4 Affected Environment, Environmental Consequences, and Mitigation

4.9 Wetlands and Floodplains

4.9.1 Introduction

This section assesses the potential construction and operational impacts of the No Build Alternative and Build Alternative on wetlands and floodplains. This section also identifies measures that would be implemented to avoid, minimize, and mitigate construction and operational effects of the Build Alternative on wetlands and floodplains.

4.9.1.1 Regulatory Context

Wetland and floodplain resources are subject to jurisdiction under the following acts, regulations, and order:

- Federal Water Pollution Control Act of 1972 (33 U.S. Code [USC] 1251-1376), as amended by U.S. Clean Water Act (1977) and U.S. Water Quality Act (1987), Section 401 and Section 404
- Rivers and Harbors Act of 1899 (33 USC 403), Section 10
- Massachusetts Wetlands Protection Act (Massachusetts General Laws [MGL] Chapter 131 Section 40) and its implementing regulations (310 Code of Massachusetts Regulations [CMR] 10.00)
- Location and Hydraulic Design of Encroachments on Flood Plains, 23 Code of Federal Regulations (CFR) 650
- Executive Order 13112, Invasive Species

4.9.1.2 Methodology and Study Area

The Wetlands and Floodplains Study Areas include the Sagamore Bridge and Bourne Bridge interchange approaches and Cape Cod Canal. The Study Areas for the wetlands and floodplains analysis include the Project Limits where physical work would occur within a construction zone as well as a 500-foot buffer from the construction zone. Wetlands or Waters of the United States (WOTUS), floodplains, vernal pools, and Areas of Critical Environmental Concern (ACEC) within the Study Areas were identified using a range of data sources, including the following:

- GIS Mapping
- Field wetland delineations (2020, 2021, and 2024)
- Vernal pool surveys (May 2020)
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps
- Coastal Zone Management Mapping
- U.S. Army Corps of Engineers (USACE) Major Rehabilitation Evaluation Environmental Assessment

Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report, Section 4.2**, for definitions of protected resources and **Appendix 4.9, Attachment 1, Abbreviated Notice of Resource Area Delineation**, for a summary and details of the wetland identification process.

4.9.2 Affected Environment

4.9.2.1 State Inland Resource Areas

In the Wetlands and Floodplains Study Areas, the following state-regulated inland resource areas were identified in the Sagamore North quadrant, Bourne North quadrant, and Bourne South quadrant interchange approaches:

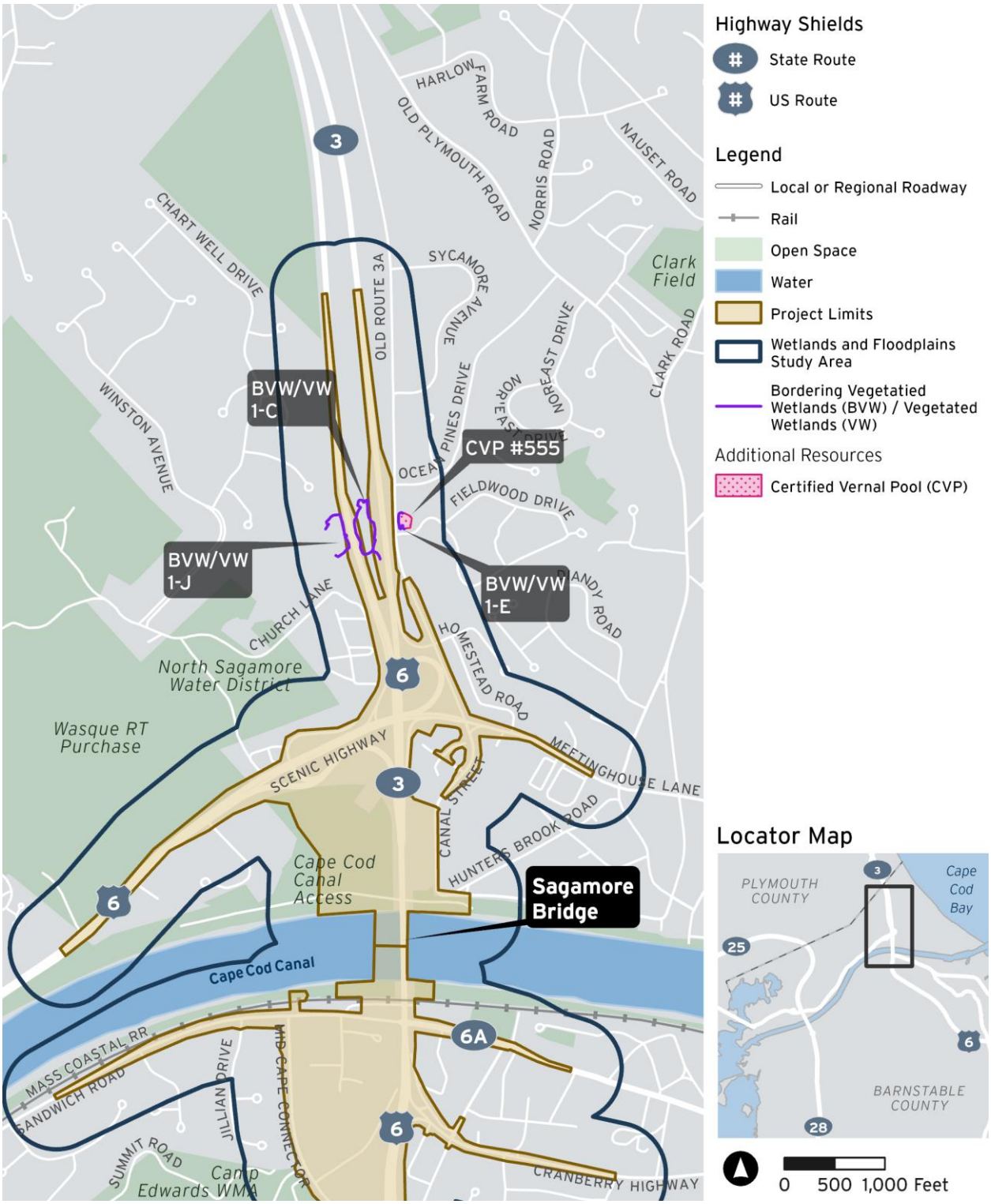
- Bank
- Bordering Land Subject to Flooding (BLSF)
- Bordering Vegetated Wetland (BVW)
- Land Under Water Bodies and Waterways (LUW)

In addition, there are 100-foot buffer zones from the edges of both Bank and BVW. **Table 4.9-1** defines and **Figure 4.9-1 through Figure 4.9-3** depict these resources.

Table 4.9-1. Definitions of State Inland Wetland Resources

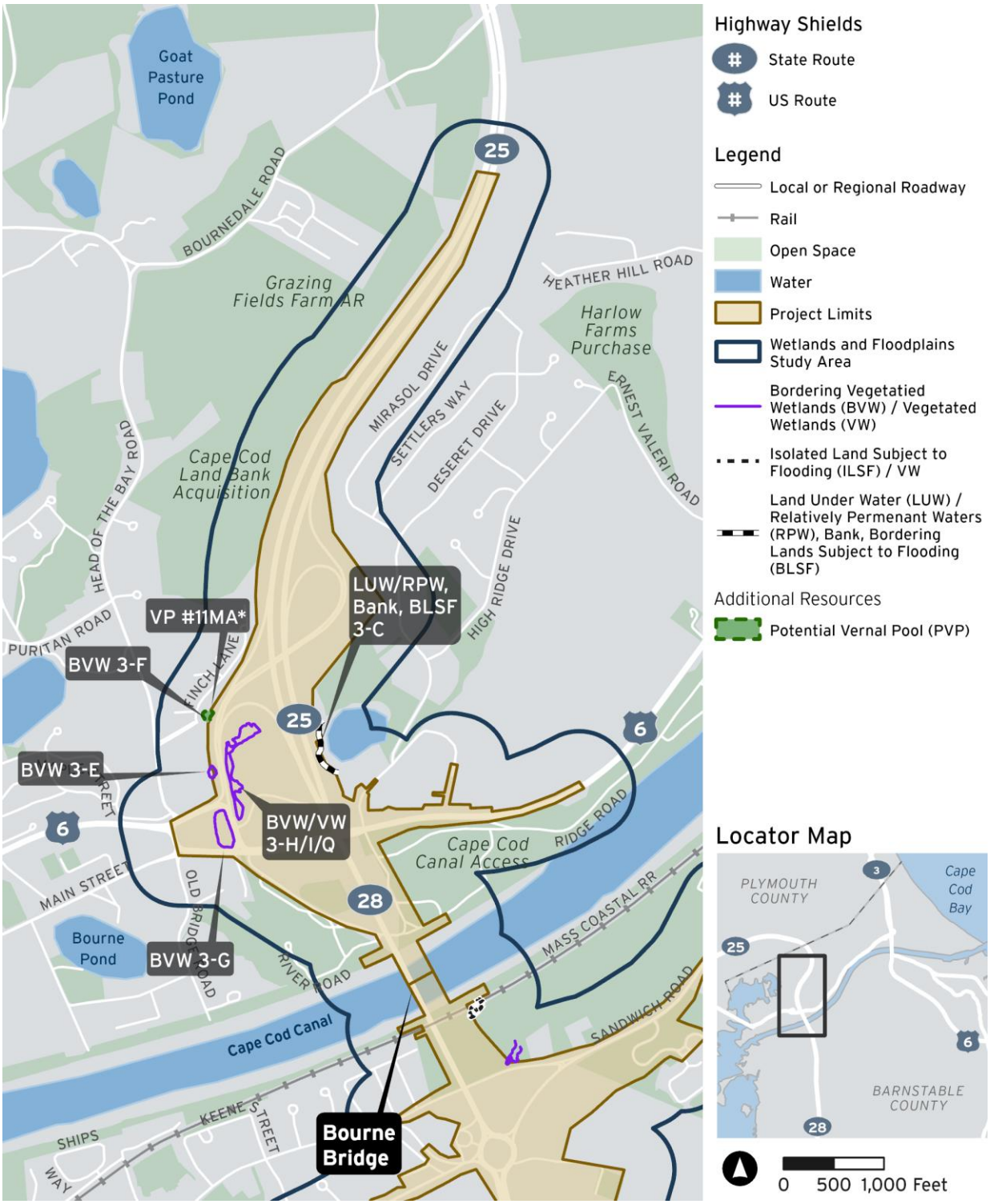
Resource	Definition
Bank	The portion of the land surface that normally abuts and confines a water body (stream lake or pond).
Bordering Land Subject to Flooding	An area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds, or lakes. It extends from the banks of these waterways and water bodies; where a Bordering Vegetated Wetland occurs, it extends from said wetland.
Bordering Vegetated Wetland	Freshwater wetlands that border on creeks, rivers, streams, ponds, and lakes, including wet meadows, marshes, swamps, and bogs. These wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants.
Land Under Water Bodies and Waterways	The bottom of, or land underneath, any creek, river, stream, pond, or lake.

Figure 4.9-1. State and Federal Inland Wetland Resource Areas (Sagamore North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

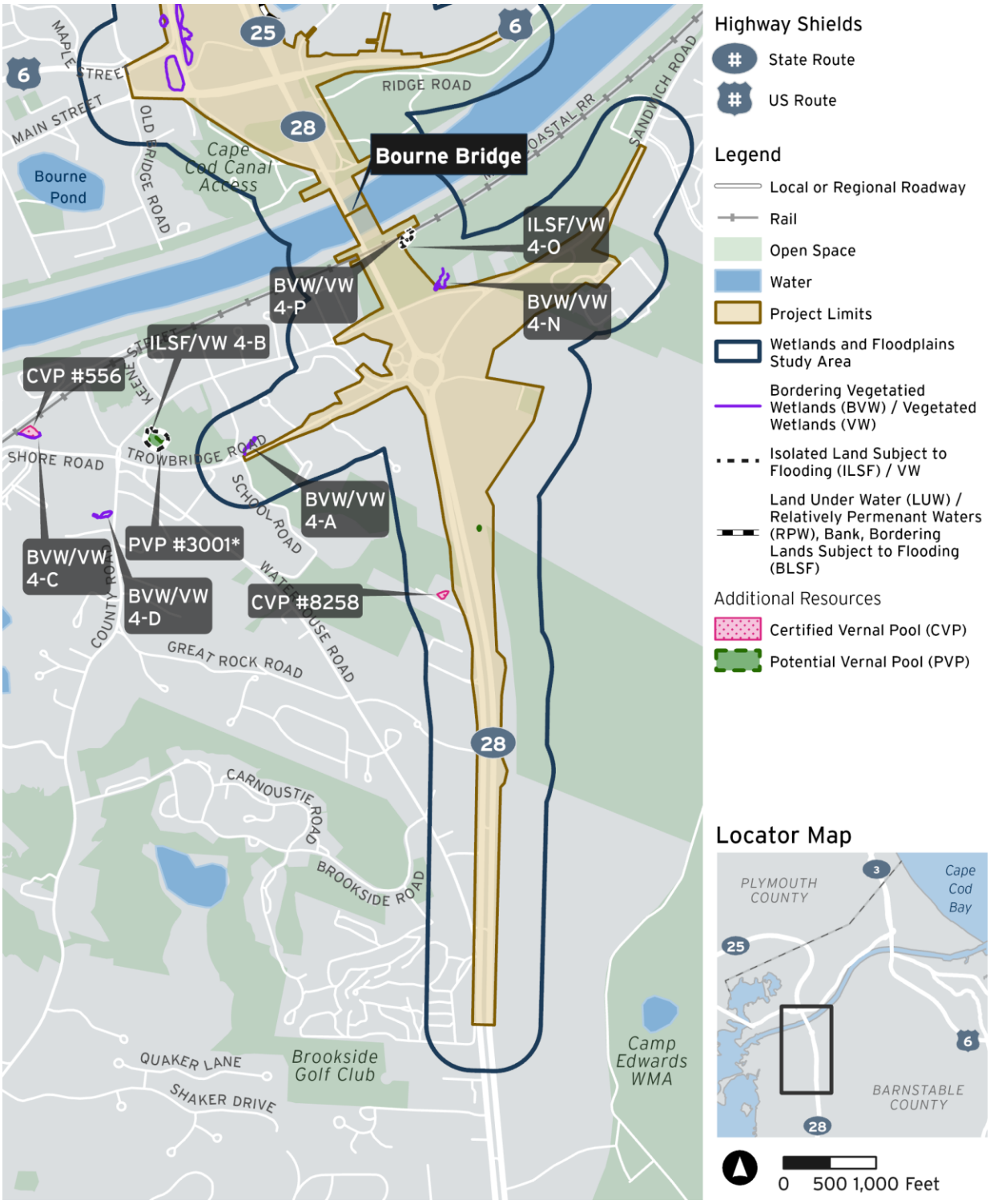
Figure 4.9-2. State and Federal Inland Wetlands (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Note: * Vernal Pool certification criteria not met.

Figure 4.9-3. State and Federal Inland Wetlands (Bourne South Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Note: Vernal Pool certification criteria not met.

Of those wetland areas identified, three of which are within the Bourne North quadrant interchange approach, would be impacted. **Table 4.9-2** lists these three wetland areas.

Table 4.9-2. State Inland Wetlands (Bourne North Quadrant Interchange Approach)

Figure Number	Wetland ID[1]	State Resource Area Type	Location	Description
Figure 4.9-2	Series 3-E	Bordering Vegetated Wetland	Northeast of CVS parking lot on west side of State Route 25 eastbound off-ramp to U.S. Route 6/State Route 28; connected to 3-H/I/Q via culvert under State Route 25 ramps; eventually flows to Cape Cod Canal	Sparsely vegetated forested wetland dominated by alder buckthorn (*Frangula alnus*), red maple (*Acer rubrum*), and sensitive fern (*Onoclea sensibilis*)
Figure 4.9-2	Series 3-H/I/Q	Bordering Vegetated Wetland	East side of U.S. Route 6/State Route 28 southbound ramp to State Route 25; connected to wetland resource 3-G via culvert under U.S. Route 6/State Route 28 ramp; eventually flows to the Cape Cod Canal via culvert	Dominant vegetation includes arrowwood (*Viburnum dentatum*), red maple, gray birch (*Betula populifolia*), steeplebush (*Spira tomentosa*), and small cranberry (*Vaccinium oxycoccos*)
Figure 4.9-2	Series 3-C	• Bordering Vegetated Wetland • Land Under Waterbodies and Waterways • Bank • Bordering Land Subject to Flooding	Nightingale Pond; east of State Route 25 northbound	Dominant vegetation on edge of pond includes black gum (*Nyssa sylvatica*), sweet pepperbush (*Clethra alnifolia*), and highbush blueberry (*Vaccinium corymbosum*)

[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD)[1] and additional field investigations.

[1] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), Massachusetts Department of Transportation Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

Vernal Pools

Vernal pools in the Wetlands and Floodplains Study Area are described in the Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment.[2] **Table 4.9-3** describes and **Figure 4.9-1 through Figure 4.9-3** map the five vernal pools within or adjacent to the Wetlands and Floodplains Study Areas.

