Cape Cod Bridges Program

Bourne, Massachusetts

Appendix 4.6
Land Use, Zoning, and Community Cohesion Technical Report

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ACEC	Areas of Critical Environmental Concern
EPA	U.S. Environmental Protection Agency
LCP	The Town of Bourne Local Comprehensive Plan
MassDOT	Massachusetts Department of Transportation
NEPA	National Environmental Policy Act
Program	Cape Cod Bridges Program
RPP	Cape Cod Regional Policy Plan
SSA	sole source aquifer
SUP	shared-use path
SWPPP	Stormwater Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers

1 Introduction

This Land Use, Zoning, and Community Cohesion Technical Report has been prepared in support of the Final Environmental Impact Statement for the Cape Cod Bridges Program (Program), in accordance with the following federal and state statutes, regulations, and guidance:

- National Environmental Policy Act (NEPA) of 1969, as amended, 42 United States Code (USC) 4321 et seq.
- *Efficient Environmental Reviews for Project Decisionmaking and One Federal Decision,* 39 USC 139.
- Federal Highway Administration's regulations implementing NEPA, *Environmental Impact and Related Procedures* (23 Code of Federal Regulations 771), and corresponding guidance, Technical Advisory (T 6640.8A): *Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (October 30, 1987).

2 Summary of Findings

2.1 Affected Environment

The affected environment of the Bourne and Sagamore Bridge Land Use Study Areas encompasses a mix of residential, commercial, industrial, institutional, park/open space, and transportation/ impervious land uses, as well as natural features. Both Study Areas primarily comprise park/open space, residential, and transportation land uses.

Zoning in both areas reflects a diverse range of designations, with Residential Districts prominently represented, followed by Government, Business, and Scenic Development Zones, particularly around Cape Cod Canal. Notably, the Bourne Bridge area includes a Downtown Overlay District with varied classifications for mixed-use development.

Key local and regional master plans relevant to the Study Areas, including the Town of Bourne's Local Comprehensive Plan and the Cape Cod Regional Policy Plan, emphasize the preservation of open space, cultural heritage, and the protection of historical and natural resources, aligning with zoning and land use strategies to maintain the region's character while accommodating growth.

2.2 No Build Alternative

For the No Build Alternative, the bridges would be maintained in their current alignments, and no changes to land use or development patterns would occur. The No Build Alternative would not result in direct changes to land use or development patterns but may have indirect effects on quality of life and community cohesion for existing neighborhoods in the Study Areas. Also, the No Build Alternative would not advance the goals and objectives identified in local and regional land use policies and plans.

2.3 Build Alternative

For the Build Alternative, the new alignment and the areas needed for construction staging and the demolition of the existing bridges and interchange improvements would result in unavoidable temporary and permanent property effects, resulting in permanent land use changes. Massachusetts Department of Transportation (MassDOT) proposes to mitigate for these effects by providing a buffer area to separate residential areas from the transportation land uses. In addition, the Build Alternative would strengthen overall community cohesion and provide quality-of-life benefits for existing neighborhoods through improved access, mobility, and connectivity throughout the Study Areas. Refer to **Section 7, Mitigation Measures,** for additional details.

2.4 Mitigation

Mitigation strategies for the Build Alternative address several potential land alteration and community cohesion effects. For land alteration**,** a substantial landscaping plan will be implemented for temporarily disturbed areas to repair, restore, and enhance the landscape flanking the mainline highways, bridges, and local roads and connections (refer to **Appendix 3.2, Attachment 5, Landscaping Plans**). A Stormwater Pollution Prevention Plan (SWPPP) will manage construction effects, including sediment controls, construction phasing, and erosion prevention, while a stormwater treatment system will handle operational effects using green infrastructure like rain gardens and infiltration basins. For community cohesion, all existing pedestrian and bicycle accommodations and routes as well as access to community facilities in the Study Area will be maintained during construction. Temporary, construction-period connections for pedestrians and bicyclists are provided in **Appendix 3.2, Attachment 4, Construction Schematics**. Clear signage and mapping will be provided for alternative routes during the temporary closure of the Canal Service Road as part of the construction effort. The Build Alternative would result in a reduction in regional traffic on local roads and improved neighborhood accessibility to support community cohesion.

