and Outreach

Project Website

To keep local stakeholders abreast of the CZM Resiliency Grant-funded Targeted Vulnerability Assessment of Low-Lying Roadways, a project website was established where the municipal project team could openly share project updates, presentations, and deliverables with residents. A screenshot of the webpage is included below, which can be accessed via the following link:

https://www.eastham-ma.gov/conservation/news/low-lying-roadways-vulnerabilities-assessment-czm-coastal-resilience-grant-project



Publications in Local Press

Throughout the FY20 project, the municipal project team and the Woods Hole Group have coordinated with journalists from the Provincetown Independent, a local, weekly publication to discuss the Targeted Vulnerability Assessment of Low-Lying Roadways project. A recent article, which ran in conjunction with the May 27, 2020 public meeting emphasized the need for action to improve the resilience of municipal roadways. The text of the article is included below. The original publication can be accessed via the following link: https://provincetownindependent.org/news/2020/05/28/eastham-roadway-study-shows-flooding-is-imminent/

FUTURE SHOCK

Eastham Roadway Study Shows Flooding Is Imminent

The town must consider infrastructure improvements

By Ryan Fitzgerald May 28, 2020

EASTHAM — In a few decades, some of Eastham's most used roads could be underwater.

The town, in coordination with environmental consultants from the Woods Hole Group (WHG), has studied its vulnerable low-lying roadways, including four identified during the state's municipal vulnerability preparedness program: Bridge Road, Smith Lane, Samoset Road, and Dyer Prince Road. During storm surges, these roads have been inundated and become impassable.

The town received a $150,000 grant from the Mass. Office of Coastal Zone Management last year to conduct an assessment and improve coastal resilience of its low-lying roadways.

"This is a really important first step," said Conservation Agent Shana Brogan. "It's important to do this thoughtfully and strategically."

With a marsh system directly alongside it, Bridge Road in Eastham is highly susceptible to flooding. (Photo Ryan Fitzgerald)

WHG first put gauges in marsh systems along these roads to better understand the tides. The group studied the existing conditions of the roadways; identified assets, utilities, municipal resources, owners, and abutters; and used town-wide and site-specific inundation maps and figures to gauge sea level rise and flood or storm surge probabilities.

"Quite a bit of data collection went into this whole process," said Adam Finkle of WHG.

When considering only sea level rise and not including storm or flood surges, WHG determined that by 2050, all four roads would experience daily inundation on some parts of the roadway from the marsh systems near them. By 2070, they would basically be underwater.

The group also used data modeling to determine the probability of flooding during a given year.

"What makes this type of modeling unique is you can focus on very specific points along the roadway," Finkle said.

The town's fire dept. considers a road impassible for regular vehicles if there is six or more inches of water on the road and impassable for an emergency vehicle if there is 18 or more inches of water on the road.

Now that the study is complete, the town must decide the best method to move forward.

The first step is to maintain the existing infrastructure of the roads. Design alternatives could include elevating the road, improving the marsh to help buffer the effects of a storm, fiber rolls, vegetated berms, sloping rock revetments, and driving sheeting along the edge of the road to maintain that edge. Finkle said any of these alternatives could be paired.

The town will have to evaluate its budget and risk tolerance in determining solutions as well.

These ideas were scheduled to be discussed at a virtual public hearing hosted by the project team via Zoom on May 27.

Brogan said that, after that meeting, the team would present public feedback and imagery from the assessment to the select board.

Working with abutters along the roadways, including 350 property owners, will be key, and the fact of the hearing being virtual might help.

"A lot of these property owners don't live here year-round," Brogan said. "Normally they wouldn't be able to make it to these meetings."

Following the public meeting, a second article was published on June 11, 2020, highlighting feedback received from members of the public relative to the low-lying roadways project. The text of the article is included below. The original publication can be accessed via the following link: https://provincetownindependent.org/news/2020/06/11/eastham-residents-react-to-roadway-study/

CLIMATE CHANGE

Eastham Residents React to Roadway Study

Prioritizing infrastructure improvements will be tricky

By Ryan Fitzgerald Jun 11, 2020

EASTHAM — There are 350 property owners who live along Bridge Road, Smith Lane, Samoset Road, and Dyer Prince Road in Eastham. Nearly 40 residents participated in a virtual public hearing on May 27 hosted by Shana Brogan of the town's natural resources dept. and Adam Finkle of the Woods Hole Group (WHG) to discuss the low-lying roadway study recently conducted by the town's consultants.

The study assessed the vulnerability of each of the four roadways to sea level rise and storm surge in the coming decades. The roadways were identified during the state's municipal vulnerability preparedness program. Eastham received a $150,000 grant from the Mass. Office of Coastal Zone Management (CZM) last year to conduct the assessment in an effort to improve coastal resiliency.

Access to the 350 properties that abut the roadways could become restricted in the next few decades due to increased flooding if major improvements aren't made, the study concluded.

"When I see the projections for what's going to happen to Dyer Prence Road, I say to myself, 'Well, I got another 20 years, maybe, in my house,' " said Nick Debs during the hearing. Dyer Prince Road leads to the Eastham side of Rock Harbor.

Dyer Prince Road is the only access to the Eastham side of Rock Harbor. The marsh system below it makes it susceptible to serious flooding. (Photo Ryan Fitzgerald)

As reported in the May 28 Independent, WHG's roadway assessment showed that the effects of sea level rise alone, not including storm or flood surges, would cause all four roads to experience daily inundation on some parts of the roadway from the marsh systems that sit beside them by 2050. By 2070, they would basically be underwater.

Finkle said that right now the most important thing is to maintain the existing infrastructure of the roads. This could be done by elevating the road; improving the marsh to help buffer effects of a storm; using fiber rolls, vegetated berms, or sloping rock revetments; and driving sheeting along the edge of the road to maintain that edge. Any of these approaches could be paired.

Prioritizing and vetting improvements to the roadways will be key. Some of the alternatives may not work for everyone.

"If Dyer Prince Road were raised four feet, for instance, I would not be able to get in my driveway," Debs said. "There's not enough slope."

"We have to try to figure out if some of the solutions that we're talking about may also have benefits for adjacent parcels or not," Finkle said.

Safety is at a premium with this project, and that's why Bridge Road may be of the highest priority, as it is the primary evacuation route other than Route 6.

"I think we came up with Bridge Road as our top priority because it involves so many people when trying to evacuate," Police Chief Adam Bohannon said. "We've actually had a couple of situations where Bridge Road was blocked from flooding or other reasons, and so was Route 6, and the town was basically isolated."

Nor'easters in January and March of 2018 took a toll on the Outer Cape and caused significant flooding along Bridge Road, Samoset Road, and other areas of Eastham.

"Those 2018 storms were very near exceeding that 100-year storm threshold," Finkle said. "So, a one percent probability storm, except instead of them being 100 years apart, we had back-to-back storms in the same month that nearly exceeded that threshold."

Fire Chief Kent Farrenkopf said his department had to evacuate someone from Samoset Road during one of the 2018 nor'easters. Since then, the department obtained a high-water rescue truck that can better serve in such situations.

The fire dept. considers a road impassible for vehicles if there is six inches of water on the road and impassable for an emergency vehicle if there is 18 inches of water on the road.