Table 4.9-3. Summary of Spring 2020 Vernal Pool Surveys

Figure No.	Survey Area/Wetland ID[1]	Vernal Pool ID[2]	Vernal Pool ID[3]	Comments
Figure 4.9-1	Sagamore North Quadrant/BVW 1-E	05DN	Certified #555	Within 100 feet of proposed work
Figure 4.9-2	Bourne North Quadrant/BVW 3-F	11MA	None	Does not meet biological criteria for certification
Figure 4.9-3	Bourne South Quadrant/ 4-B (Isolated Land Subject to Flooding [ILSF])	03MA	Potential #3001	Does not meet biological criteria for certification
Figure 4.9-3	Bourne South Quadrant/IVW 4W	05MA	None	Does not meet biological criteria for certification
Figure 4.9-3	Bourne South Quadrant/BVW	07MA	Certified #8258	Within 100 feet of proposed work

[1] As identified in the ANRAD[3] and additional field investigations.

[2] As identified in Stantec (2020).[4]

[3] As identified by the Massachusetts Department of Fish and Wildlife Natural Heritage and Endangered Species Program.[5]

4.9.2.2 State Coastal Resource Areas

State coastal resource areas identified within the Sagamore and Bourne Bridge Study Area are defined in **Table 4.9-4**, mapped in **Figure 4.9-4 through Figure 4.9-7**, and described in **Table 4.9-6**.

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[2] Stantec Consulting Services Inc. 2020. Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment, MassDOT Project # 14-33419, Barnstable County, Massachusetts. Stantec Consulting Services Inc., Boston, Massachusetts. December.

[3] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

[4] Stantec Consulting Services Inc. 2020. Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment, MassDOT Project # 14-33419, Barnstable County, Massachusetts. Stantec Consulting Services Inc., Boston, Massachusetts. December.

[5] Massachusetts Division of Fisheries and Wildlife. 2009. Guidelines for the Certification of Vernal Pool Habitat (updated 2020). Massachusetts Division of Fisheries and Wildlife. Westborough, Massachusetts. March.

Water elevations within the Cape Cod Canal were obtained from the USACE.[6] Elevations in the USACE report were based on mean sea level datum and converted to North American Vertical Datum of 1988 (NAVD88) to establish the state jurisdictional limits. **Table 4.9-5** presents water elevations pertinent to state and federal jurisdictional limits. Variations in the values presented in **Table 4.9-5** result from differences in the timing and amplitude of the tides in Buzzards Bay and Cape Cod Bay: Buzzards Bay tide range is approximately 6 feet compared to Cape Cod Bay's range of approximately 10 feet, and the high and low tides precede that of Cape Cod Bay by about 3 hours.

Table 4.9-4. Definitions of State Coastal Resource Areas

Resource	Definition
Land Under Ocean (LUO)	Land extending from the mean low water line seaward to the boundary of the municipality's jurisdiction and includes land under estuaries.
Coastal Bank (CB)	The seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach, land subject to tidal action, or other wetland.
Rocky Intertidal Shore (RIS)	Naturally occurring rocky areas, such as bedrock or boulder-strewn areas between the mean high water line and the mean low water line.
Land Containing Shellfish	Land under the ocean, tidal flats, rocky intertidal shores, salt marshes and land under salt ponds when any such land contains shellfish.
Land Subject to Tidal Action (LSTA)	Land subject to the periodic rise and fall of a coastal water body, including spring tides.
Banks of our Land Under Ocean Underlying an Anadromous/Catadromous Fish Run	Area within estuaries, ponds, streams, creeks, rivers, lakes, or coastal waters, which is a spawning or feeding ground or passageway for anadromous or catadromous fish and which is identified by the Division of Marine Fisheries or has been mapped on the Coastal Atlas of the Coastal Zone Management Program.
Land Subject to Coastal Storm Flowage (LSCSF)	Land subject to inundation caused by coastal storms up to and including that caused by the 100-year storm surge of record or storm of record.

Table 4.9-5. Cape Cod Canal Water Elevations in Feet (Based on NAVD88)

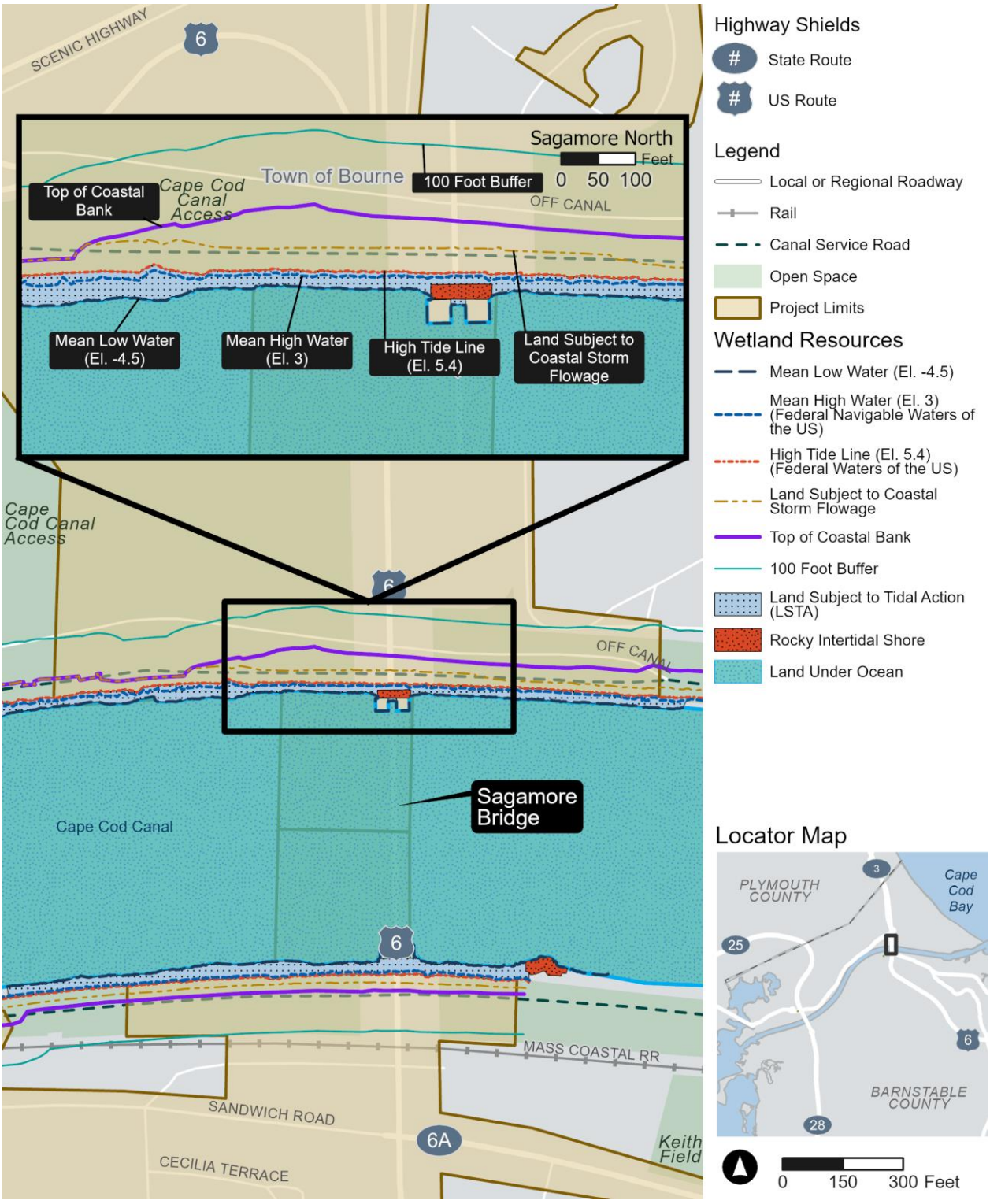
Location	High Tide Line	Mean High Water	Mean Low Water
Sagamore Bridge	5.4	3.0	-4.5
Bourne Bridge	2.9	1.5	-3.0

[6] U.S. Army Corps of Engineers (USACE). 2022. Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation, Cape Cod Canal Highway Bridges, Massachusetts. New England District, Concord, Massachusetts. March.

The Study Areas were reviewed for the presence/absence of other state coastal resources (i.e., coastal beach, coastal dune, barrier beach, salt marsh, and land under salt ponds). These coastal resources were not observed.

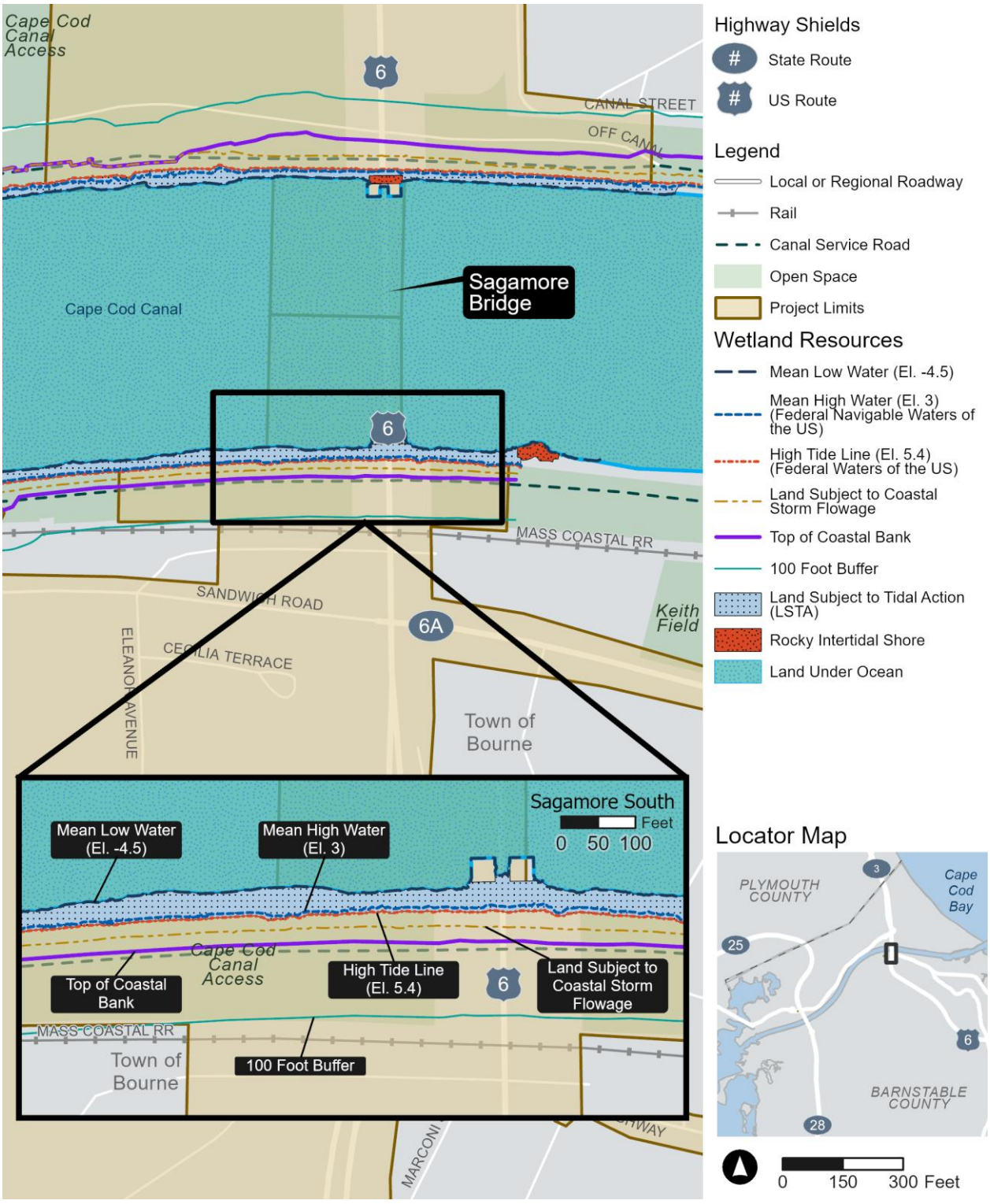
Exhibit 4.9-1 through Exhibit 4.9-8 depict the canal resource areas. As depicted in these exhibits, riprap comprises much of the shoreline along the canal.

Figure 4.9-4. State and Federal Coastal Resource Areas (Sagamore North Quadrant)



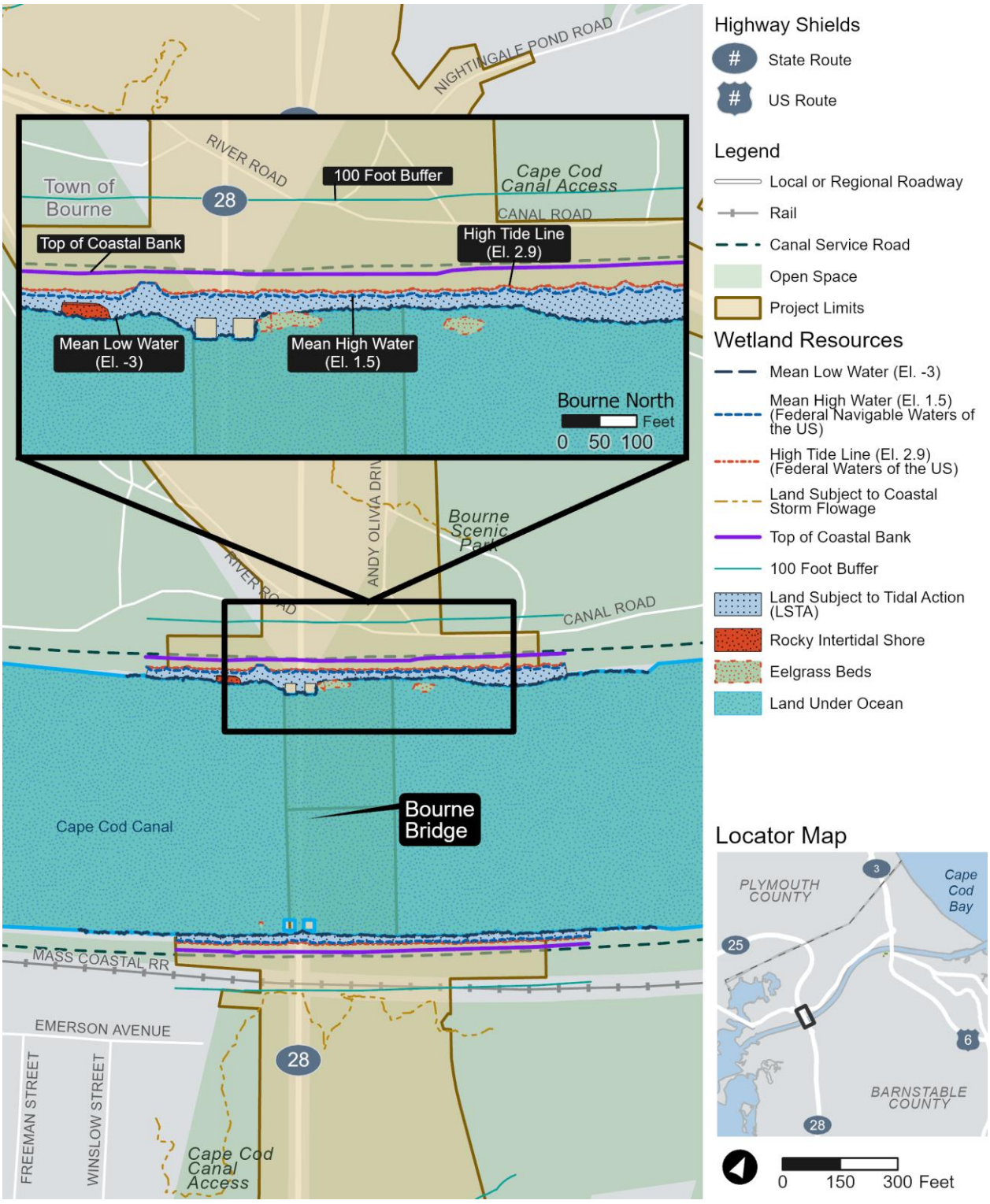
Source: Massachusetts Department of Transportation, 2025

Figure 4.9-5. State and Federal Coastal Resource Areas (Sagamore South Quadrant)