3 Proposed Action and Alternatives

3.1 Purpose and Need

In partnership with the Federal Highway Administration and the New England District of the U.S. Army Corps of Engineers (USACE), MassDOT proposes advancing the Program in the town of Bourne, Barnstable County, Massachusetts.

The purpose of the Program is to improve cross-canal mobility and accessibility between Cape Cod and mainland Massachusetts for all road users and to address the increasing maintenance needs and functional obsolescence of the aging Sagamore Bridge and Bourne Bridge (also known as the Cape Cod Canal highway bridges).

The needs for the Program are as follows:

- Address the deteriorating structural condition and escalating maintenance demands of Sagamore Bridge and Bourne Bridge.
- Address the substandard design elements of Sagamore Bridge and Bourne Bridge, the immediate mainline approaches, and their adjacent interchanges and intersections.
- Improve vehicular traffic operations.
- Improve accommodations for pedestrians and bicyclists.

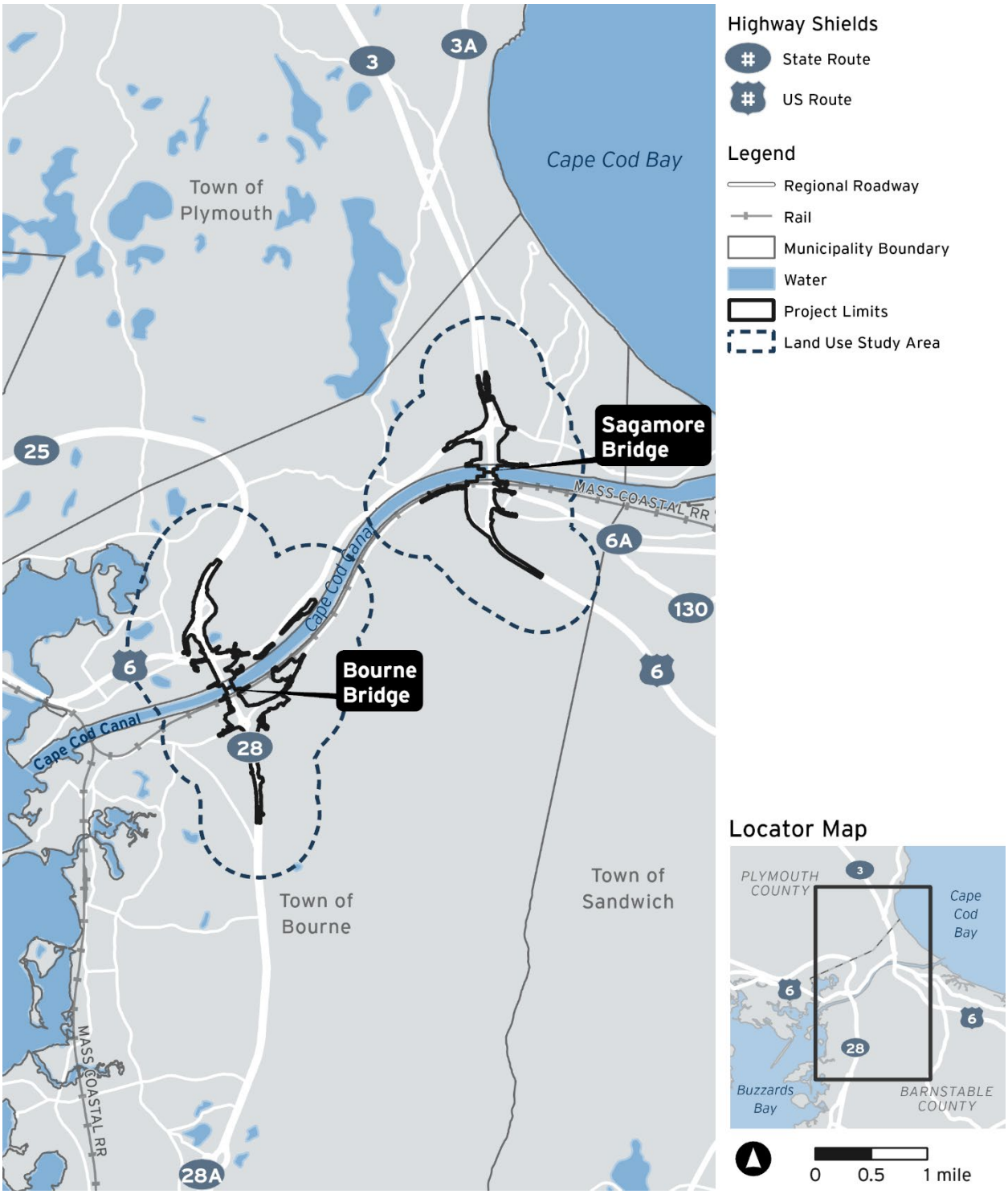
3.2 Study Area

For the purposes of this analysis, the Bourne Bridge Study Area and Sagamore Bridge Study Area are collectively referred to as the "Study Areas." The Land Use Study Areas consists of 0.5-mile buffers from the construction limits for the Build Alternative at Sagamore Bridge and Bourne Bridge. **Figure 3.3-1** reflects the refined Project Limits and Study Areas. MassDOT defined these Study Areas to evaluate the direct and indirect effects of the Build Alternative on land use proximate to the Build Alternative. "Direct effects" are caused by the action and occur at the same time and place, whereas "indirect effects" are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.

3.3 Build Alternative

The Build Alternative would incorporate USACE's Major Rehabilitation Evaluation Report and Environmental Assessment's (MRER/EA) preferred alternative of replacing both highway bridges with new bridges, each with four through-travel lanes and two auxiliary lanes (in-kind bridge replacement that would be updated to comply with federal and state highway and design safety standards). The Program proposes to replace Sagamore Bridge and Bourne Bridge with parallel, twin tied-arch bridge structures that would be supported on delta frames with an approximate 700-foot mainline span length. At both the Bourne Bridge and Sagamore Bridge crossings, the replacement mainline alignment locations would be offline and inboard of the existing bridges on the side of the canal between the bridges. At both canal crossings, the Program would reconfigure the highway interchange approach networks north and south of Cape Cod Canal to align with the replacement bridges. The replacement bridges and their interchange approaches would accommodate shared-use pedestrian and bicycle paths that would connect to the local roadway network on both sides of Cape Cod Canal in the town of Bourne.