"We're trying to adapt to the issues as we go along, by getting a vehicle that will help us get in there," the chief said. But if flooding were to exceed that height, not even the rescue truck would be able to get past.

The town will ultimately have to identify what it can afford. Finkle said the plan is to apply for a second round of state funding to pursue design alternatives.

"The hope is that the next round of funding allows us to vet the design and create an engineering plan from that," he said.

"We need to evaluate what the costs would be," said Brogan. "It could be extremely expensive."

The town will hold another virtual public hearing on this topic on a date in late June still to be set. Then Finkle and town officials will develop the preliminary design alternatives to prevent future flooding at two sites along one or two of the four roadways included in the study.

Feedback at the next public hearing will help determine where those two sites will be.

Direct Mailings

In addition to electronic resources, the municipal project team also distributed direct mailings to approximately 350 abutters of the (4) low-lying roadway sites, to generate interest in the May 27, 2020 and June 25, 2020 public meetings. Nearly 40 abutters participated in the meeting, offering constructive comments and feedback. The Town is actively working to cultivate ongoing participation amongst abutters as the project advances towards the design phase.

APPENDIX F. PROJECT TEAM MEETING MINUTES

CZM Resiliency Grant Kick-Off Meeting Agenda

Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham

November 13, 2019, 12:30pm

- **Introductions**
  - Woods Hole Group Project Team
  - Town of Eastham – Natural Resources, DPW, Planning

- **Funding Mechanism**
  - 2020 Massachusetts CZM Coastal Resiliency Grant
  - $149k award; $50k municipal match
  - Awarded August 2019
  - Contract Finalized November 2019

- **Project Overview and Scope of Work (see proposal)**
  - (4) Project sites identified and during previous planning efforts (i.e. MVP) (p. 1-3)
  - Details regarding geographic scope and existing conditions (p. 4-6)
  - Scope of Work (see proposal p. 6-8)
  - Summary of Deliverable Dates (p. 12)

- **Accelerated Schedule and Next Steps**
  - Woods Hole Group
    - 1.2 Site Survey and Existing Conditions Plans – (Dec.-Jan.)
    - 1.3 Deploy Tide Gauges – Complete
    - 1.4 ID Existing Regulations – (Dec. – Jan.)
    - 1.8 Public Meeting (Dec. – Jan.)
  - Town of Eastham
    - 1.1 ID Assts, Utilities, Resources of Concern – (ASAP)
    - 1.4 ID applicable Conservation / Zoning Bylaws – (Nov. – Dec.)
    - 1.5 Outreach and Education (Dec. – Jan.)
    - 1.6 Property Ownership, Roadway Easements (Nov. – Dec.)
    - 1.8 Facilitate Public Meeting (Dec. – Jan)

FY20 Eastham CZM Resiliency Grant Kick-Off Meeting

Eastham Public Library

November 13, 2019

Municipal Project Team: Shana Brogan, Silvio Genao, Paul Lagg

CZM: Patricia Bowie, Steve McKenna

Public: Steve Mague

Woods Hole Group: Adam Finkle, Kirk Bosma (remote)

Meeting Minutes

Project Overview:

- Initial planning efforts – MVP Certification, Harbor Plan, Hazard Mitigation Plan, etc.
- Follow-up efforts – CZM Resiliency Grant
    - ID/Prioritize Features
    - Understand Existing Conditions
    - Develop Conceptual Alternatives
    - Once Developed, pursue implementation funding
- Paul Lagg- currently updating Hazard Mitigation Plan. Would road safety audit lend itself to this project?
- Possibly target public meeting pre-Christmas 2019
    - Notifications to all abutting homeowners
    - Steve McKenna – prefer to develop alternatives, then schedule public meeting.
    - Comment period to follow

Discussion of Project Components/Tasks:

- Steve McKenna – Roadways have known elevations that flood during storms – is modeling premature in this case? If it takes longer for water to drain out of areas upstream of culvert, drainage is an issue, then culvert assessment is warranted. But, without data (storm of record) to prove neighborhoods do not drain effectively, modeling is premature.
- Elevations along each stretch of roadway will be part of the solution. Stream/tidal conditions under the road will rip up roadway surface.
- Steve McKenna – makes sense to look at culverts from a resilience/restoration perspective. No problems upstream today? Forcing culvert/tidal conditions will change with time.
- Adam Finkle / Kirk Bosma – looking at future conditions upstream of culverts – control future water elevations through active/passive water control. Resilience of upstream areas is the goal, restoration is a bonus, opportunistic approach. Focused on base-level resilience – what we are doing looks at future conditions.
- Adam Finkle – Planning to target areas that are most low-lying and make accessible in the short-term.

- Steve McKenna – modeling may be more appropriate as another funding source – MVP Action Grant is better suited. Clear of what is funded and why. Recommendations for reallocation: focus on design at primary action site. If you find hydrology is impacted, then assess culvert. ID highest priority site for implementation. If culvert site is highest priority, $ could be reallocated to design at priority location. Hold off on modeling.
- Steve Mague – Mapping how storm tides make their way inland (how it gets there, not how far it extends). Storm of record +4.0'NAVD. IDing low-lying roadway locations. Fieldwork complete, now using storm tide profile, lidar data, water level data to ID "pathway", field verified. GIS-based "bathtub" assessment.
- Steve McKenna – Ensure development of inundation maps and figures has no redundancy to Steve Mague's work with Mark Borelli.
- Kirk Bosma – Both are useful in their own ways, should be looking at both sets of data/deliverables.

Adjourn.

CZM Resiliency Grant Update Meeting Agenda

Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham

February 6, 2020, 9:00am

- **Introductions**

- **Update on Project Deliverables**
  - Tidal Data
  - Progress Plans

- **Overview of Vulnerability Assessment (Methods)**
  - Typical Vulnerability Assessment
  - How this Assessment Differs from a Typical V.A.
  - Modified, Streamlined Approach

- **Next Steps**
  - Advance Site Plans
  - Establish Scoring Criteria
  - Prioritize Sites
  - Develop Inundation Maps and Figures
  - Public Meeting – **End of March 2020**

- **Adjourn**

FY20 Eastham CZM Resiliency Grant Update Meeting

Eastham Town Hall

February 6, 2020

Municipal Project Team: Shana Brogan, Silvio Genao, Paul Lagg

CZM: Steve McKenna

Woods Hole Group: Adam Finkle, Joe Famely

Meeting Minutes

Review Deliverables and Next Steps

- Adam Finkle - Review Existing Conditions Plans; Tidal Data Sets.
    - Confirm locus maps sent from P. Lagg re: Parcel Data.
- Joe Famely – for next steps, State SLR projects (high, not extreme) will be used for planning purposes. Projected SLR scenarios modified for locality to dial in elevations for planning purposes.
- Joe Famely – clarifying MC-FRM outputs.
    - Probabilities, duration, depth, wind, waves, currents, flood paths, volumes, etc. are the inputs used to generate probabilistic outputs.
    - Outputs of model can be site-specific, allowing client to determine risk tolerance.
    - Risk = probability of inundation x consequence of inundation.
    - "Rank" ordering assets (roadways) – no need to prioritize the highest ranked asset (road), ok to target more achievable :low hanging fruit" instead

Public Meeting Planning

- Engaging component
- Not too presentation-heavy
- Visuals ahead of the meeting
- Describe the work being done, less background
- Differentiate typical v. storm tides

Adjourn.