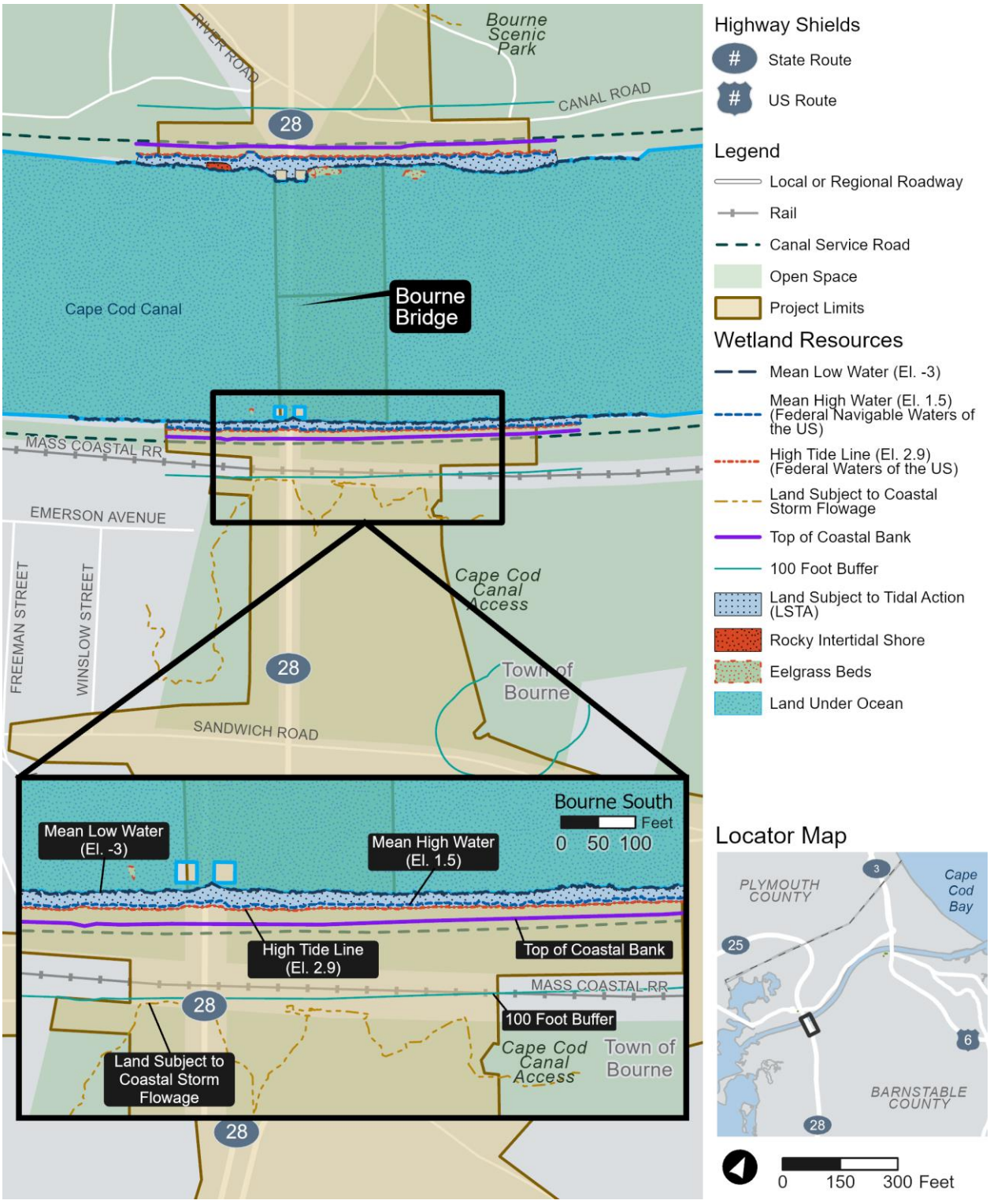
Source: Massachusetts Department of Transportation, 2025

Figure 4.9-6. State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Figure 4.9-7. State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Table 4.9-6. State Coastal Resource Areas

Resource Area Type	Location	How Determined
Land Under Ocean	Within Cape Cod Canal	Below mean low water elevation based on U.S Army Corps of Engineers (2022)[1]
Coastal Bank	Along north and south shorelines of entire length of Cape Cod Canal; 100-foot buffer applies	Massachusetts Department of Environmental Protection Wetlands Program Policy 92-1 Coastal Banks
Rocky Intertidal Shore	1,652 square feet at Sagamore North quadrant approach and 1,167 square feet at Bourne North quadrant approach	Based on field observations between mean high water and mean low water
Land Subject to Tidal Action	Within the Cape Cod Canal	Between mean low water and High Tide Line (including spring tides) based on U.S Army Corps of Engineers (2022)[1]
Banks of or Land Under the Ocean Underlying an Anadromous/Catadromous Fish Run	Along north and south shorelines of entire length of Cape Cod Canal	As mapped by Massachusetts Department of Fish and Game Division of Marine Fisheries
Land Containing Shellfish	Within Cape Cod Canal	As mapped by Massachusetts Department of Fish and Game Division of Marine Fisheries
Land Subject to Coastal Storm Flowage or 1% annual chance flood hazard	Elevation 14 feet NAVD88 at Sagamore Bridge, elevation 16 feet NAVD88 west of Bourne Bridge, and elevation 15 feet NAVD88 east of Bourne Bridge	Based on Federal Emergency Management Agency Flood Insurance Study and Rate Map and elevation verified by survey

[1] U.S. Army Corps of Engineers (USACE). 2022. Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation, Cape Cod Canal Highway Bridges, Massachusetts. New England District, Concord, Massachusetts. March.

Exhibit 4.9-1. Banks of Cape Cod Canal Adjacent to Sagamore North Quadrant Bridge Piers, Looking East

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-2. Banks of Cape Cod Canal Adjacent to Sagamore North Quadrant Bridge Piers, Looking South

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-3. Banks of Cape Cod Canal Adjacent to Sagamore South Quadrant Bridge Piers, Looking East

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-4. Banks of Cape Cod Canal Adjacent to Sagamore South Quadrant Bridge Piers, Looking East-Northeast

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-5. Banks of Cape Cod Canal Adjacent to Bourne North Quadrant Bridge Piers, Looking East

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-6. Banks of Cape Cod Canal Adjacent to Bourne North Quadrant Bridge Piers, Looking South

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-7. Banks of Cape Cod Canal Adjacent to Bourne South Quadrant Bridge Piers, Looking East

Source: Massachusetts Department of Transportation, 2024

Exhibit 4.9-8. Banks of Cape Cod Canal Adjacent to Bourne South Quadrant Bridge Piers, Looking East (closeup view)

Source: Massachusetts Department of Transportation, 2024

4.9.2.3 Waters of the United States

The Cape Cod Bridges Program (Program) is proceeding under the presumption that aquatic resources that meet the Clean Water Act's (CWA) definition of wetlands and any Relatively Permanent Water with a High Tide Line, Mean High Water mark, or Ordinary High Water mark are subject to USACE jurisdiction pursuant to the CWA and/or Section 10 of the Rivers and Harbors Act of 1899. The terms WOTUS and federal are used interchangeably to refer to these aquatic resources.

Inland Waters of the United States

Inland WOTUS were identified in the Sagamore North quadrant, Bourne North quadrant, and Bourne South quadrant interchange approaches. **Figure 4.9-1 through Figure 4.9-3** depict these resources. Of those wetland resources identified, three — all of which are within the Bourne North quadrant interchange approach — would be impacted. **Table 4.9-7** lists these three WOTUS.

Table 4.9-7. Federal Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)

Figure No.	Wetland ID[1]	Resource Area Type	Location	Description
Figure 4.9-2	Series 3-E	Vegetated Wetland	Northeast of CVS parking lot on west side of State Route 25 eastbound off-ramp to U.S. Route 6/State Route 28; connected to 3-H/I/Q via culvert under State Route 25 ramps; eventually flows to Cape Cod Canal.	Sparsely vegetated forested wetland dominated by alder buckthorn, red maple, and sensitive fern
Figure 4.9-2	Series 3-H/I/Q	Vegetated Wetland	East side of U.S. Route 6/State Route 28 southbound ramp to State Route 25; connected to wetland resource 3-G via culvert under U.S. Route 6/State Route 28 ramp; eventually flows to the Cape Cod Canal via culvert	Dominant vegetation includes arrowwood, red maple, gray birch, steeplebush, and small cranberry
Figure 4.9-2	Series 3-C	Vegetated Wetland and Relatively Permanent Water	Nightingale Pond; east of State Route 25 northbound	Dominant vegetation on edge of pond includes black gum, sweet pepperbush, and highbush blueberry

[1] As identified in the ANRAD[7] and additional field investigations.

[7] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

Coastal (Tidal) Waters of the United States

Coastal WOTUS are those waters subject to the ebb and flow of the tide. Cape Cod Canal is a tidal Navigable WOTUS. Coastal WOTUS identified within the Cape Cod Canal Study Area at both bridge locations are depicted in **Figure 4.9-4 through Figure 4.9-7**. Water elevations pertinent to federal jurisdictional limits are as presented for state jurisdictional limits in **Table 4.9-5** and were obtained from the USACE.[8] The Bourne North quadrant includes two eelgrass beds totaling 2,345 square feet east of the existing piers and the Bourne South quadrant includes one 100-square-foot eelgrass bed west of the existing piers along with isolated eelgrass sprigs further west (**Figure 4.9-7**). The Sagamore Bridge location does not include areas vegetated with eelgrass.[9]

4.9.2.4 Floodplains

FEMA Flood Insurance Rate Map panels (25001C0316K, 25001C0318K, 25001C0311K, 250010C4K, 25001C0501J, and 25001C0502J) identify the 1% annual chance flood hazard (i.e., 100-year floodplain) boundary within the Study Area. The limits of the FEMA-delineated floodplain within the Study Area are mapped in **Figure 4.9-8** and **Figure 4.9-9**.

The FEMA Flood Insurance Study and Map, with a revised effective date of July 6, 2021, shows Cape Cod Canal as Zone AE, 1% annual chance flood hazard ranging between elevation 16 feet NAVD88 to the west of Bourne Bridge to elevation 15 feet NAVD88 to the east of Bourne Bridge. At Sagamore Bridge, the 1% annual chance flood hazard is elevation 14 feet NAVD88.

At the Bourne North quadrant interchange approach, Zone AE extends beyond the banks of Cape Cod Canal into Belmont Circle. At the Bourne South quadrant interchange approach, the flood zone extends into the adjacent properties on either side of the bridge. At the Sagamore North quadrant interchange approach, Zone AE is along the landward edge of the existing pedestrian path, and at the Sagamore South quadrant interchange approach, Zone AE is confined to the banks of Cape Cod Canal.

Zone A flood zone (i.e., 1% annual chance flood hazard) with no Base Flood Elevation is associated with Nightingale Pond, which is in the Bourne North quadrant. Considering no Base Flood Elevation is provided, a hydrologic analysis was conducted to determine it. The analysis determined the Base Flood Elevation to be 14.5 feet NAVD88.

4.9.2.5 Areas of Critical Environmental Concern

The Herring River Watershed is a mapped ACEC that occurs within the Sagamore North quadrant interchange approach (**Figure 4.9-10**). The ACEC is mapped on the west side of State Route 3 and includes BVW series 1-J. At the southern end of the Bourne South quadrant interchange approach, the Project Limits overlap with the Bourne Back River ACEC (**Figure 4.9-11**).

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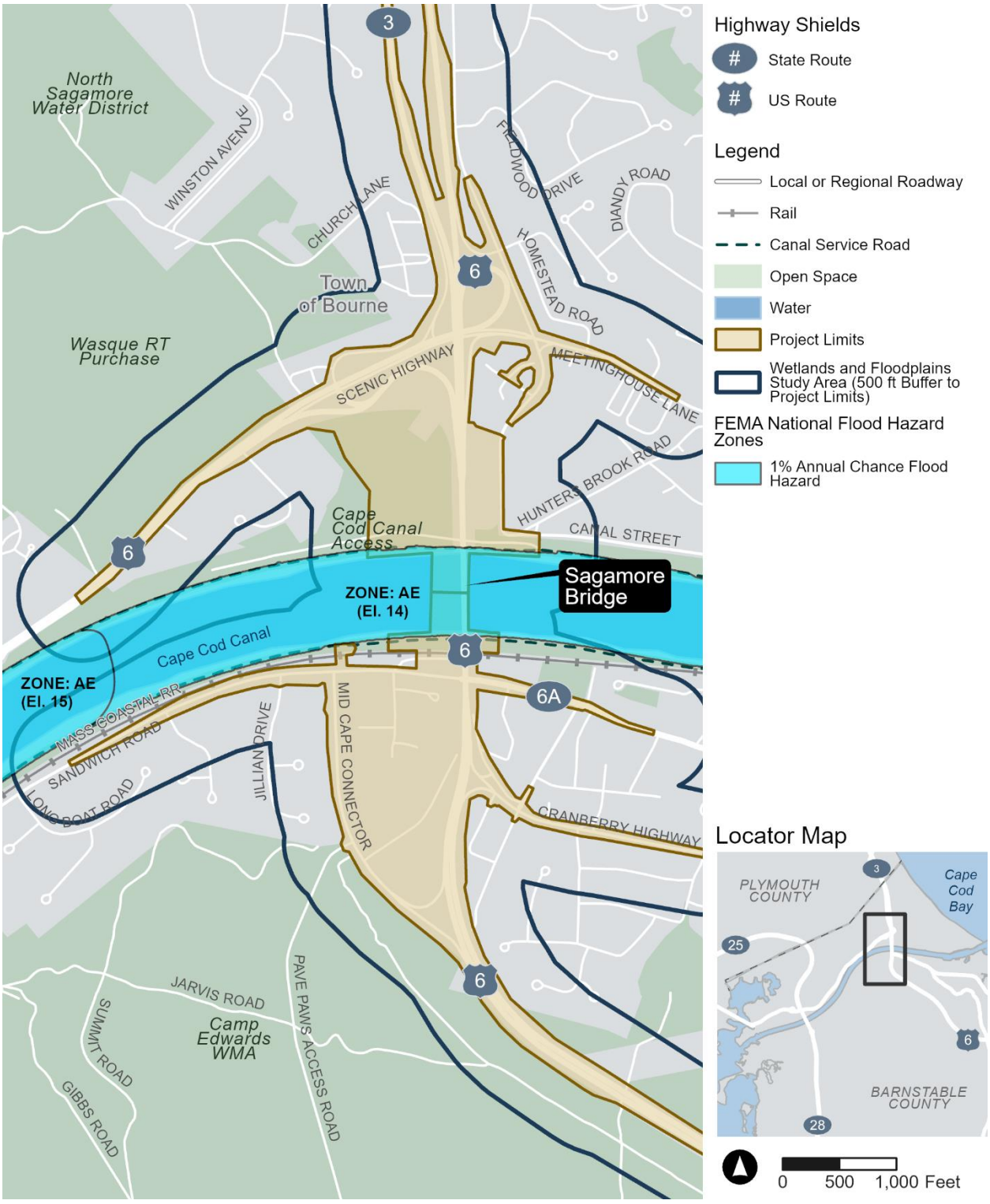
[8] U.S. Army Corps of Engineers. 2022. Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation, Cape Cod Canal Highway Bridges, Massachusetts. New England District, Concord, Massachusetts. March.

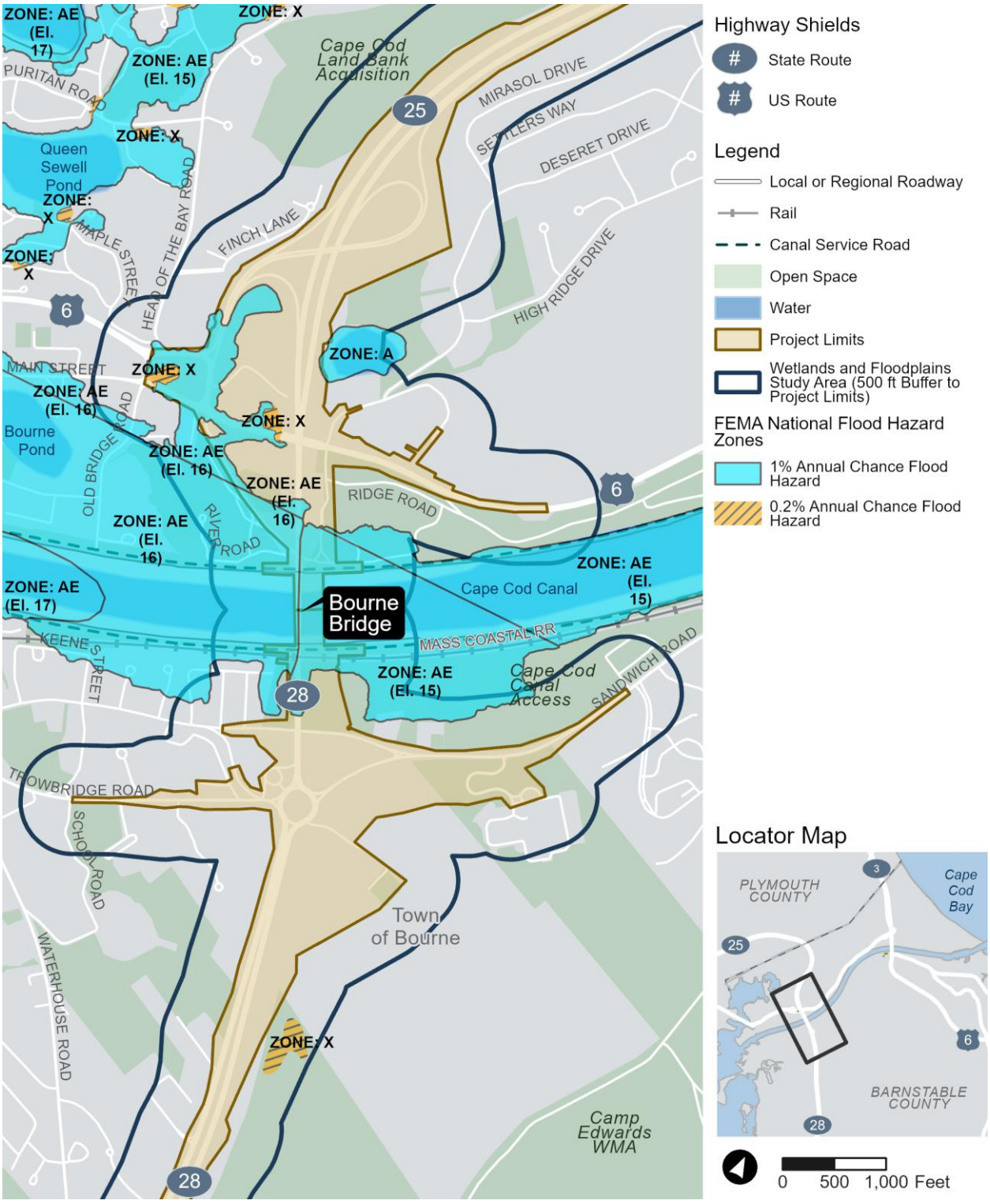
[9] The Eelgrass Survey Report is provided in **Appendix 4.11, Attachment 3**.