Figure 3.3-1. Land Use Study Areas



Source: Massachusetts Department of Transportation, 2025

Table 3.3-1 presents a description of the Program elements/design parameters of the recommended Build Alternative: Replacement Highway Bridges Built to Modern Design Standards (Preferred Alternative).

Table 3.3-1. Cape Cod Bridges Program Preferred Alternative

Program Element/ Program Design Parameter	Description
Highway Bridges	Replacement of both highway bridges with new bridges with four through-traffic lanes and two auxiliary lanes (in-kind bridge replacement updated to comply with federal and state highway and design safety standards).
Highway Bridge Cross-Section and Shared-Use Path	Each replacement highway bridge span would provide two 12-foot-wide through-travel lanes (one in each direction), one 12-foot-wide entrance/exit (auxiliary) lane, a 6-foot-wide median shoulder, and a 12-foot-wide exterior shoulder. Each crossing location would include one bidirectional pedestrian and bicycle shared-use path, separated from vehicular traffic by the shoulder and barrier. The usable width of the shared-use path would be 14 feet wide on the bridge main spans, 20-feet-wide on the interchange approaches, and 12 feet wide on the connecting roadways.
Bridge Vertical and Horizontal Clearances	The replacement bridges would maintain the existing vertical clearance of 135 feet above mean high water and account for 3.3 feet of fluctuations in relative sea level, thereby providing a vertical clearance of 138.3 feet above mean high water. The replacement bridges would provide a minimum of 500 feet of horizontal channel width consistent with the authorized navigational channel width and existing conditions.
Main Span Length and Bridge Pier Location	The replacement bridges would have a main span length of 720 feet, which would locate the bridge piers at the waterline adjacent to the service road (shoreline piers) into the riprap slope but above the low tide line.
Bridge Deck Configuration	Each bridge (Sagamore and Bourne) would have two separate decks (twin structures).
Mainline Alignment	The mainline alignment locations at both bridges would be offline inboard. Both spans of the replacement highway bridges would be outside the footprint of the existing bridge, 7 feet apart and parallel to each other (offline), and on the side of the Cape Cod Canal between the existing bridges (inboard). The replacement main spans at the Sagamore crossing would be west of existing Sagamore Bridge toward Buzzards Bay. The replacement main spans at the Bourne crossing would be east of existing Bourne Bridge toward Cape Cod Bay.
Bridge Type	The replacement bridges would be steel twin network tied-arch bridges with delta frames supporting a 720-foot mainline span.