CZM Resiliency Grant - Site Prioritization Meeting

Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham

March 6, 2020, 9:00am

- **Introductions**

- **Update on Project Deliverables**
  - Tidal Data; Progress Plans; Development of Assessment Metrics

- **Overview of a Vulnerability Assessment**
  - Process and Application of Results
  - How this Assessment Differs from a Typical V.A. (Modified Metrics)

- **Discussion**
  - Existing conditions and concerns at each project site

- **Sea Level Rise and Storm Surge Scenarios**
  - Changing conditions – 2030, 2050, 2070

- **Discussion**
  - Changes in vulnerability relative to SLR and Storm Surge scenarios

- **Next Steps**
  - Prioritize between project sites
  - Develop Inundation Maps and Figures
  - Public Meeting – **End of March-April 2020**

- **Adjourn**

FY20 Eastham CZM Resiliency Grant Update Meeting

Eastham Town Hall

March 6, 2020

Municipal Project Team – Shana Brogan, Silvio Genao, Paul Lagg, Chief of Police, Fire Chief

CZM – Steve McKenna

Woods Hole Group – Adam Finkle, Joe Famely

Meeting Minutes

- General Municipal Project Team Feedback re: Site-Specific Concerns
    - Smith Lane
        - Close to highway
        - 2-3' water in roadway at times
        - Town high water vehicles needed at times – 3' clearance max for high water vehicles; 18" max for fire trucks
    - Dyer Prince
        - Advance notice to pull boats
        - No services on Eastham side of Rock Harbor
        - 48 slips total
        - Not always flooding impeding road – could be utility pole, tree, etc.
    - Bridge Road
        - Bridge Road is the main artery – access to all other roadways via Bridge Road
        - Floods regularly – Route 6 does not
        - 2 instances when both roads were impassible
        - Bridge road is in ACES – terrapins, other wildlife concerns
        - Bike path as possible evacuation route in addition to flood control capabilities
    - Samoset Road
        - Sheeting may be easier than marsh restorations
        - Porta potties pulled from beach parking by vendors ahead of storms
        - Shellfish grants – owners responsible for gear
        - Signage to close beaches during storm prep
        - Could use additional catch basins for stormwater and spill containment
        - Interest in raising road with sheeting at bend in the road
- Joe Famely – Important conversation to be had: daily access vs. risk tolerance for storm access → these preferences will drive development of design criteria.
- Shana Brogan – Bridge Road is a high priority, same impacts as Samoset, some utility-related concerns
- Police Chief – Easier to deal with other roads when they flood – bridge road is tougher to deal with
- Steve McKenna – Less focus on Smith Lane (due to State study of Route 6), more on Bridge Road

- Silvio Genao – Bridge Road is important, understand that you can't design your way out of every scenario, know your thresholds, advance what you can control.
- Paul Lagg – Hazard mitigation planning efforts, no established thresholds for abandoning resources. Use results of this project to inform Harbor Plan action items and additional equipment, training, etc. in addition to infrastructure projects. Costs of infrastructure planning vs. equipment and training may be a consideration for Town.
- Consensus: Bridge Road has greatest vulnerability.
- Until Town has costs associated with alternatives designed over 50-year design life, relative to 100 yr. storm event, decision/tolerance will be driven by funding.
- Scale of project – differences between DOT Rt. 6 study and Town CZM study
- Broader context – previous planning efforts have led Town here

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642 - 2544
All departments 508 240-5900
www.eastham-ma.gov

Remote Participation Information for Meeting

THIS IS A REMOTE PARTICIPATION MEETING. PUBLIC PARTICIPATION IS ONLINE OR TELEPHONE THROUGH THE ZOOM PROGRAM OR APP

Under the Executive Order suspending certain provisions of the Open Meeting Law, signed by Governor Baker on March 12, 2020, all members in any meeting of the public body may participate remotely.

Name of Committee that is Meeting: Select Board

Date and Time of Meeting: Monday, June 8, 2020 at 5:30 PM

To join the meeting via Zoom, either use this link to the meeting:

https://us02web.zoom.us/j/86349547807?pwd=aWNjU1FVYmxKakFqOCswUnhyUzZsUT09

OR

Go to https://zoom.us/join, and if necessary, download the Zoom app. Once you are in Zoom, enter the meeting ID number 863 4954 7807, hit enter, then enter the password 787394.

To join the meeting by phone, call 1-646-558-8656, then enter the meeting ID # 863 4954 7807

One tap mobile: +16465588656,,86349547807# US (New York)

The meeting will be live broadcast on local access channel 18, and live streaming on the Town Website at https://www.eastham-ma.gov/home/pages/channel-18

MEETING AGENDA FOLLOWS

AGENDA
EASTHAM SELECT BOARD
Eastham Town Hall, 2500 State Highway, Eastham, MA
Monday, June 8, 2020 at 5:30 PM

Location: Eastham Town Hall - Earle Mountain Room

I. PUBLIC/SELECT BOARD INFORMATION

II. APPOINTMENTS

5:35 PM Introduce Richard Bienvenue, Assistant Town Administrator/Finance Director – Jacqui Beebe & Richard Bienvenue

5:45 PM Low-lying Road Plan and Grant Next Steps – Shana Brogan, Conservation Agent

6:15 PM Town Election Updates – Cindy Nicholson, Town Clerk

III. LICENSING

A. Renewal of Seasonal Hawker and Peddler Licenses
   1. Winterbottom Ice Cream 2 LLC dba Perry's Cape Cod Ice Cream Trucks, 47 South Boulevard, Onset, MA 02558 – Truck 1
   2. Winterbottom Ice Cream 2 LLC dba Perry's Cape Cod Ice Cream Trucks, 47 South Boulevard, Onset, MA 02558 – Truck 2

IV. ADMINISTRATIVE MATTERS

A. Action/Discussion (discussion & vote may be taken)
   1. Committee Re-Appointments:
      a. Affordable Housing Trust - Carolyn Mcpherson
      b. Board of Assessors - Joanna Buffington, Denise Kopasz, W. Davis Hobbs
      c. Board of Cemetery Commissioners - Sylvia Sullivan
      d. Board of Health - Adele Blong
      e. Cable TV License Renewal Advisory Committee - Beverly Hobbs, Denise Kopasz
      f. Conservation Commission - Karen Strauss, Charles Wagner
      g. Council on Aging Board of Directors - Richard Ramon, Lucile Cashin
      h. Cultural Council - Brian LaValley
      i. Finance Committee - Thomas Gardner
      j. Forest Advisory Committee - Henry Lind, Janet Benjamins
      k. Human Services Advisory Committee – Kate Berg, Dilys Smith, Felice Coral
      l. Open Space Committee – Frances Lewis, Joanna Buffington
      m. Zoning Board of Appeals – Robert Bruns
   2. Town Meeting Date Set for September 21, 2020 *(vote)*
   3. COVID-19 Update