Figure 4.9-8. Floodplains (Sagamore Bridge)



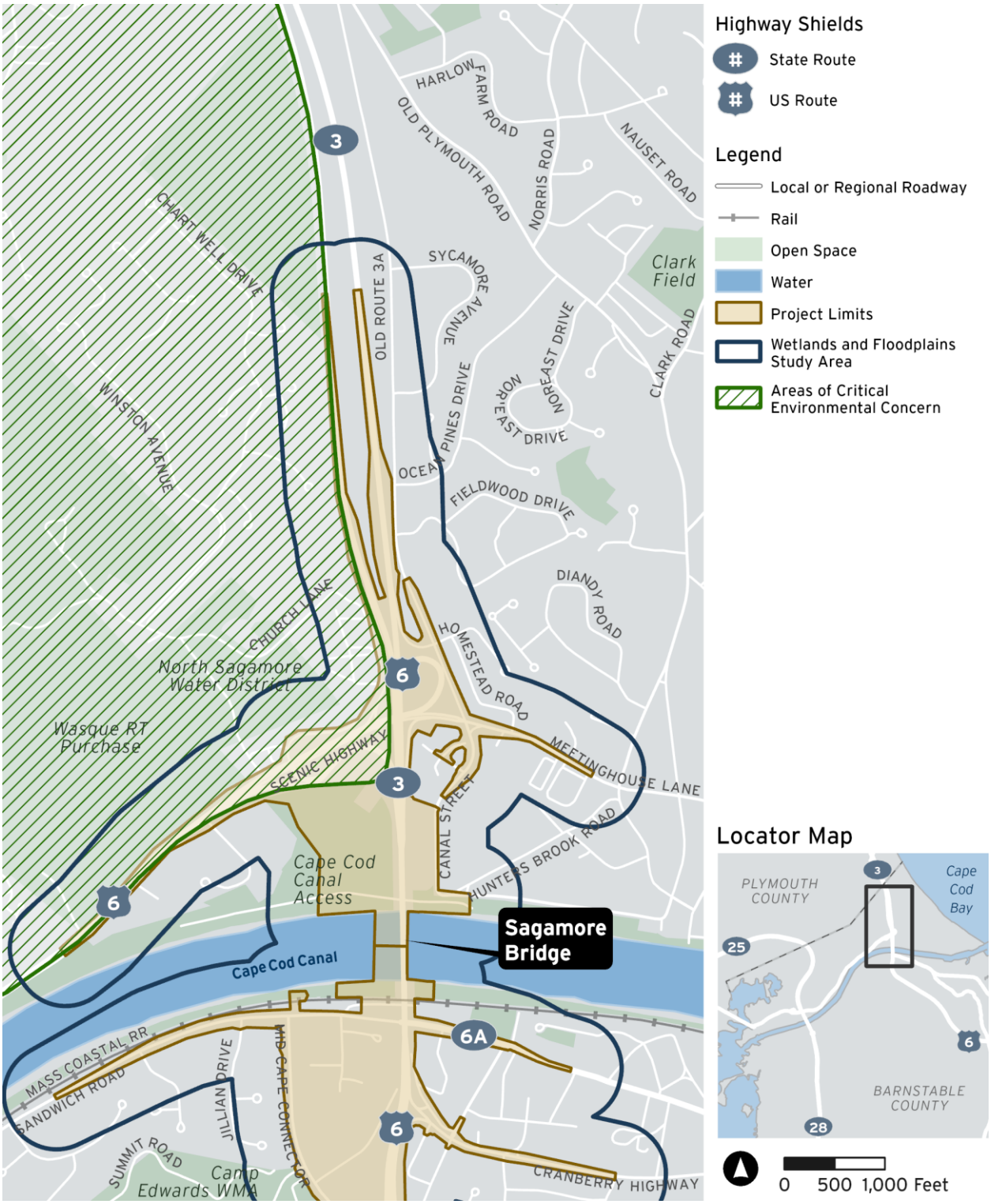
Source: Massachusetts Department of Transportation, 2025

Figure 4.9-9. Floodplains (Bourne Bridge)



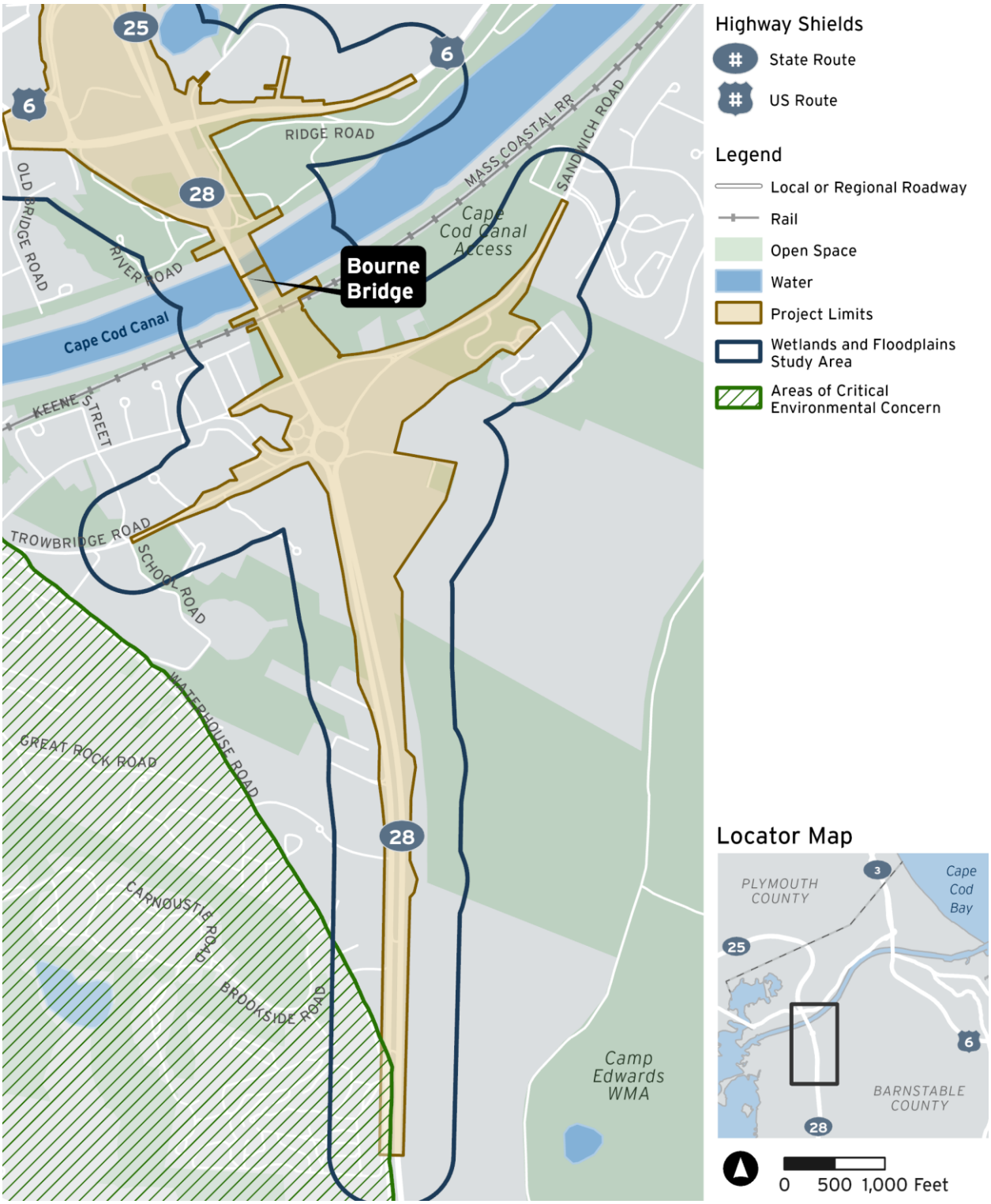
Source: Massachusetts Department of Transportation, 2025

Figure 4.9-10. Areas of Critical Environmental Concern (Sagamore North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Figure 4.9-11. Areas of Critical Environmental Concern (Bourne South Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

4.9.3 No Build Alternative

For the No Build Alternative, Sagamore and Bourne Bridges would not be replaced. The USACE would continue to conduct maintenance activities at both bridges. These activities would not result in permanent impacts to state or federal resource areas. Effects would be similar to those that occurred during prior maintenance activities for which the USACE analyzed pursuant to the National Environmental Policy Act.

4.9.4 Build Alternative

4.9.4.1 Construction-Term Impacts

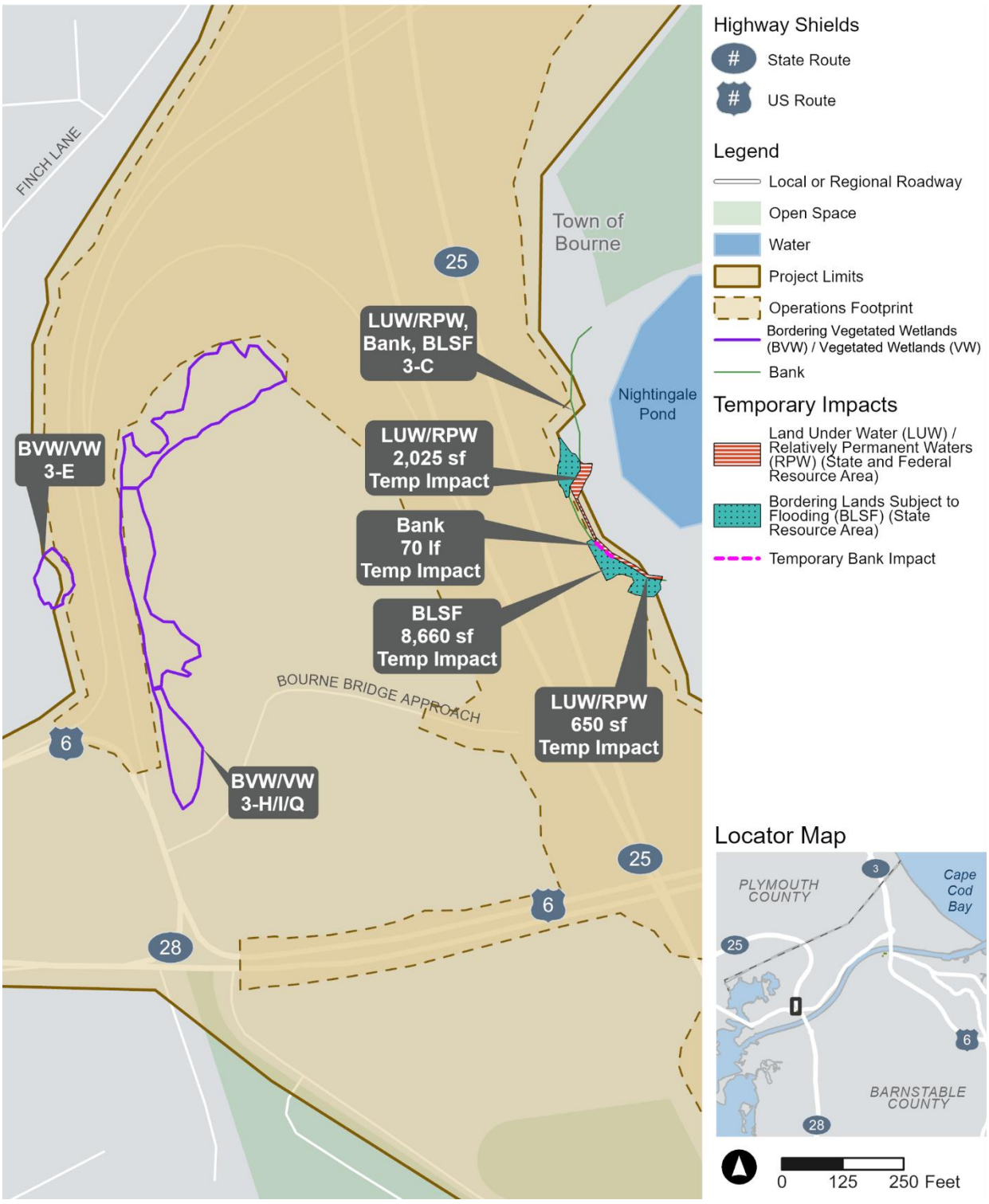
The Build Alternative would result in temporary and permanent impacts to both state and federal resources and in both inland and coastal areas. Temporary construction-term alterations would include filling, excavating, and installing structures. Permanent alterations would result from Build Alternative components, including the new bridge piers, riprap pier protection, and retaining walls. Dredging would also be required to facilitate marine vessel access to temporary construction structures.

Impacts to State and Federal Inland Wetland Resource Areas

The Bourne North quadrant interchange approach would include roadway widening, additional lanes and/or accommodations for a shared-use path that would affect state and federal wetlands. In each location, retaining walls would be constructed to minimize the extent of fill in jurisdictional resources. The temporary alteration would allow for an 11.5-foot-wide work zone to construct the retaining walls. After construction, the same work zone would be narrowed to a 10-foot-wide grass surface, access path for maintenance purposes during operations. The 10-foot-wide access path would be considered a permanent impact. Unavoidable impacts to wetlands are mapped in **Figure 4.9-12** and **Figure 4.9-13** and described in **Table 4.9-8**; permanent impacts to wetlands would be compensated (refer to **Section 4.9.5**).

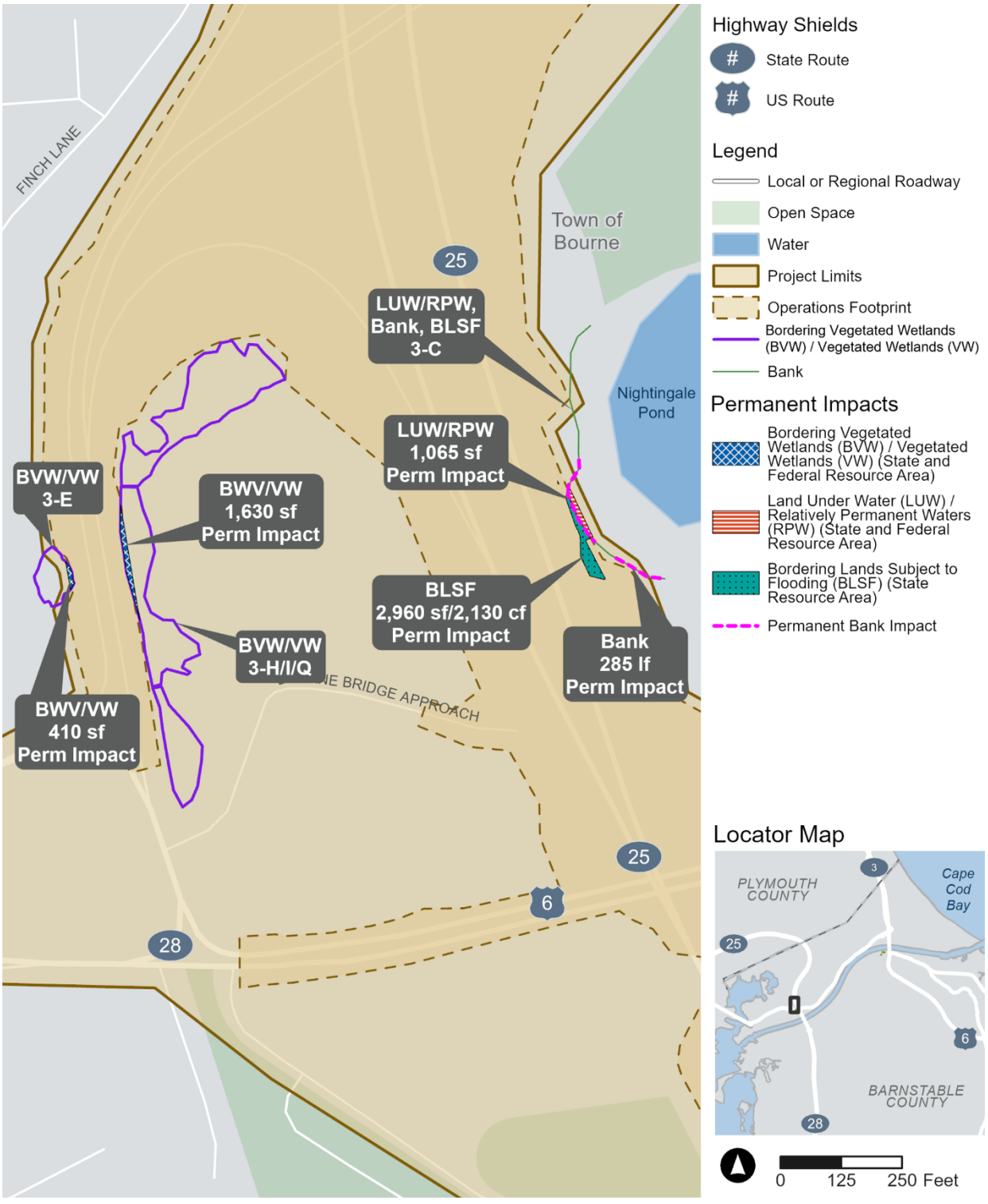
Construction of the Bourne South quadrant, Sagamore North quadrant, and Sagamore South quadrant interchange approaches would not result in impacts to wetlands. However, part of this work would occur proximal to two vernal pools: one in the Bourne South quadrant and one in the Sagamore North quadrant interchange approaches (**Table 4.9-9**). Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report, Section 7.1.1,** for details on work proximate to vernal pools.

Figure 4.9-12. Potential Temporary Impacts to State and Federal Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Figure 4.9-13. Potential Permanent Impacts to State and Federal Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Table 4.9-8. Potential Impacts to State and Federal Inland Wetland Resource Areas

Resource[1]	Temporary Impacts	Permanent Impacts	Reason for Impact
BVW 3-E *VW 3-E*[2]	—	410 square feet (<0.01 acre)	Fill for widening State Route 25 east- and westbound off-ramps to U.S. Route 6/State Route 28 and add second travel lane
BVW 3-H/I/Q *VW 3-H/I/Q*[2]	—	1,630 square feet (0.03 acre)	Fill for widening State Route 25 east- and westbound on-ramps from U.S. Route 6/State Route 28 and accommodate shared-use path
LUW 3-C *RPW 3-H/I/Q*[2]	2,675 square feet (0.06 acre)	1,065 square feet (0.02 acre)	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound
Bank 3-C	70 linear feet	285 linear feet	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound
BLSF 3-C	8,660 square feet	2,960 square feet (2,130 cubic feet)	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound

BLSF = Bordering Land Subject to Flooding, BVW = Bordering Vegetated Wetland, RPW = Relatively Permanent Water, VW = Vegetated Wetland

[1] As identified in the ANRAD[10] and additional field investigations.

[2] Identified as Waters of the United States.

[10] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

Table 4.9-9. Potential Work for Bourne North Quadrant and Sagamore North Quadrant Interchange Approaches Proximate to Vernal Pools

Survey Area/ Wetland ID[1]	Vernal Pool ID[2]	Vernal Pool ID[3]	Work Within 100 Feet of Resource	Comment
Sagamore North quadrant/ BVW 1-E	05DN	Certified #555	Roadway widening for extension of acceleration lane within 75 feet of Vernal Pool	Work to occur along State Route 3 northbound and separated by State Road
Bourne South quadrant/BVW	07MA	Certified #8258	Work limited to repaving 1,150 square feet of existing driveway	Work to occur approximately 70 feet from Vernal Pool

[1] As identified in the ANRAD[11] and additional field investigations.

[2] As identified in Stantec (2020).[12]

[3] As identified by Massachusetts Department of Fish and Wildlife Natural Heritage and Endangered Species Program.[13]

Potential Impacts to State and Federal Coastal Resource Areas

Replacing Sagamore and Bourne Bridges would remove eight piers from below mean high water and construct eight new piers in Cape Cod Canal. Each bridge would be supported by four new piers to accommodate both the north- and southbound decks over Cape Cod Canal. Each pier would be partially located within the riprap banks of the canal shoreline and partially below mean high water and HTL.

Temporary structures would include barge docks, cofferdams surrounding the work areas for pier removal and installation, bulkheads to create level work area platforms on two sides of each pier cofferdam, pile-supported work trestles to facilitate work from above the water surface, and bollards and pile-supported dolphins to accommodate work barges. The existing riprap along the shoreline would be temporarily removed to accommodate the sheet pile installations. Excavation would occur to remove the existing piers to a minimum of 2 feet below the mudline and to install the new piers. Dredging would also be required to facilitate marine vessel access to the temporary work structures. Temporary impacts are represented on two sets of figures due to the overlap of the trestles and other structures. **Figure 4.9-14 through Figure 4.9-20** show the temporary impacts to state and federal coastal resource areas.

[11] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

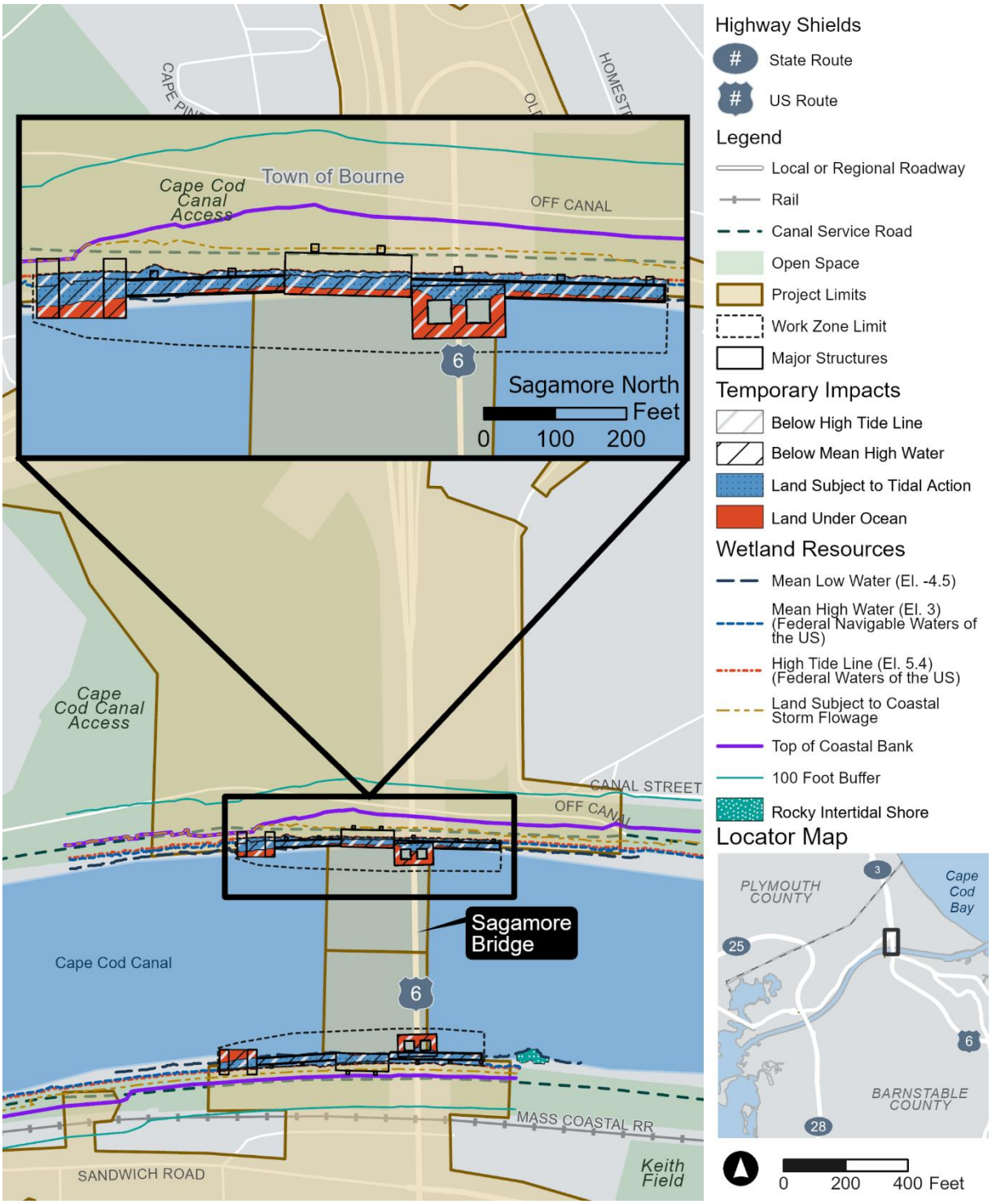
[12] Stantec Consulting Services Inc. 2020. Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment, MassDOT Project # 14-33419, Barnstable County, Massachusetts. Stantec Consulting Services Inc., Boston, Massachusetts. December.

[13] Massachusetts Division of Fisheries and Wildlife. 2009. Guidelines for the Certification of Vernal Pool Habitat (updated 2020). Massachusetts Division of Fisheries and Wildlife. Westborough, Massachusetts. March.

Permanent structures would include the new bridge piers and their foundations and riprap protection. The eelgrass beds within the Bourne North quadrant would be permanently impacted by the proposed pier protection riprap. **Figure 4.9-22 through Figure 4.9-25** show the permanent impacts to state and federal coastal resource areas.

Table 4.9-10 and **Table 4.9-11** summarize the potential temporary and permanent impacts to state and federal coastal resource areas for both bridges. Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report, Table 6-5 through Table 6-8,** for detailed assessments of these impacts by proposed activity for each bridge quadrant.

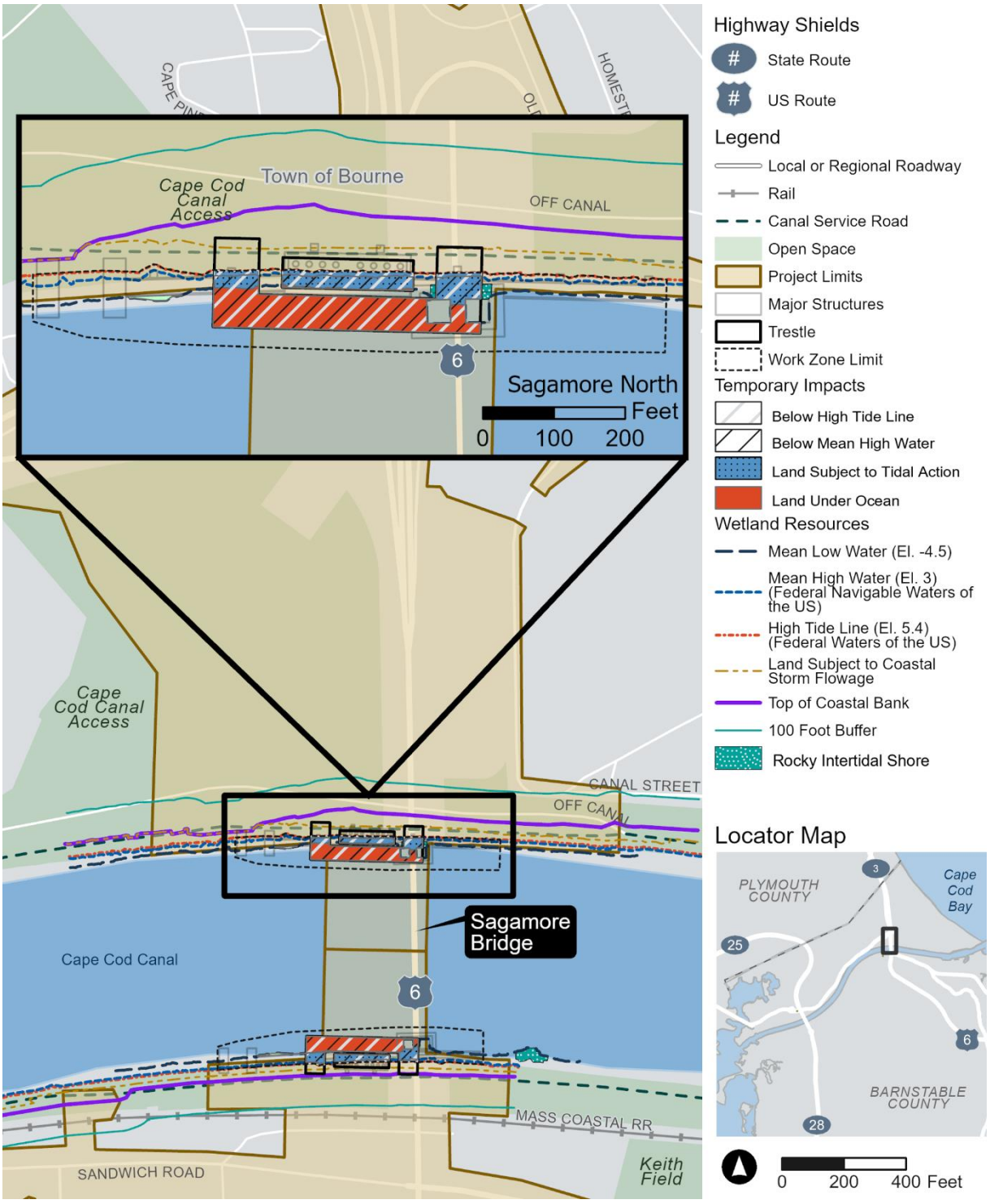
Figure 4.9-14. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

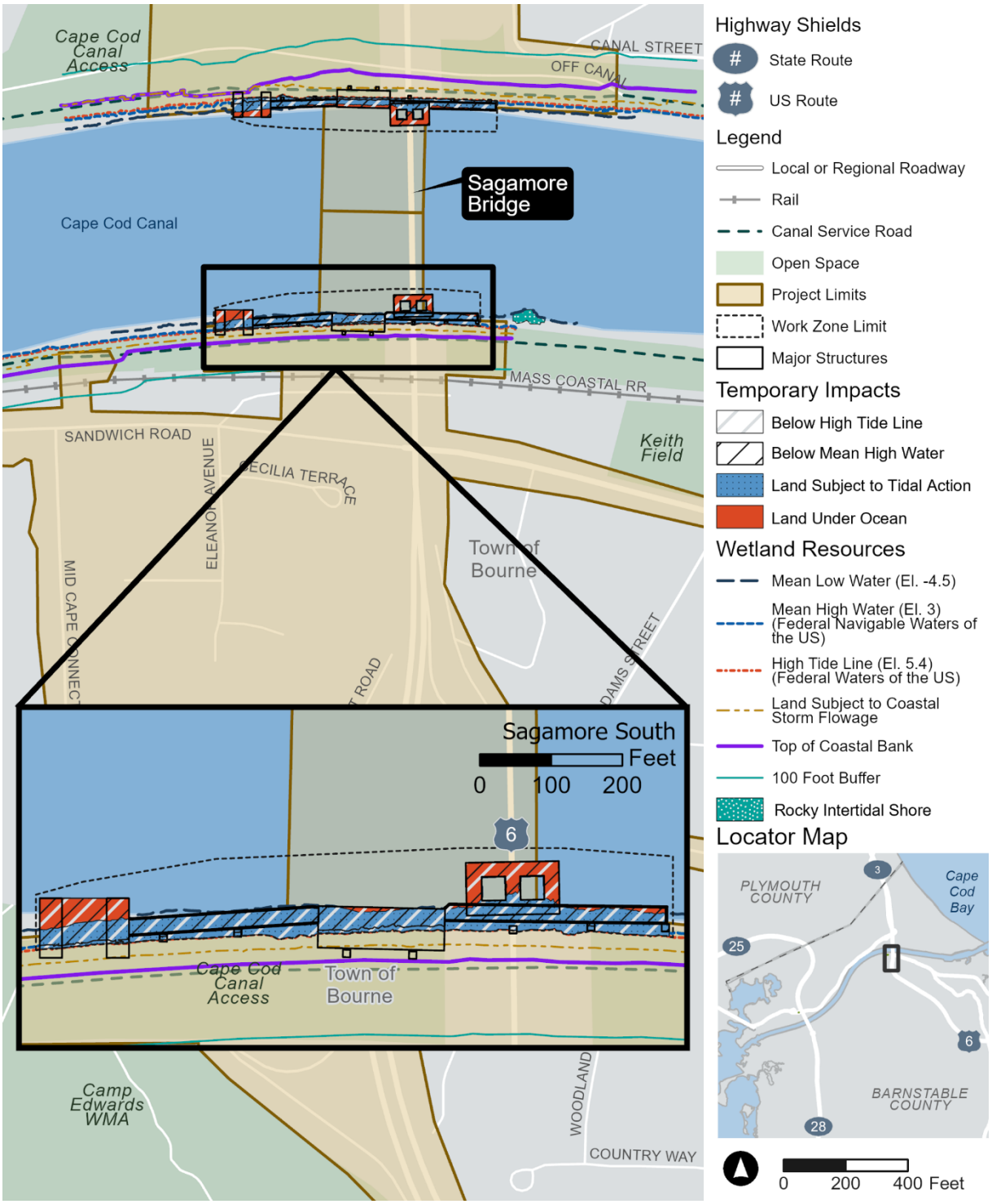
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging would be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 4.9-15. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