V. MINUTES

A. Monday, June 1, 2020 – Regular Session

VI. TOWN ADMINISTRATOR'S REPORT

VII. OTHER BUSINESS/CORRESPONDENCE

VIII. ADJOURNMENT

Upcoming Meetings

Monday, June 29, 2020	5:30 PM	Regular Meeting
Monday, July 13, 2020	5:30 PM	Regular Meeting
Monday, July 27, 2020	5:30 PM	Regular Meeting

- **This meeting will be live broadcast on Local Access Channel 18, and Live Streaming is available on the Town website at www.eastham-ma.gov./home/pages/channel-18**
- Under the Executive Order Suspending Certain Provisions of the Open Meeting Law, signed by Governor Baker on March 12, 2020, all members in any meeting of the public body may participate remotely.
- *Per the Attorney General's Office: The Board of Selectmen may hold an open session for topics not reasonably anticipated by the Chair 48 hours in advance of the meeting.*
- *If you are deaf or hard of hearing or are a person with a disability who requires an accommodation, contact Laurie Gillespie-Lee, 508-240-5900 x3207*

FY20 Eastham CZM Resiliency Grant Board of Selectmen Update Meeting

Held Remotely via Zoom

June 8, 2020

Municipal Project Team: Shana Brogan

Town of Eastham Board of Selectmen

Woods Hole Group: Adam Finkle

Meeting Minutes

- Shana Brogan introduced project to the Board of Selectmen and acknowledged CZM Resiliency Grant funding mechanism.
- Adam Finkle updated the Board of Selectmen on project deliverables, work completed to date, and future goals and objectives. A presentation was displayed and circulated, which included inundation maps and figures as well as conceptual design imagery for improved resilience.
    - Covered the following (2) sets of imagery – SLR (static change in tides over time, no storm data), MC-FRM model results – MA-DOT statewide model.
    - Provided cursory overview of conceptual design alternatives for each site.
    - For sake of time, focus on Town-wide imagery, rather than site-specific imagery.
- Adam Finkle and Shana Brogan fielded questions from the Board of Selectmen, which included the following (2) specific points of feedback from the Board:
    - Is there the possibility of temporary (emergency) bridge access – bridge sections that can be added / removed during storm events?
        - Adam Finkle – Could be considered as part of emergency plan, not as permanent solution.
    - Could you please clarify the tidal datums (SLR scenarios) used to develop the inundation maps and figures?
        - Adam Finkle – Based on high (not extreme) emissions scenarios projected out to 2070.
- Shana Brogan informed Board of Selectmen that Town was currently seeking subsequent funding for design-engineering at (2) sites.

Shana Brogan and Adam Finkle left virtual meeting.

CZM Resiliency Grant Update Meeting Agenda

Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham

June 10, 2020

- **Introductions**

- **Update on Project Deliverables**
  - Preliminary Roadway Prioritization Matrix
  - Roadway Side Slope Alternatives

- **Overview of Roadway Prioritization Process**
  - Review feedback from the Steering Committee
  - Assign numerical values to qualitative responses
  - Draft consequence scoring matrix

- **Review Roadway Side Slope Alternatives**
  - Solicit feedback from Steering Committee

- **Next Steps**
  - Consequence Scoring
  - Asset Risk Profiles

- **Adjourn**

FY20 Eastham CZM Resiliency Grant Update Meeting

Held Remotely via Teams

June 10, 2020

Municipal Project Team – Shana Brogan, Paul Lagg, Silvio Genao

Massachusetts CZM – Steve McKenna

Woods Hole Group – Adam Finkle

Meeting Minutes

Review Deliverables and Next Steps

- Adam Finkle – Review feedback from steering committee regarding roadway prioritization. Request is there is any more verbal feedback municipal project team would like included in consequence scoring matrix
    - P. Lagg – based on all the visual aids and data available, it seems prudent to consider improvements at bridge road given its importance for evacuation, emergency response, etc. Possibly, consider a outer Cape regionally funded project at the Bridge Road site, given the importance of the roadway not only to Eastham, but to the entire outer Cape. If Route 6 becomes impassible, it is the only other option.
    - S. Genao – echoing what Paul said, it is important to act and preserve resources along Bridge Road. It will be a big undertaking, but there are other opportunities to act in the short term to shore up resources along Samoset that will not be as complicated or expensive. Cost will be an important consideration when considering the most appropriate alternative for each site.
    - S. Brogan – Important to consider the natural resource areas located along each road and the impacts of any improvements. Bridge road is of high importance and it should be included as a high priority site when applying for FY21 funding.
- Adam Finkle – reviewed the following conceptual alternatives developed by Woods Hole Group:
    - Reconstruct, stabilize, and revegetate side slopes
        - 1.5:1 slope
        - 2:1 slope
        - 3:1 slope
    - Terraced Living Shoreline
    - ACBM and/or Geocell reinforced and revegetated side slopes
        - 1:1 slope
        - 2:1 slope
        - 3:1 slope
    - Open Bridge Span
    - Sloping Rock Revetment
    - Vertical Sheet Piles
- Adam Finkle – requested feedback regarding side slope alternatives

    - P. Lagg – Outer Cape regional approach may help to bridge funding gap for any large scale project on Bridge Road.
    - S. Genao – Selection of alternatives comes down to funding.
    - S. Brogan – Alternatives should consider impacts to adjacent resource areas.
- Shana Brogan – provided overview of FY 21 CZM Resiliency Grant Application and proposed scope.
    - All parties agreed that the FY 20 Grant Cycle has generated meaningful results, engaged multiple departments and diverse stakeholders, and provided a firm foundation for future design engineering and permitting of alternatives to improve the resilience of low- lying roadways.

Adjourn.

CZM Resiliency Grant Update Meeting Agenda

Targeted Vulnerability Assessment of Low-Lying Roadways in the Town of Eastham

June 25, 2020

- **Introductions**

- **Update on Project Deliverables**
  - Feedback received from June 24, 2020 Public Meeting
  - Consequence Scoring Matrix
  - Asset Risk Profiles
  - Next Steps

- **Consequence Scoring**
  - Review consequence scoring matrix
  - Bridge Road and Samoset Road → Highest consequence of loss

- **Asset Risk Profiles**
  - Risk for individual assets projected out through 2070
  - Can develop asset-specific design criteria

- **Next Steps**
  - Final report
  - FY21 CZM Resiliency Grant Application

- **Adjourn**

FY20 Eastham CZM Resiliency Grant Update Meeting

Held Remotely via Teams

June 25, 2020

Municipal Project Team – Shana Brogan, Paul Lagg, Silvio Genao, Police Chief, Fire Chief

Woods Hole Group – Adam Finkle

Meeting Minutes

Review Deliverables and Next Steps

- All participants – reflected on feedback received during June 24, 2020 Public Meeting.
    - Regarding Bridge Span Alternative
        - S. Genao – Bridge span may be more resilient and allow for enhanced tidal flow, but it will impact water main infrastructure, cause visual impacts, and have higher costs. May also have issues fitting bridge in available footprint. It would be a significant project 10+ years in design, permitting, construction. Need a solution in the short term.
        - P. Lagg – visual impact would be significant. If bridge needs to be higher, the public may underestimate the impact. In the past, raising the water main to the height of the existing bridge was a concern.
        - S. Brogan – The FY 21 scope included a bridge analysis, public education, establishment of design criteria, and another smaller project along Samoset.
- Adam Finkle – reviewed the consequence scoring matrix, which established priority between each of the low-lying roadways. Illustrated how municipal project team comments were assigned numerical values and incorporated into matrix. Discussed priority level:
    - Bridge – High
    - Samoset – High
    - Dyer Prince – Mod-High
    - Smith – Low
- Adam Finkle – discussed the asset risk profiles developed for municipal features/assets located along each roadway. Using present day and future water levels, individual Town assets (utility poles, water gates, culverts, etc.) were assigned individual probabilistic risk scores projected from the present day through 2030, 2050, 2070.
    - P. Lagg – would it be possible to receive the data as a .shp file?
    - A. Finkle – will look into conversion.
- Shana Brogan – provided an overview of FY21 CZM Resiliency Grant Application and discussed next steps. Recognized the commitment of all municipal project team members and thanked all for their participation.