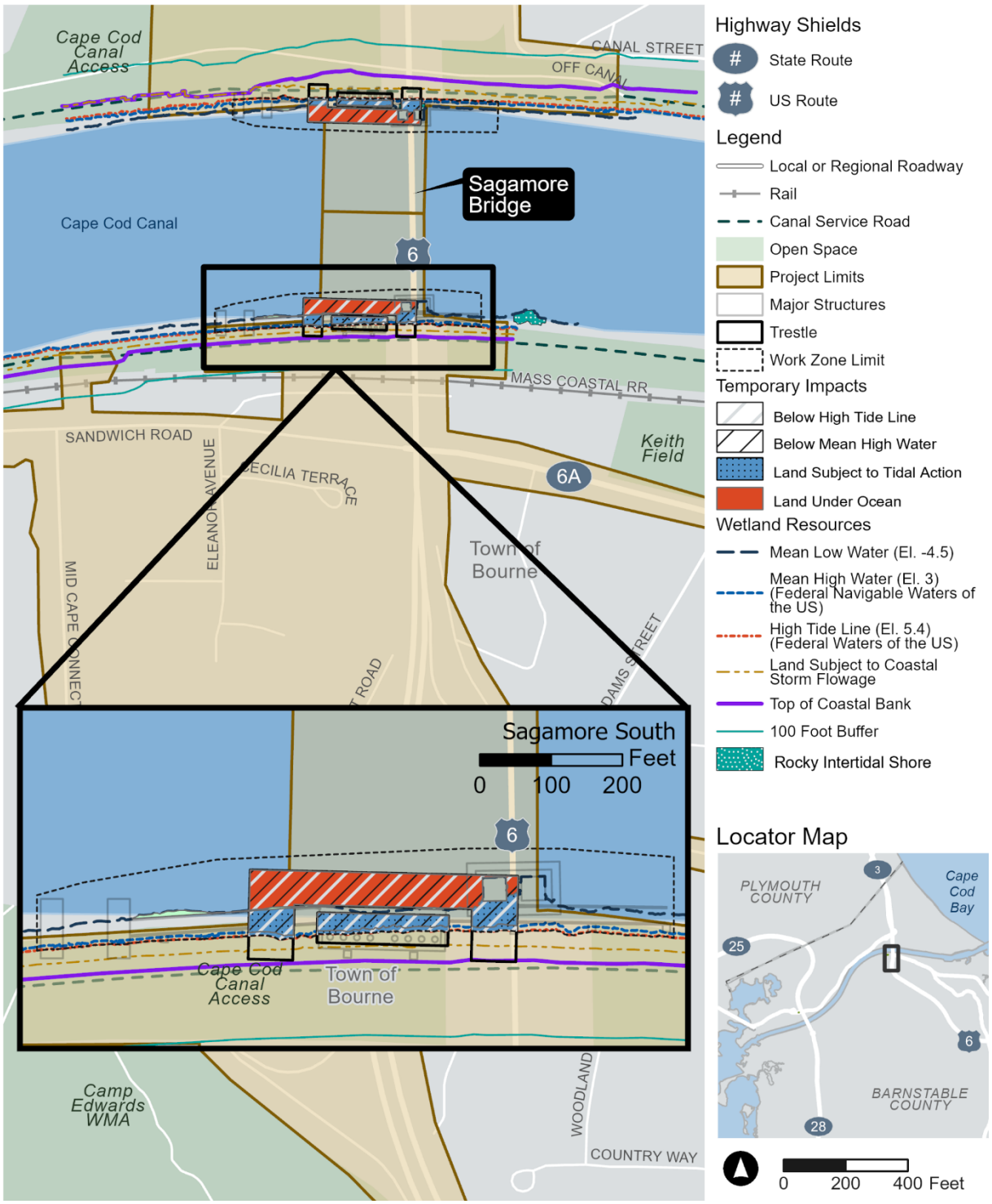
Figure 4.9-16. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2025

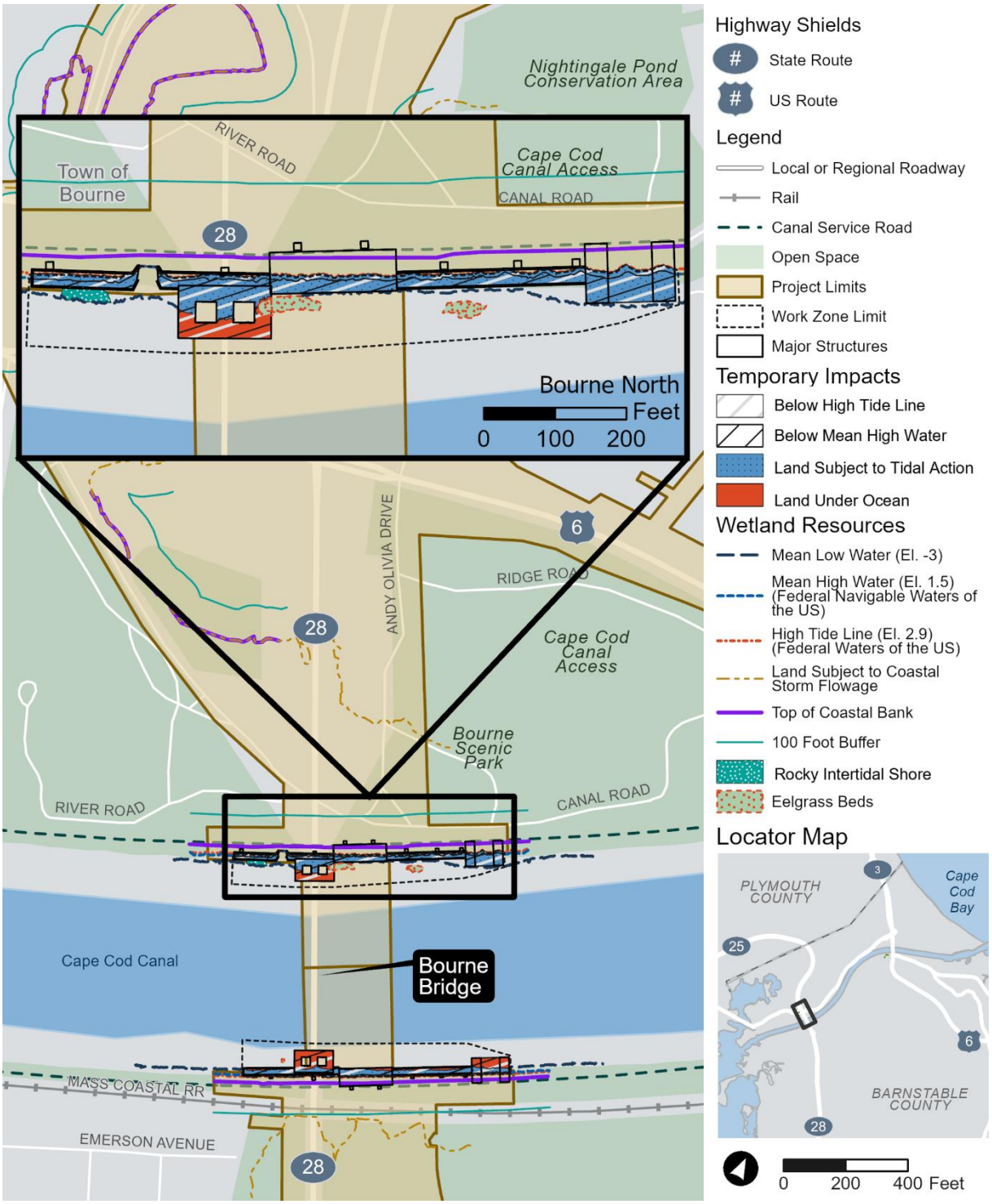
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging would be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 4.9-17. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Sagamore Bridge South)



Source: Massachusetts Department of Transportation, 2025

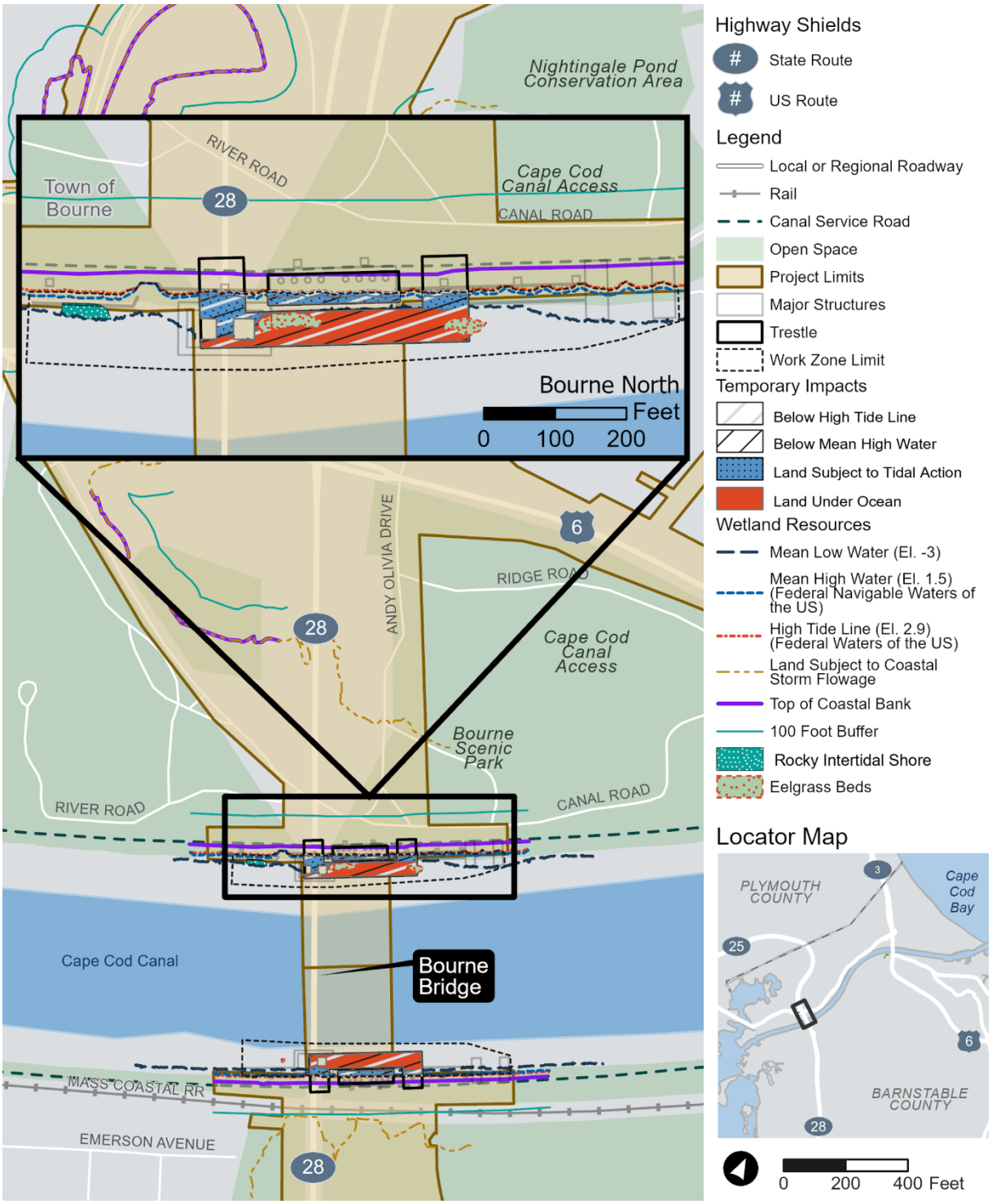
Figure 4.9-18. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

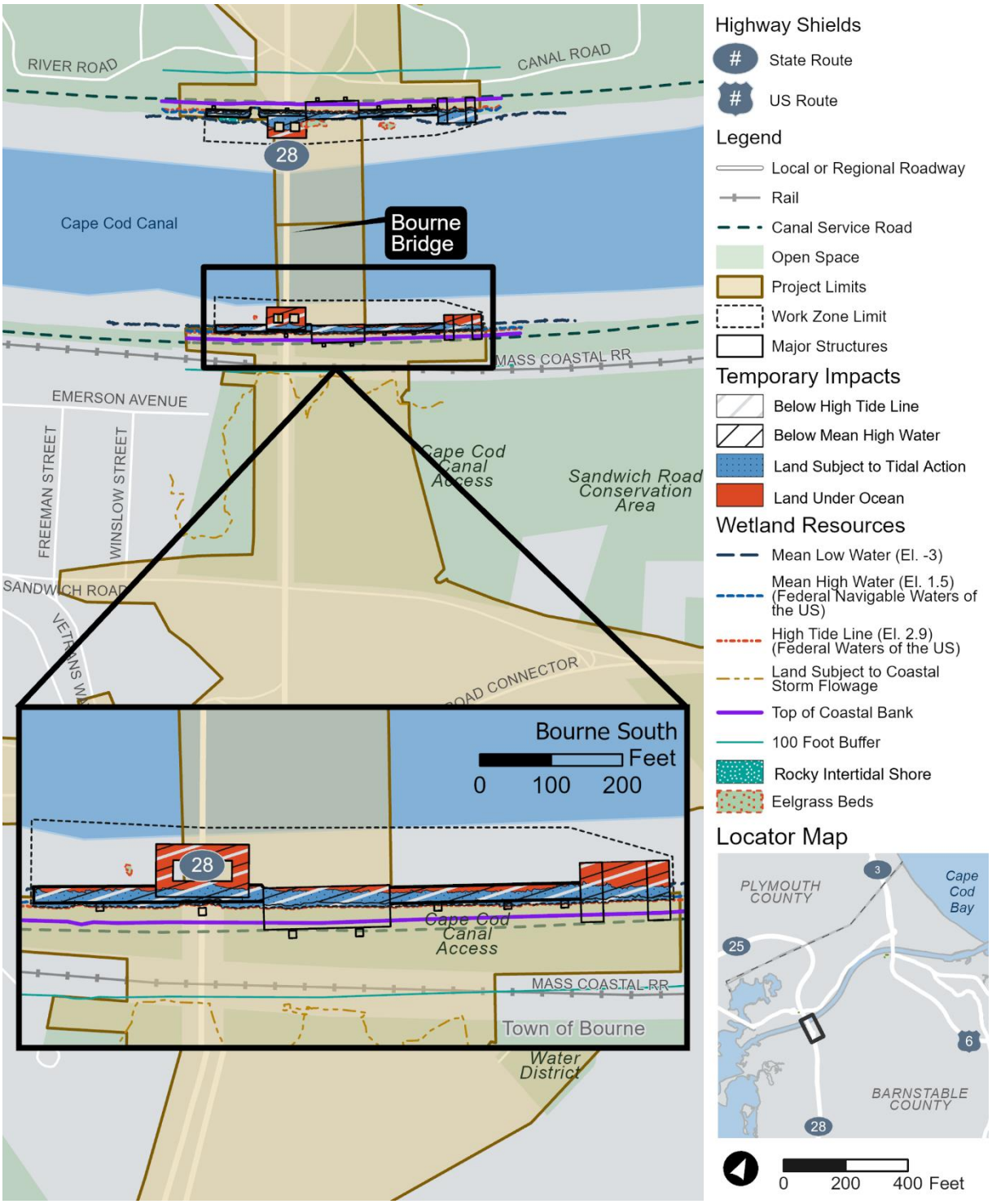
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging would be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 4.9-19. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

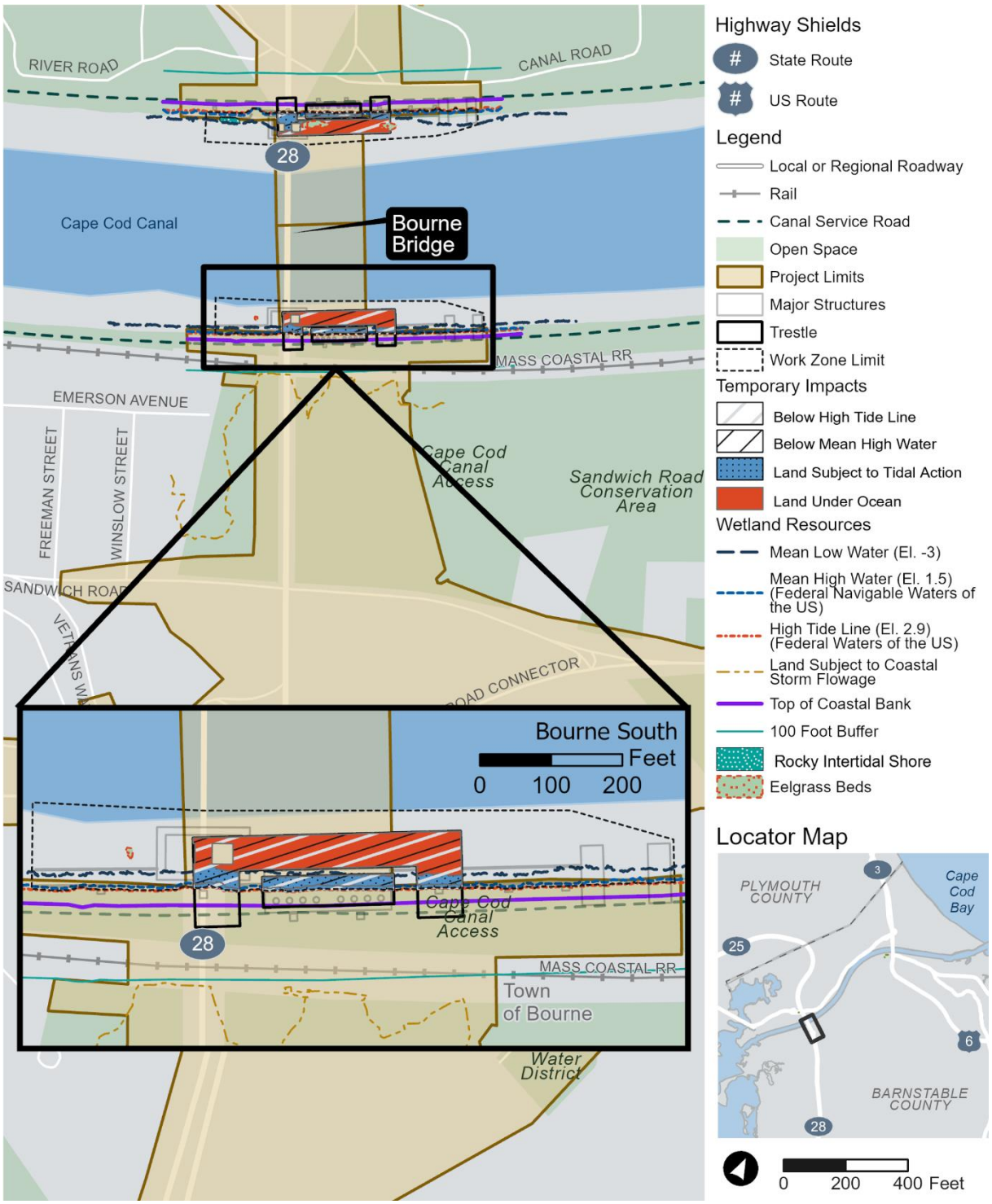
Figure 4.9-20. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

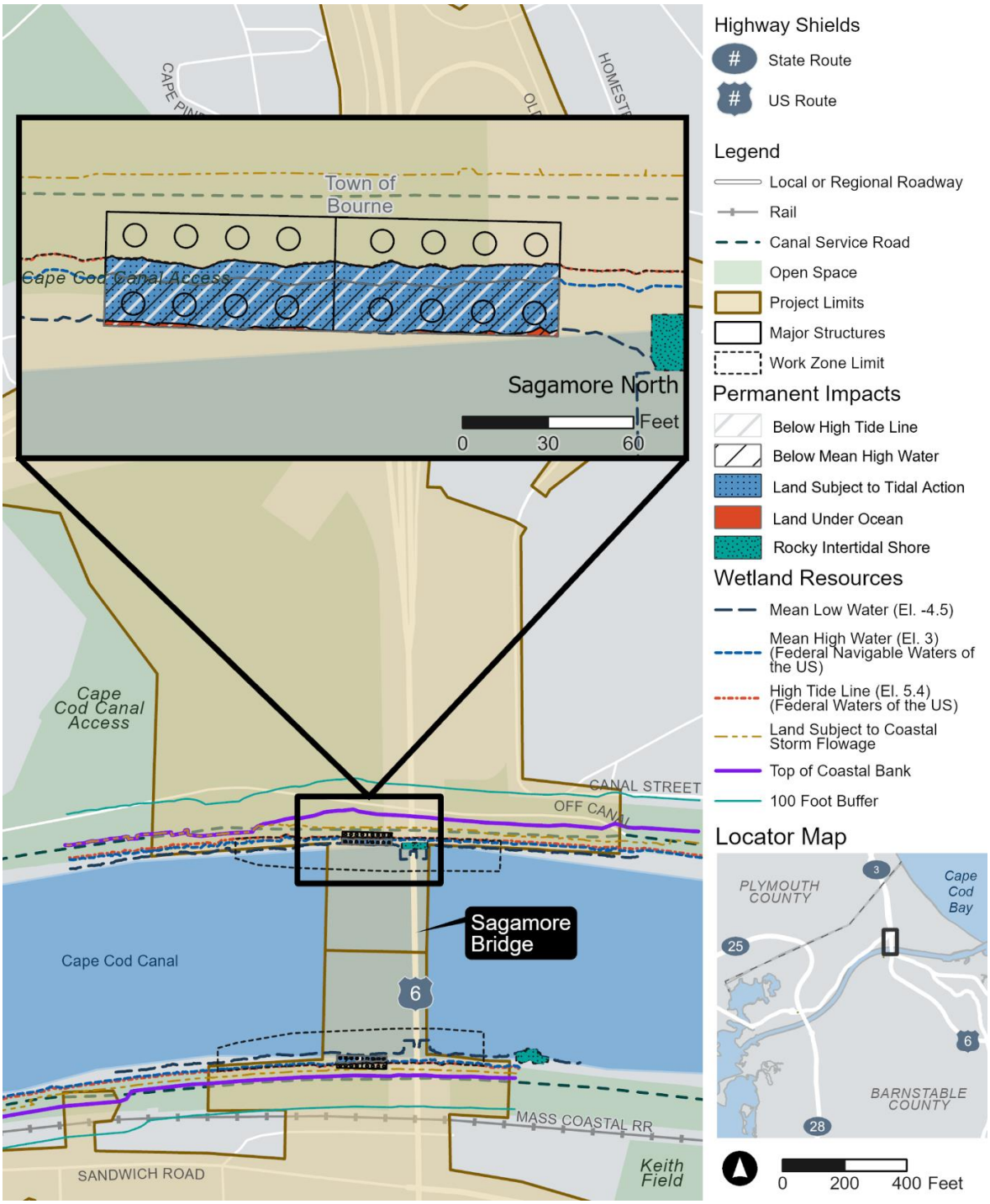
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging would be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 4.9-21. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

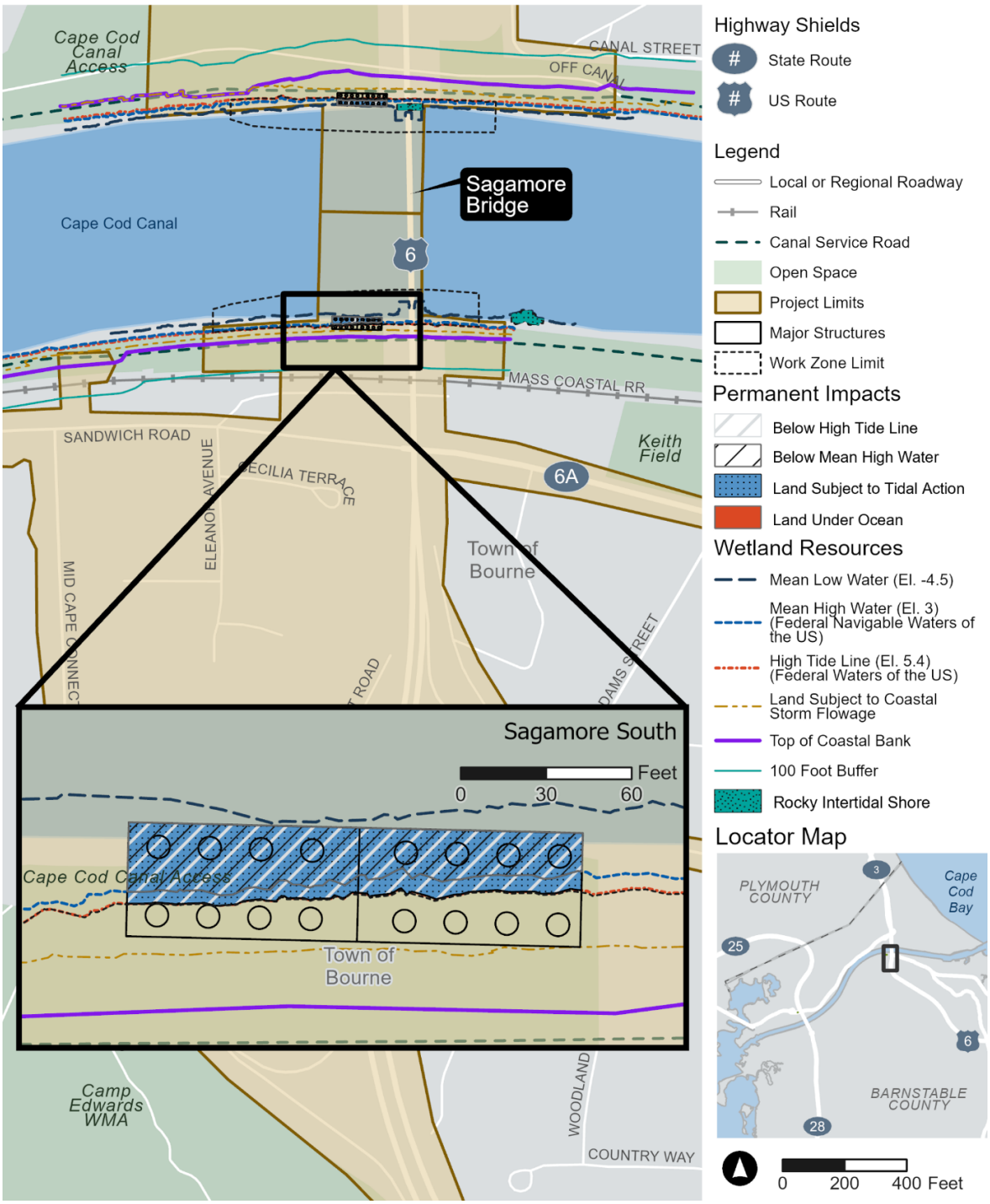
Figure 4.9-22. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection would occur below the high tide line; additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging would be required. The footprint for both will be developed during design advancement.

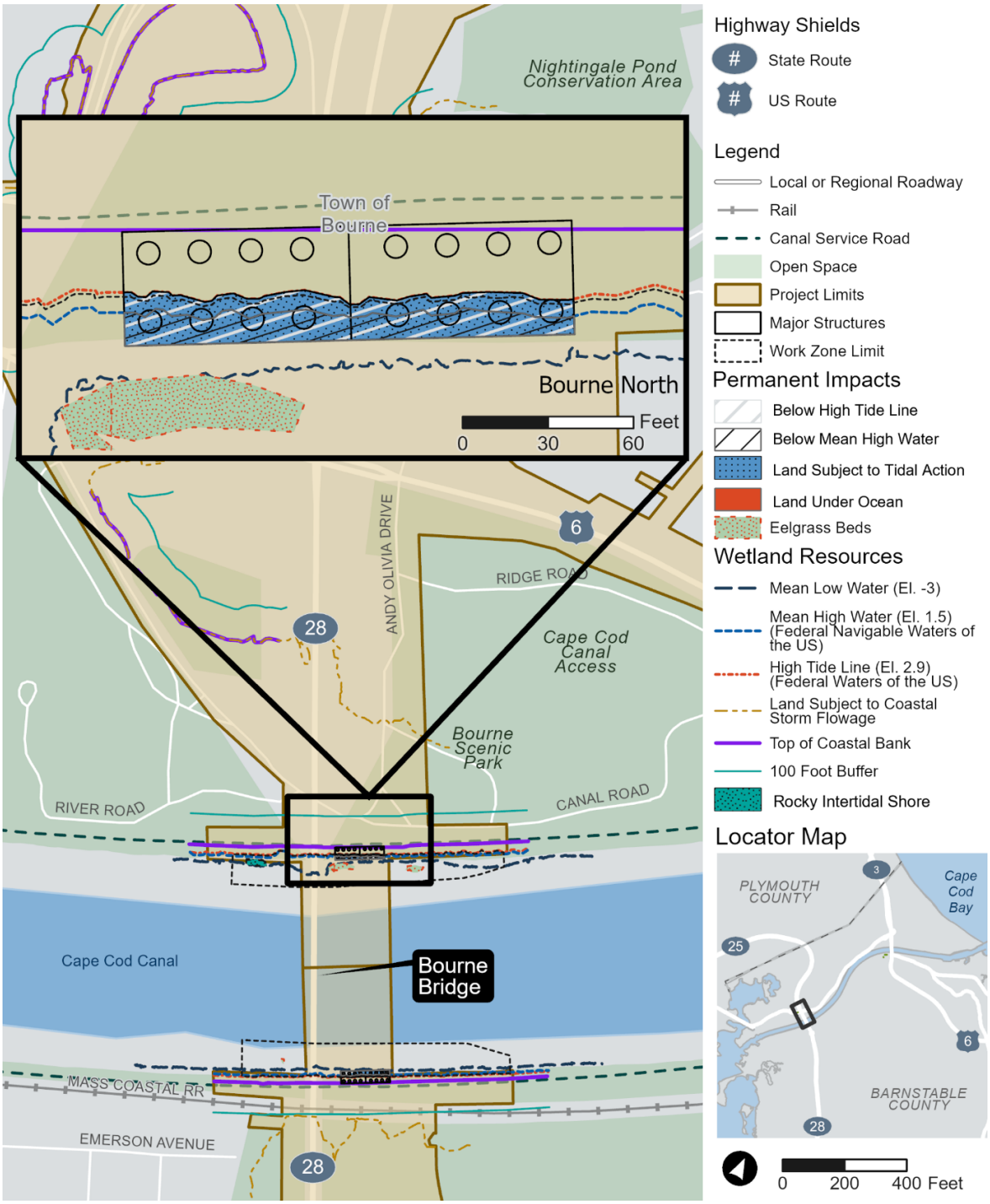
Figure 4.9-23. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection would occur below high tide line; additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging would be required. The footprint for both will be developed during design advancement.

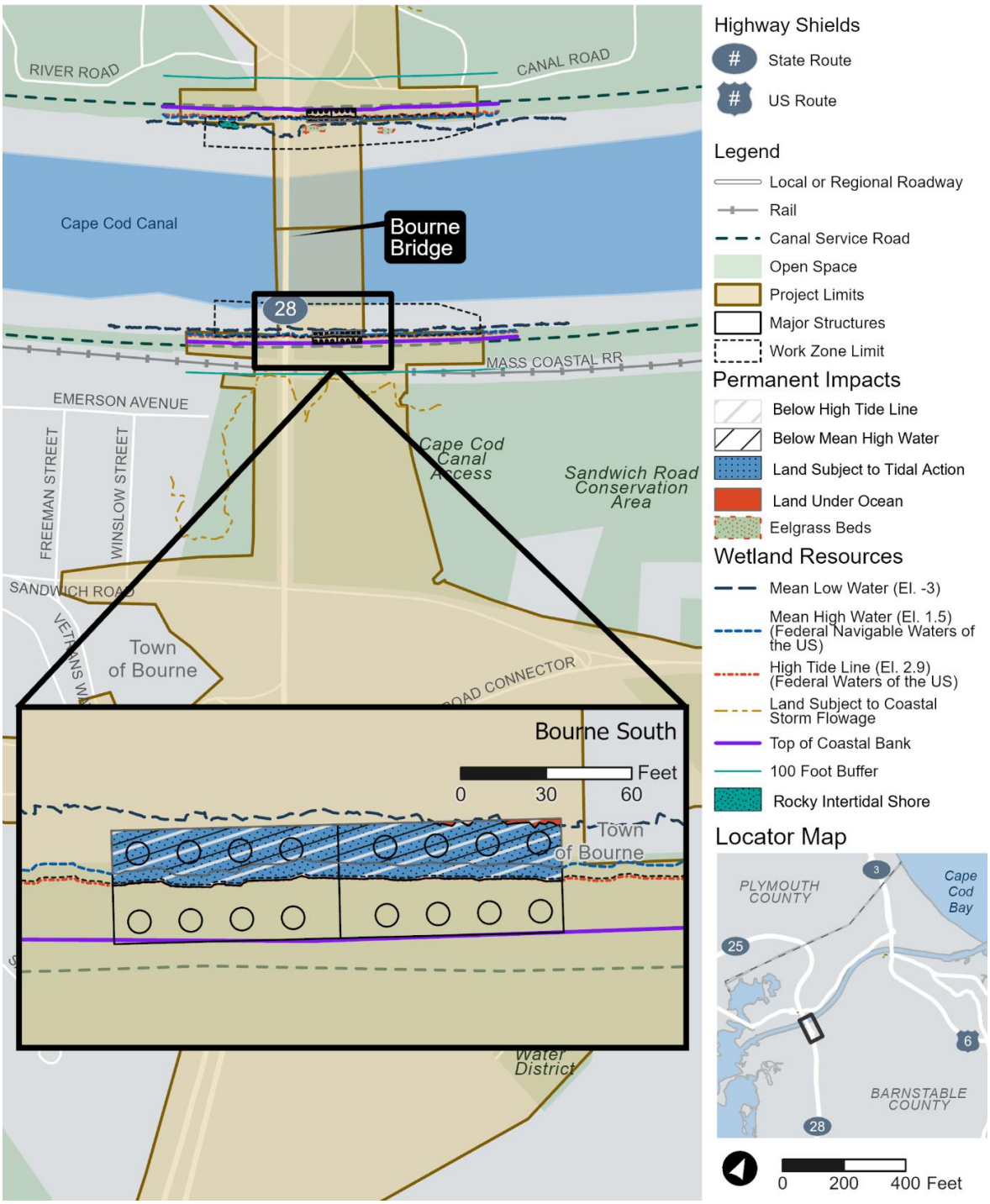
Figure 4.9-24. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection would occur below high tide line; additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging would be required. The footprint for both will be developed during design advancement.