Adjourn.

APPENDIX G. PROJECT TEAM FEEDBACK ROADWAY PRIORITIZATION

Police Chief – Adam Bohannon

Conservation Administrator – Shana Brogan

Town Planner – Paul Lagg

DPW Director – Silvio Genao

Roadway prioritization metrics	Smith Lane	Dyer Prince Rd.	Bridge Rd.	Samoset Rd.
Importance of roadway for evacuation? Primary, secondary, non-critical for evacuation, etc. *Please explain.*	Non-Critical. Very few residents and businesses.	Non-Critical. Very few residents.	Primary. Bridge Road is a main artery within the town and essential for evacuation.	Secondary. Moderately populated with side/connecting roadways.
	Non-critical. However, could be used as staging area. WildCare wildlife rehabilitation Center and approximately two full-time occupied dwellings.	Secondary – Some residents immediately along the roadway and one cul-de-sac neighborhood. Primarily second homes at this time.	Primary. The secondary evacuation route for the Outer Cape area. It is critical to remain passible, especially during peak population times as well as prior, after, and during storm events to maintain public safety, access impacted areas, and the remainder of the town should Route 6 be impacted.	Secondary/contains several neighborhoods, but not a main thoroughfare. All roads could contain vulnerable populations.
	High Only one access out of area	High, evac route connects to Bridge Rd which is also impacted by SLR, no alternative evac route	High Only alternate access to Route 6	High Samoset is important access point to Bridge Road evac route

	High. Only means of access and egress for that area (cul-de-sac)	High. Enough homes to warrant a concern if access is impeded	Highest. Part of only alternate route through Eastham besides Route 6	High. Enough homes to warrant a concern if access is impeded
Importance of roadway for emergency response? Number of homes, vulnerable populations, etc. *Please explain.*	Non-Critical. Very few residents and businesses.	Secondary. Minimal residents, however this road provides access to the harbor should a marine response be needed.	Primary. Bridge Road is a main artery within the town and essential for emergency response	Secondary. Moderately populated with side/connecting roadways.
	Somewhat important. Access to all areas is important as all residents are important regardless of their location in town.	Town's emergency response vessel is located at Rock Harbor. It also used to assist other towns, such as Orleans, who does not have an emergency response vessel in the Harbor and shares the responsibility with Eastham. Rock Harbor can be a heavily used area during peak times. Also location of future Harbormaster station.	Critical. This is the main roadway through town. Response vehicles should have access at all times.	Important. The roadway needs to be passible in peak seasons as it leads to 30 acres of aquaculture businesses, and the Town's most popular bathing beach. Several neighborhoods are located off Samoset.
	High No alternative access if blocked	High, enough homes to warrant concern and connection to public infrastructure at Rock harbor	High Only alternate access to Route 6	High Samoset is important access point to Bridge Road evac route
	Lowest. Not many homes	High. Enough homes to warrant a concern if access is impeded	Highest. Part of only alternate route through Eastham besides Route 6	High. Enough homes to warrant a concern if access is impeded
Importance of roadway for access to municipal assets? Utility access, boat ramps, shellfishing, beach parking, etc. *Please explain.*	Non-Critical. No town assets.	Critical. Town owned harbor at end of road which houses emergency response boat.	Critical. Multiple town owned beaches/parking areas along this roadway	Critical. Eastham's largest beach is located at the end of this road.
	Somewhat important. Access point to town-owned conservation land (for quality of life and abutting the bike trail), culvert, hydrant.	Highly important. Provides access to Town's emergency boat, docks with private vessels, boat ramp, commercial shellfishing, town beach, town conservation area, water mains and hydrants, two recently replace culverts, Shellfishing flats, mooring areas,	Important. Water mains, access to town beaches, shellfishing areas.	Highly important. Town's most valued and popular beach located here, 30 acres of shellfish farms operated by local residents, shellfish flats, mooring areas, water mains, designated Area of Critical Environmental Concern.

		future location of harbormaster station.		
	Low	High - Rock Harbor facilities are important and town is investing in major infrastructure improvements	High Only alternate access to Route 6	High Samoset is important access point to Bridge Road evac route
	Lowest. No major assets are located in the area	High. Only means to access Rock Harbor	Highest. Part of only alternate route through Eastham besides Route 6	Very High. Loss of road imminent at certain locations
Concerns relative to Sea Level Rise (SLR) (daily flooding) Projected out from present-day, 2030, 2050, 2070, site-specific concerns, etc. *Please explain.*	Not-Critical. Minimal residents/businesses	Road floods frequently. However not heavily populated.	Very concerned. Bridge Road is a main artery within the town and essential for evacuation, travel, and emergency response.	Somewhat concerned. Moderately populated, connecting roads, and large beach parking area.
	Needed long-term planning for alternative access to WildCare and other properties. Perhaps off Route 6? There is interest in the ability to connect Boat Meadow and Town Cove.	In peak season, daily access is highly important. In the middle of winter, it is not as critical as there is not a high population of fulltime homeowners.	Highly important to maintain access at all times of the day for the entire Outer Cape.	Very important during peak season to have access to beach goers and for aquaculturists to access tidal flats.
	Low if BMP are initiated SLR should be mitigated	High	High	Low-med if flooding contained to beach side end of road not cutting off dwellings.
	Lowest. Upgrades to infrastructure should alleviate issue. Longest impact long term based on your projections	High, based on your projections	Very High. Bridge area already experiences major flooding	High, based on your projections
Projected usable life of roadway relative to (SLR) From Town's perspective, how long until SLR impacts render section of roadway impassible / unusable (relative to MA-DOT guidelines). *Please explain.*	Unknown.	Unknown.	Unknown.	Unknown.
	If any of the roads are impassible for small vehicles, I imagine repeated flooding can erode side slopes and undermine the road eventually so it no longer has useable life			