Figure 4.9-25. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 sf of riprap for pier protection would occur below the high tide line; additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging would be required. The footprint for both will be developed during design advancement.

Table 4.9-10. Potential Impacts to State and Federal Coastal Resource Areas (Sagamore Bridge)

Resource Area		Temporary Impacts	Permanent Impacts	Reason for Impact[1]
Federal	Waters of the United States (WOTUS)	121,675 square feet (sf) (2.79 acres [ac])	54,035 sf (1.24 ac)	• Temporary: cofferdams, bulkheads, shoreline sheeting, trestles, bollards, docks, and dolphins • Permanent: new bridge piers and riprap pier protection
	WOTUS – (Excavation/ Dredge)	51,000/139,600 sf (1.17/3.20 ac) 28,000/39,000 cubic yards	Refer to note [1]	• Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal
State	Land Under Ocean	68,799 sf	38,523 sf	• Temporary: cofferdams, bulkheads, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap pier protection
	Coastal Bank	1,299 linear feet (lf)	420 lf	• Temporary: cofferdams, shoreline sheeting, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection
	Rocky Intertidal Shore	Refer to note [1]	1,652 sf	• Temporary: cofferdams and work trestle piles • Permanent: piers and riprap pier protection
	Land Subject to Tidal Action	52,876 sf	17,112 sf	• Temporary: cofferdams, shoreline sheet piles, bulkhead, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap pier protection
	Land Subject to Coastal Storm Flowage	—	6,900 sf	• Temporary: cofferdams, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection

[1] The Massachusetts Department of Transportation (MassDOT) is coordinating the design of the bridge pier protection system with the U.S. Army Corps of Engineers. As design advances, MassDOT will finalize the area of protection and quantities of riprap, which will be included in the Final Environmental Impact Statement and federal and state permit applications.

Table 4.9-11. Potential Impacts to State and Federal Coastal Resource Areas (Bourne Bridge)

Resource Area		Temporary Impacts	Permanent Impacts	Reason for Impact [1]
Federal	Waters of the United States (WOTUS)	119,730 square feet (sf) (2.75 acres [ac])	53,510 sf (1.23 ac)	• Temporary: cofferdams, bulkheads, shoreline sheeting, trestle, bollards, docks, and dolphins • Permanent: new bridge piers and riprap pier protection (includes 2,445 sf impact to eelgrass beds)
	WOTUS - dredge	51,000/139,600 sf (1.17/3.20 ac) 28,000/39,000 cubic yards	Refer to note [1]	• Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal
State	Land Under Ocean	71,296 sf	38,445 sf	• Temporary: cofferdams, bulkheads, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap pier protection
	Coastal Bank	1,300 linear feet (lf)	440 lf	• Temporary: cofferdams, shoreline sheeting, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection
	Rocky Intertidal Shore	1,167 sf	Refer to note [1]	• Temporary: bulkheads and excavation/dredge • Permanent: piers and riprap pier protection
	Land Subject to Tidal Action	47,267 sf	15,118 sf	• Temporary: cofferdams, shoreline sheet piles, bulkhead, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap
	Land Subject to Coastal Storm Flowage	Refer to note [1]	9,000 sf	• Temporary: cofferdams, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection

[1] Massachusetts Department of Transportation (MassDOT) is coordinating the design of the bridge pier protection system with the U.S. Army Corps of Engineers. As design advances, MassDOT will finalize the area of protection and quantities of riprap, which will be included in the Final Environmental Impact Statement and federal and state permit applications.

Floodplains

The construction of the westbound ramp from U.S. Route 6 to State Route 25 and auxiliary lane on State Route 25 would result in potential temporary impacts (9,760 square feet) and permanent impacts (2,960 square feet; 5,160 cubic feet) to the floodplains associated with Nightingale Pond (3-C). The new piers at both Sagamore and Bourne Bridges would result in 15,900 square feet of permanent impacts to the floodplain associated with riprap placement for pier protection in Cape Cod Canal.

Areas of Critical Environmental Concern

Within the Sagamore North quadrant approach interchange, Series 1-J BVW is mapped within the Herring River Watershed ACEC. There are no permanent or temporary impacts proposed within Wetland 1-J.

Within the Bourne South quadrant approach interchange area, the Bourne Back River ACEC is mapped on the west side of the State Route 28 southbound travel lane and extends 15 feet east into the median. The Project Limit is approximately 1,200 feet north of the ACEC limit within State Route 28 southbound. Therefore, no temporary or permanent impacts are proposed within the Bourne Back River ACEC.

4.9.4.2 Indirect Effects

Indirect effects are those effects which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include related effects on air and water and other natural systems, including ecosystems. There are no indirect effects to inland wetlands or coastal resource areas that would result in changes to the functions and values in terms of the overall wetland hydrology, or fragmentation. The Build Alternative impacts would not result in isolated fragments of wetlands or waterways. Potential indirect effects include the unintended introduction of invasive plant species.

4.9.4.3 Operation-Term Impact Assessment

Once the highway approaches and bridges are constructed, operation-term impacts would be limited to the maintenance of Build Alternative components including the stormwater management system. The stormwater management system would be maintained in accordance with the Build Alternative-specific Operations and Maintenance Plan, which would include good housekeeping and pollution prevention measures to minimize sediment from reaching receiving waters during operations. Refer to **Section 4.10** for additional details pertaining to water quality and stormwater management.

4.9.4.4 Summary

Construction of the Bourne North quadrant interchange approach would result in temporary and permanent impacts to inland wetland resources. Construction of both bridges would result in temporary and permanent impacts to coastal wetland resources. Indirect impacts resulting from construction may include the unintended introduction of invasive plant species. Operation-term impacts would be limited to the maintenance of project components including the stormwater management system.

Temporary impacts to inland wetland resources are limited to wetland 3-C while permanent impacts would occur to wetland resources 3-C, 3-E, and 3-H/I/Q, all located in the Bourne North quadrant.

The primary functions of wetland 3-C, an approximately seven-acre waterbody, are fish and wildlife habitat. The total temporary and permanent impacts represent approximately one percent of the resource area and occur along its outer fringe. The temporary impacts would be restored in place and permanent impacts would be compensated through creation of an additional waterbody, approximately 2.4 times larger than the impact area, adjacent to the impact area (refer to **Section 4.9.5**).

The primary functions of wetlands 3-E and 3-H/I/Q are groundwater recharge/discharge and wildlife habitat. These vegetated wetlands occur on opposite sides of a road from each other but are connected by a culvert. The total permanent impacts to these wetlands represent approximately 3.6 percent of these resource areas and occur along the outer fringe of these resources. The permanent impacts will be compensated through creation of additional vegetated wetland, approximately 1.5 times larger than the impacts, adjacent to wetland 3-H/I/Q (refer to **Section 4.9.5**).

Because temporary impacts will be restored and additional wetland resources in excess of the permanent impacts will be created, the loss of wetland resources is considered short-term. Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report.**

A Biological Assessment has been prepared for the Program's effects on marine species which may utilize the wetland resource areas that would be impacted by the Program. This assessment concluded that all effects of the Program, when added to baseline conditions and accounting for the proposed conservation and mitigation measures discussed in **Section 4.11, Threatened, Endangered, and Protected Species and Habitats**, are too small to be meaningfully measured or detected and, therefore, are considered insignificant or are extremely unlikely to occur.

MassDOT submitted a final Essential Fish Habitat Assessment and Wildlife Coordination Act Consultation Worksheet on March 6, 2025, incorporating NOAA Fisheries' Essential Fish Habitat Conservation Recommendations and proposing an approach to compensatory mitigation of affected submerged aquatic vegetation. On March 12, 2025, MassDOT provided written concurrence with NOAA Fisheries' recommendation and committed to measures to avoid, minimize, and mitigate impacts to Essential Fish Habitat, consistent with NOAA Fisheries' recommendations. Refer to **Section 4.11** for more information.

4.9.5 Compensation

4.9.5.1 Requirements and Guidance

State Resources

For any impacts that are unable to be avoided or minimized, the MA WPA regulations contain performance standards for each resource area, intended to ensure protection of their functions and values. The performance standards require that projects first seek to avoid and minimize impacts to wetland resource areas, and where impacts are unavoidable, ensure no adverse effects on the interests protected by the WPA such as flood control, water quality, and wildlife habitat. Refer to

Appendix 4.9, Wetlands and Floodplains Technical Report, Attachment 2 for a discussion of the Program's conformance with performance standards of the MA WPA regulations.

Federal Resources

After practicable measures have been taken to avoid and minimize impacts to WOTUS, Section 404(b)(1) of the federal CWA requires compensation for unavoidable, permanent impacts to WOTUS. Compensation for permanent impacts would be provided through Permittee-responsible mitigation in the form of vegetated wetland creation within the Wetlands and Floodplains Study Areas along with participation in the Massachusetts Department of Fish and Wildlife's In-Lieu Fee Program. Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report, Section 9** to review how the Build Alternative would conform to the performance standards of the CWA for impacts associated with dredge and fill.

4.9.5.2 Mitigation for Impacts to State and Federal Inland Wetland Resource Areas

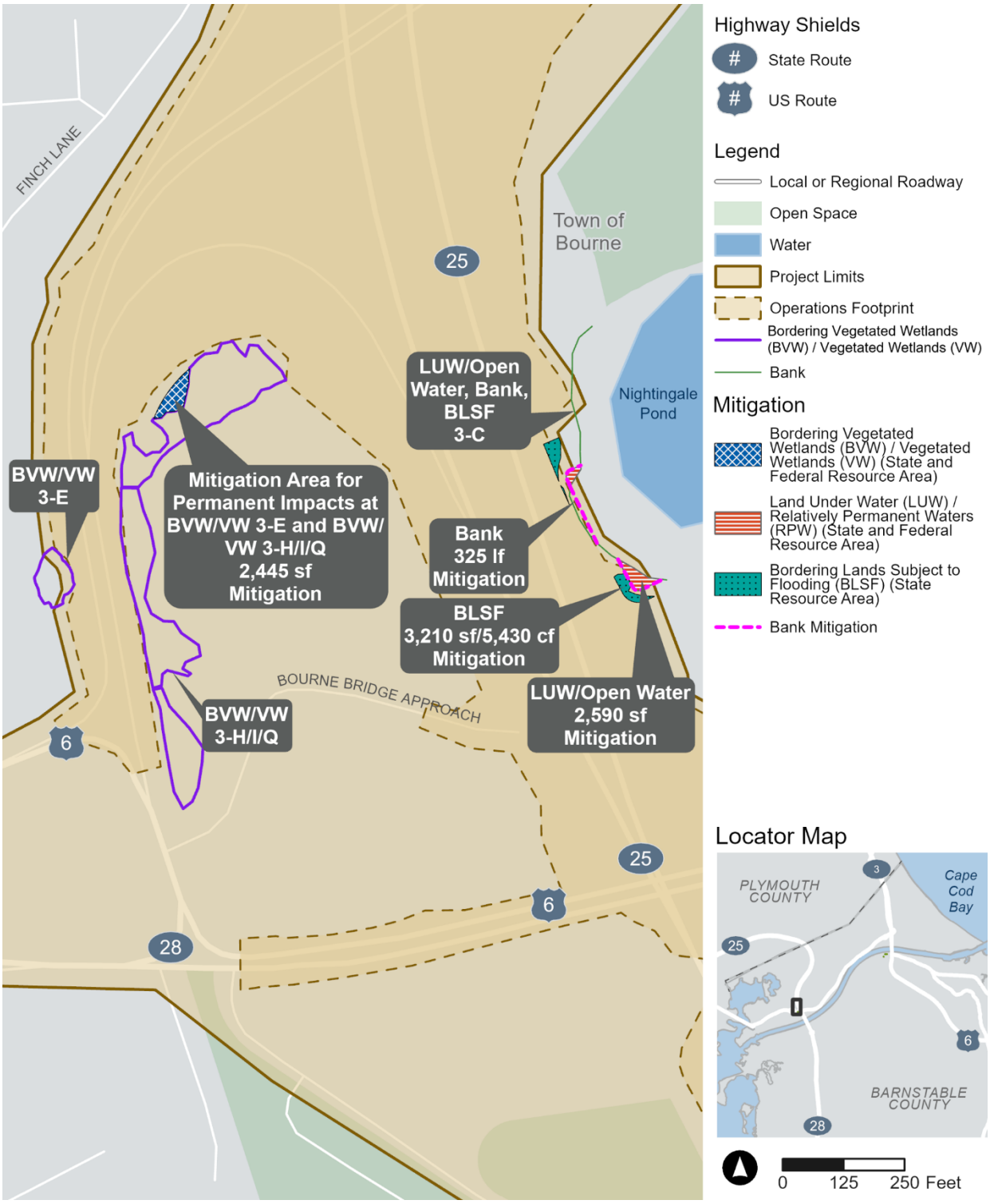
Compensation for Permanent Impacts

Figure 4.9-26 illustrates and **Table 4.9-12** summarizes the proposed on-site compensation for permanent impacts to inland resources. Refer to **Appendix 4.9, Wetlands and Floodplains Technical Report, Section 8.2,** for details on the Build Alternative's mitigation program.

Compensation for Temporary Impacts

Upon completion of construction, temporary impacts to wetland resources associated with Nightingale Pond will be compensated through in-kind restoration.

Figure 4.9-26. Potential On-site Compensation for State and Federal Inland Wetlands



Source: Massachusetts Department of Transportation, 2025

Table 4.9-12. Potential On-site Compensation for Permanent Impacts to Inland Wetlands

Wetland Series ID[1]	State Resource		Federal Resource		Impact to Compensation (Creation) Ratio
	Impact Type and Extent	Compensation	Impact Type and Extent	Compensation[2]	
3-E	Bordering Vegetated Wetland (BVW) 410 square feet (sf)	BVW 615 sf	Vegetated Wetland (VW) 410 sf	VW/615 sf	1:1.5
3-H/I/Q	BVW 1,630 sf	BVW 2,445 sf	VW 1,630 sf	VW/2,445 sf	1:1.5
3-C (Nightingale Pond)	Bank 285 linear feet (lf)	Bank 325 lf	Not applicable (N/A)	N/A	1:1.1
	Land Under Water (LUW) 1,065 sf	LUW: 2,590 sf	Relatively Permanent Water (RPW) 2,590 sf	N/A	1:2.4
	Bordering Land Subject to Flooding (BLSF) 2,130 cubic feet (cf)/2,960 sf	BLSF 3,210 sf/5,430 cf	N/A	N/A	1:2.5

[1] As identified in the ANRAD[14] and additional field investigations.

[2] In addition to creation of vegetated wetland, credits would be purchased through the Massachusetts Department of Fish and Wildlife In-Lieu Fee Program.

4.9.5.3 Compensation for Impacts to State and Federal Coastal Resource Areas

Compensation for Permanent Impacts

The removal of the existing bridge piers would result in the restoration of approximately 6,400 square feet of Navigable WOTUS and Land Under Ocean. Compensation for net impacts to federal and state resource areas will be coordinated with the USACE and Massachusetts Department of Environmental Protection and presented in the Final Environmental Impact Statement.

Compensation for Temporary Impacts

Temporary impacts to state and federal coastal resource areas will be compensated through in-kind restoration and natural reestablishment.

[14] HNTB Corporation. December 2021 and April 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts.

4.9.5.4 Construction-Term Mitigation Measures

Construction-related pollutants, stormwater runoff, and dewatering activities may affect wetland resource areas. The potential impacts would be avoided and minimized through the development and implementation of a Stormwater Pollution Prevention Plan, required pursuant to the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities.

For conformance with Executive Order 13112, the contract would include specifications for the management and disposal of soil and plant material and prevention of the spread of invasive species via equipment.