	and the infrastructure needs to be modified or replaced.			
				High Important access to commercial and recreational assets for shellfishing and beach
	Lowest	Low. Recently paved, infrastructure in good shape even during minor flood events	High. Continued flooding with salt water detrimental to the road	Very High. Road is already experiencing erosion and minor loss of road edge in various locations
Concerns relative to storm surge Projected out from present-day, 2030, 2050, 2070. *Please Explain.*	Very concerned moving forward. Road already floods from storm surge.	Very concerned moving forward. Road already floods from storm surge.	Very concerned moving forward. Road already floods from storm surge.	Very concerned moving forward. Road already floods from storm surge.
	Road already flooding during storms. Increased frequency and magnitude of flooding will need to be addressed. A plan can be developed for these areas in the off season, while other planning efforts are underway.	Dyer Prince and Rock Harbor are very concerning. Long-term planning efforts are critical for this end of town to continue to be accessed.	Very concerned as this roadway already floods. It should be highly resilient to storm impacts given the number of neighborhoods and town areas it provides access to. Long-term planning is needed to ensure the entire length of roadway is resilient to flooding and passable to both passenger vehicles and rescue apparatus, for evacuations during all times of the year.	This road is already undermined. It is already being impacted in one section during somewhat minor coastal storms and higher high tides. First Encounter Beach is culturally and economically important to the town and residents.
	Low	High concern, loss of access will impact residences and also impact commercial and recreational fishing industries which is vital to community		High Important access to commercial and recreational assets for shellfishing and beach
	Not many beyond access to homes	Loss of access to our only port (Rock Harbor) severely affecting (or eliminating) commercial fishing in Eastham	Loss main artery and emergency response ability, loss of major assets (water main, bridge, etc.)	Loss of access to Eastham's largest beach (First Encounter) and aquaculture grants, severely affecting commercial shellfishing in Town
Projected tipping point of storm surge risk	Unknown	Unknown	Unknown	Unknown.

At what point do things become unattainable at each site? Present, 2030, 2050, 2070? Town tolerance for inundation, asset loss, depth, frequency, duration, etc. What are the primary concerns? *Please explain.*				
	While prioritizing, the town should work to ensure that all roads should be resilient to storm surge and daily tidal rages.C This should be through long-term planning efforts, evacuation plans for these specific neighborhoods, public education, and homeowners along these areas beginning to think about making their properties more resilient as well.			
	2050	2030-2050	2030-2050	2030-2050
	Based on your projections, sometime between 2050 and 2070	Based on your projections, sometime between 2030 and 2050	Based on your projections, soon after 2050	Based on your projections, sometime between 2030 and 2050
Other criteria to consider? Further Comments?	Cost is a major factor. Short, mid, and longer-term costs should be weighed.			
	Should look at the effects that resizing culvert and raising the road have on projections. Could be most feasible location to address	Earthen berms had been placed on roadside in the past with positive results. Possibility and effects of installing them again, instead of raising the road, should be looked into	Probably the location that will require the most involved repair. New bridge and water mains have been recently installed, and alternative routes of access and egress must be kept at all times	Multimodal access to the beach is important. Road is banked towards marsh. Leveling road (raising its SE edge) and adding a wooden elevated boardwalk/bike path should be considered

APPENDIX H. MC-FRM FLOOD RISK TABLES

Site-Specific MC-FRM Flood Risk Probability Tables

MC-FRRM flood risk probability tables were used to generate probabilistic risk profiles for municipal assets located along each low-lying roadway.

	Smith Lane	Water Levels ft-NAVD		
Risk Level	Present	2030	2050	2070
0.1	8.03	8.03	12.94	15.72
0.2	7.94	7.94	12.65	15.35
0.5	7.80	7.80	12.19	14.77
1	7.70	7.70	11.85	14.34
2	7.59	7.59	11.51	13.90
5	7.45	7.45	11.04	13.31
10	7.34	7.34	10.68	12.85
20	7.22	7.22	10.29	12.35
25	7.18	7.18	10.15	12.18
30	7.15	7.15	10.03	12.03
50	7.02	7.02	9.61	11.50
100	6.73	6.73	8.69	10.33

	Dyer Prince	Water Levels ft-NAVD		
Risk Lev	Present	2030	2050	2070
0.1	11.57	12.92	15.43	17.09
0.2	11.19	12.52	14.92	16.60
0.5	10.59	11.91	14.15	15.84
1	10.14	11.44	13.56	15.27
2	9.68	10.97	12.97	14.70
5	9.07	10.34	12.18	13.92
10	8.59	9.84	11.56	13.32
20	8.07	9.31	10.89	12.66
25	7.89	9.12	10.65	12.43
30	7.73	8.96	10.44	12.23
50	7.19	8.39	9.73	11.54
100	5.95	7.14	8.16	10.00

	Bridge	Water Levels ft-NAVD		
Risk Level	Present	2030	2050	2070
0.1	11.42	13.10	15.54	17.11
0.2	11.05	12.68	15.03	16.61
0.5	10.47	12.04	14.24	15.86
1	10.04	11.56	13.65	15.29
2	9.60	11.07	13.05	14.71
5	9.01	10.41	12.24	13.94
10	8.54	9.90	11.60	13.33
20	8.04	9.35	10.92	12.67
25	7.87	9.15	10.68	12.44
30	7.71	8.98	10.47	12.24
50	7.18	8.39	9.75	11.55
100	5.99	7.09	8.15	10.01

	Samoset	Water Levels ft-NAVD		
Risk Level	Present	2030	2050	2070
0.1	11.31	12.94	15.38	17.15
0.2	10.95	12.55	14.89	16.67
0.5	10.41	11.95	14.14	15.92
1	9.99	11.49	13.57	15.35
2	9.58	11.03	13.00	14.78
5	9.02	10.41	12.23	14.02
10	8.58	9.92	11.62	13.41
20	8.10	9.40	10.97	12.77
25	7.94	9.22	10.74	12.54
30	7.79	9.06	10.54	12.34
50	7.29	8.50	9.85	11.65
100	6.15	7.27	8.33	10.13

APPENDIX I. MAY PUBLIC MEETING MINUTES

FY20 Eastham CZM Resiliency Grant Public Meeting #1

Held Remotely via Zoom

May 27, 2020

Municipal Project Team – Shana Brogan, Silvio Genao, Chief of Police, Fire Chief

Woods Hole Group – Adam Finkle

Members of the Public

Meeting Minutes

- Shana Brogan opens meeting, introduces public to project. Acknowledges grant funding mechanism. Introduces Adam Finkle, Woods Hole Group.
- Adam Finkle presents work completed to date, site-specific inundation maps and figures.
- Municipal Project Team and Woods Hole Group field questions from the public. Public may also submit comments directly to conservation@eastham-ma.gov

Public Questions, Comments, Feedback

Joanna Buffington, resident – Dyer Prince Culvert, previous APCC study. Recommends revisiting data to se if it lends itself to this project. Continued Bridge Road access is critical.

Shana Brogan / Adam Finkle, Town of Eastham, WHG – Smith Lane may be a lower priority given larger State-level assessment

Nick Dibbs, resident – Dyer Prince – projections – can't raise every road – consider what is practical. Why would Town spend funds investing in roads that can't be saved? Has there been an examination of the intersection of public-private property?

Sally Diggs, resident – Marsh continuing to decline, channel getting wider, losing canals, how can this continue? Does model consider evolution of the marsh platform?

Adam Finkle, WHG – To confirm with modeling team.

Susan Trapscott, resident – Before one raises the road, consider the dam it creates – if you block water flow it can create other problems.

Adam Finkle, WHG – Acknowledged. Coastal processes analysis to help determine unforeseen impacts relative to proposed design.

Bill Allen, resident – Turtle exclusion fencing – significant erosion on seaward side of Bridge Road. Erosion and damming needs to be considered moving forward. Turtles love these

conditions, scenarios, and projections. Turtle crossing roadkill reduction should be considered along road sections or use exclusion fencing.

Shana Brogan, Town of Eastham – To involve NHESP in design consultation.

Jim, Resident – Bridge Road 2030 scenario – bottleneck. Forcing flooding elsewhere or redirecting storm surge elsewhere may be problematic.

Carol Zaglio, resident – 2016 large Dyer Prince culvert was replaced. Several footings under apron never installed under Rock Creek (downstream) side of apron. Exacerbated scouring and widening of scour. How stable is culvert apron? How resilient would changes be? Would changes consider the culvert? Was it properly installed in the first place?

Silvio Genao, Town of Eastham – to follow up on project and confirm functionality and proper installation.

Joe Pedlo, resident – Flooding of adjacent private parcels should be a major consideration. How can projections for the roads be applied to private parcels? Are there ways that the projections can lend themselves to private abutters?

Adam Finkle, WHG – info exchanged, to follow-up offline. Improvements to roads may have ancillary benefits for adjacent homeowners.

Jeff Sultin, resident – Keene Way/Dyer Prince flooding is of concern.

Received through Public Comment Portal:

1) **From:** Joyce Wood <woodjoycejackson@gmail.com>
   Sent: Wednesday, May 27, 2020 7:28 PM
   To: Shana Brogan <conservation@eastham-ma.gov>
   Subject: Meeting on low lying roads

   Shana,

   It was a very helpful meeting. Thanks for sending an alert. Please send me an email about the next meeting. My one comment is that while all these roads are vulnerable, Bridge Road is the most essential of the roads under consideration. It seems that this is what the police chief indicated. I live on Beach Road, but if Bridge is flooded at the 90 degree curve, I cannot get out and of course this is true for so many people. And any day when there is a back-up on Route 6 we see the effects on Bridge Road. Thanks again for your leadership.

   Joyce Wood 18 Beach Road

2) Hi Shana

Good meeting last night...As you know Carl's family owned the tract of land at the end of Dyer Prince for about 100 years. This old photo taken in 1932 is looking east. The next email will be a painting of it - Carl's mother noted on the back the info.
Thought you would be interested in this bit of flooding history.
Best
Susan

3)

June 5, 2020

BY EMAIL and USPS mail

Ms. Shana Brogan
Conservation Commission Agent
conservation@eastham-ma.gov
Mr. Silvio Genao
Superintendent of *Public Works* and Natural Resources
dpwdir@eastham-ma.gov
555 Old Orchard Rd
Eastham, Massachusetts 02642

Dear Ms. Brogan and Messrs Genao,

I write at your request to elaborate on my comment during the public meeting held by Eastham's Conservation Department and public safety officials, and the Woods Hole Group on Low Lying Roads, on May 27, 2020 at 6pm, by Zoom Link. The purpose of this meeting was for Adam Finkle, Coastal Scientist of Woods Hold Group, to share the results of that organization's Vulnerability Assessment as sea level rise impacts Bridge Road, Dyer Prince Road, Samoset Road, and Smith Lane, and to solicit public comment from abutters.

The Town of Eastham engaged Woods Hole Group to study and advise the municipality on how the town might best address mitigation of these roads flooding as a sea level rise impacts assets, utilities, infrastructure, access points, and abutters. The purpose of the Group's assessment is not marsh restoration.

I am an abutter to Dyer Prince Road (#227), where, since 1974, my husband and I have been property owners. During this 45-year period, we witnessed gradual deterioration of the **two obvious culverts on this road,** through which Rock Harbor Creek water flows from Cape Cod Bay.

In winter 2016, on Dyer Prince Road, two new culverts were installed to replace pre-existing culverts that were in collapsing condition. The larger culvert connects seawater running through the salt marsh southeastern side of Dyer Prince Road (parcel 19-116 and 19-117) with the salt marsh north side of the road (parcel 19-44). The culvert is 28-30 inches in diameter. A smaller culvert runs salt water running through an old ditch between parcels 19-105 and 19-104C.

My comment here is **mainly about installation of the new larger culvert**. (See Attachment A, Photos of Culvert installation)

Almost daily, I was present during the installation. I observed **large concrete footings delivered for placement under the culvert aprons**. **We estimated the size of a single footing to be approximately 2 feet wide by 2 feet high by 6 feet long.** The footings were parked for weeks on ground outside our split rail fence. The **State-approved design plan** for licensing the culvert **required the footings**, but **they were never installed**. During the process of replacing this culvert, I spoke with an on-site company representative. He told me that due to an engineering complication with placing the footings on the south side of the culvert, someone in the Eastham town offices gave his company permission to scrap the plan to place the footings. I note that it was publically reported that the licensed design plan is on file at the Barnstable Registry of Deeds. That said, I have not personally read the filed documentation.

I put forward that **not placing the footings may be accelerating the collapse of trap rock** designed to hold back the banks adjacent to the culvert. **As trap rock falls into creek, it diverts water flow velocity through the culvert**. As **velocity flow increases, it accelerates ruinous scouring of the salt marsh at Erickson parcels 19-116 and 19-117, and is now eating into Town of Eastham parcel 19-44**.

Regarding the smaller culvert that connects parcels 19-105 and 19-104C, overtopping occurs not only during occasional coastal storms, but also when the moon is full and closest to Earth (often 6-8 times a year). People who live on Dyer Prince Road; work at residential properties on the road (construction workers, house keepers, landscapers); hikers and bikers know that this **flooding occurs particularly whenever there are strong onshore winds**.

When compared with the acres of this salt marsh formed over two millennia and including understandable construction by humans during the 20th Century, as summarized in the Cape Cod Atlas of Tidally Restricted Salt Marshes by the Cape Cod Commission for the Massachusetts Wetlands Restoration Program December 2001 and at page E3, Dyer Prince Road restriction of Rock Harbor Creek, Site EA-1, December 2001 (See Attachment B), the current and rapidly accelerating marsh conditions at this culvert site are severe and appear irreversible. (Attachment C, Large Culvert and Seaward Channel, photos by C. Zaglio, May 31, 2020).

I am grateful to the Town of Eastham powers that be for creating the opportunity for residents to convey experiences and thoughts via the Zoom meeting format, particularly during this hugely unsettling time of pandemic. I am also grateful Ms. Brogan and Mr. Genao for encouraging me to provide the information in this letter. Finally, I thank Mr. Finkle for taking time to speak with me in January 2020 while he and a colleague from Wood Hole Group were conducing site survey on Dyer Prince Road.

With regard to any future public meetings on low-lying roads in Eastham, **I request that I be informed of such meetings by email. (See my email address below)**

Sincerely and Thanking You in advance,

Carol Zaglio

Carol Zaglio
227 Dyer Prince Road
Eastham, MA 20642
Carol.Zaglio@gmail.com

APPENDIX J. JUNE PUBLIC MEETING MINUTES

FY20 Eastham CZM Resiliency Grant Public Meeting #1

Held Remotely via Zoom

June 24, 2020

Municipal Project Team – Shana Brogan, Paul Lagg, Fire Chief

Woods Hole Group – Adam Finkle

Members of the Public

Meeting Minutes

- Shana Brogan opens meeting, provides progress update since last public meeting held on May 27, 2020. Acknowledges CZM grant funding mechanism. Introduces Adam Finkle, Woods Hole Group.
- Adam Finkle presents work completed since last public meeting, outlines goals of meeting:
    - Review Consequence Scoring Matrix
    - Review Asset Risk Profiles
    - Review Conceptual Designs
    - Discuss Next Steps
    - Solicit Public Feedback
- Municipal Project Team and Woods Hole Group field questions from the public. Public may also submit comments directly to conservation@eastham-ma.gov

Public Questions, Comments, Feedback:

Joyce Jackson – Timeline for bridge span alternative?

Shana Brogan – Bridge span alternative would likely be 5+ years in development for design/permitting.

Joanna Buffington – Concerns over hard-scape alternatives. Open span bridge may be most suitable alternative. Recognize costs, but most suitable long-term alternative.

John Uelia – Bridges do not address access to properties. Endless groups of bridges are not the solution. Harder solutions to shore up municipal infrastructure are of interest.

Pete Zaglio – Dyer Prince road – what are the projected tidal ranges moving forward? How do they differ from changes 1950-present? How have levels changed?

Adam Finkle – Will send projected tidal datums for Eastham to Shana for distribution.

Karen Strauss – Diamondback terrapins are a concern, ACEC, NHESP concerns. Terraced side slopes may allow for turtle gardens.

Adam Finkle – Proposed FY21 scope of work includes design consultation with regulators. May be possible to include turtle gardens in future design plans.

Shana Brogan – Bridge assessment to gauge condition/longevity also included in proposed FY21 scope of work.

James Arnold – Bridge is preferable as a long-term solution. Opens up marsh for flood attenuation.

John Uelia – Bridge would impact many parcels. Islands of neighborhoods connected by roads may leave out some residents.

Adam Finkle – Likely that some combination of alternatives would be most suitable. May be possible to adapt and shore up existing infrastructure in the short-term while a longer-term alternative (such as a bridge) is designed, permitted, and funded.

Carol Zaglio – Rip rap is not stable adjacent Dyer Prince culvert and is impacting marsh.

Joanna Buffington – How will changes to roadway impact adjacent parcels?

Shana Brogan – Analysis to establish design criteria and gauge impacts are included in proposed FY21 scope.

Fire Chief – Any public safety related questions before signing off?

Adam Finkle/Shana Brogan – Public engagement will be a large component of any future scope. Look forward to continuing to work with core group of stakeholders and residents.

Adjourn.

Additional comments submitted via the online portal are included on the following pages.

From: The Tapscotts <tapscott@PDQ.NET>
Sent: Sunday, June 28, 2020 4:47 PM
To: Shana Brogan <conservation@eastham-ma.gov>
Subject: Follow-up comments to 24Jun20 Eastham Low-Lying Roads Zoom Mtg

Shana,

Adam Finkle's presentation at the 24June Zoom Meeting was very good. We had nothing to add to the discussion that evening but would like to endorse some of the things that were said.

1. Bridge Road and Route 6 are the only two roads from the Outer Cape that connect to the Orleans Rotary and/or to roads that lead off-Cape and to the Upper Cape. During an evacuation, Bridge Road must be high enough for the passage of personal vehicles, while the other three roads should be made passable for emergency/high water vehicles. It is less critical that the other three roads be made passable to all vehicles. Of the four Eastham low-lying roads, that gives Bridge Road the greatest need for solutions to its high water problems.

2. It seems that for each low spot, a site-specific design for raising the roadway will be required. There can't be a one-size-fits-all choice to address all the low spots, given the different geometries, proximity to marshes, proximity to homes and driveways, flow velocities, wildlife needs, etc. Green through hard solutions should be used, as appropriate.

3. The "bridge" concept (causeway?) for the curve on Bridge Road seems to be a very good design to explore.

4. We attach two photos from the Blizzard of 1978, one taken of Bridge Road and the other of Rock Harbor. How big a storm was the Blizzard of '78? How does it fit into the models Adam and others are using to generate the flooding probabilities on the low-lying roads? Was it a 100-year or a 500-year storm? How does it compare to the Jan 4-9, 2018 storm?

5. We second the comments made about increasing/preserving marsh health and helping diamond back terrapins.

Thank you,

Susan and Chris Tapscott
73 Dyer Prince Rd
Eastham

-----Original Message-----
From: The Tapscotts <tapscott@pdq.net>
Sent: Thursday, June 18, 2020 12:22 PM
To: Shana Brogan <conservation@eastham-ma.gov>
Subject: Low-Lying Roads discussion/comments

Shana,

We attended the May 27 Zoom meeting on Low-Lying Roads. Our house is at 73 Dyer Prince Rd, and at the meeting I commented that if Dyer Prince or any of the other roads discussed that evening were re-designed and elevated, that attention should be given to NOT creating dams with the elevated roadways.

During the Jan 4-9, 2018, and March 2-3, 2018, storms, we were at our house. The January storm event was by far the higher water event of the two at our house. Since that time, we have contacted the family that owned our home during the Blizzard of '78, when we also lived on Cape Cod. We wondered how high the water got at our house during that storm, and from what the previous owner said, the two storms were very comparable in water levels in the marsh and near our home.

During the Jan, 2018, storm, the highest tides and storm surge water levels occurred at about 12:30 PM on January 4, 2018. The water on Dyer Prince Rd in front of our house seemed to have traveled from further east on Dyer Prince, probably coming from the marsh near the location where the road elevation is 9.7763' on your Lidar maps of the roadway. The water barely covered the road by our house, unlike the water that made the road impassable further west of our home, in the dip near Nick Debbs' property. The water from the east proceeded to run off the roadway, mostly to the north, to the marshy area on the other side of the road. It ran into our yard but more went toward the (lower) marsh on the north side of the road. We did not see how deep the water was even further east of the 9.7763' spot; we do know that drivers were told to turn around before coming further down Dyer Prince from Bridge Rd.

Were the road surface raised at that low spot near the east end of our property and the marsh water not allowed to spread out and join the marsh on the north side of the roadway, that would possibly make the water deeper on our side of the road, which would not be helpful to our already precarious situation! That particular area with the lower elevation serves as a water relief valve, letting the water spread into the much larger marsh on the north side of the road. If it is decided to raise that stretch of the road, we would suggest that perhaps culverts or other connectors be installed to let that water transit under the new roadway to the northern marsh areas.

These are difficult problems to solve, and we look forward to the next meeting on June 24 to hear what you and others have discussed since the last meeting. We would appreciate any comments you or members of the Woods Hole Group might have about the comments, above. We'd be pleased to meet with you for a site visit near our home, in a socially distanced way, if that would be helpful. We are currently driving from Houston to the Cape, expecting to arrive on June 23. We'd just been in Eastham when the pandemic began, and we've been trapped in Houston ever since.

Thank you very much,

Susan and Chris Tapscott

73 Dyer Prince Rd
508-255-3707
Susan cell - 713-302-1202