Program Element/ Program Design Parameter	Description
Interchange Approach Network	Interchange approach improvements at each bridge would be as follows: • Sagamore Bridge Crossing: Direct connection to State Road in the Sagamore North quadrant and Westbound On-Ramp Under U.S. Route 6 with Sandwich Road Extension in the Sagamore South quadrant • Bourne Bridge Crossing: Directional Interchange in the Bourne North quadrant and a Diamond Interchange in the Bourne South quadrant
Interchange Approach Network: Sagamore North Quadrant	The selected interchange approach option for the Sagamore North quadrant is: Direct Connection to State Road (Option SN-8A). Option SN-8A would provide a single exit point from a relocated U.S. Route 6/State Route 3. It would remove the Sagamore Bridge northbound off-ramp connection to Scenic Highway/Meetinghouse Lane eastbound, and instead it would connect to State Road, north of Scenic Highway/Meetinghouse Lane. The remaining ramp connections would remain similar to existing conditions with geometric adjustments to meet the new mainline location. A double roundabout would replace the signalized intersection of Scenic Highway/Meetinghouse Lane/State Road/Canal Street. Signalized intersections along Scenic Highway would be modified for new lane configurations. The intersection of State Road at State Route 3 northbound on-ramp would be modified to accommodate the addition of the new State Route 3 northbound off-ramp with installation of a traffic signal. Option SN-8A would provide a shared-use path on the U.S. Route 6 eastbound main span that would provide connections to the south side of Scenic Highway, Canal Street, and Canal Service Road. This option would provide shared-use paths along the southern side of Scenic Highway and Meetinghouse Lane, as well as along the eastern side of State Road to Homestead Avenue and Canal Street to Bourne Park and Ride.

Program Element/ Program Design Parameter	Description
Interchange Approach Network: Sagamore South Quadrant	The selected interchange approach option for the Sagamore South quadrant is: Westbound On-Ramp Under U.S. Route 6 with Sandwich Road Extension (Option SS-3.1A). Option SS-3.1A would include Cranberry Highway Extension and would relocate the westbound on-ramp so it would share the same entrance point as the eastbound on-ramp off Mid-Cape Connector. Modifications to lane arrangements at the intersections of Mid-Cape Connector with Sandwich Road and Cranberry Highway Extension would accommodate the revised traffic patterns resulting from the extension of Cranberry Highway and the relocation of access to U.S. Route 6 (Scenic Highway) eastbound, including modifications to the existing traffic signals. There would be a connection from Cranberry Highway to Sandwich Road east of the new mainline bridge (Sandwich Road Connector). A roundabout would be provided at the intersection of the U.S. Route 6 westbound off-ramp with Cranberry Highway. An additional roundabout would be provided along Cranberry Highway providing access to Market Basket (Factory Outlet Road). There would be an access driveway to the former Christmas Tree Shops area. Option SS-3.1A would include a shared-use path on the U.S. Route 6 eastbound main span that would provide connections to Factory Outlet Road, Sandwich Road, and Canal Service Road. Pedestrian and bicycle improvements would also be included on Cranberry Highway. This option would add a new connection through Cranberry Highway Extension to Mid-Cape Connector.

Program Element/ Program Design Parameter	Description
Interchange Approach Network: Bourne North Quadrant	The selected interchange approach option for the Bourne North quadrant crossing is: Directional Interchange (BN-14.4b). Option BN-14.4b would provide a combination of direct-connection ramps between State Route 25 and U.S. Route 6 (Scenic Highway). The ramp connecting State Route 25 eastbound to Scenic Highway would be a flyover ramp passing over Nightingale Road and merging with the on-ramp from Belmont Circle before meeting up with State Route 25 mainline. The ramp connecting Scenic Highway eastbound to State Route 25 eastbound would be a flyover ramp passing over Scenic Highway, allowing vehicles to bypass Belmont Circle and eliminating the need for an additional traffic signal. This ramp would use one of the travel lanes on Scenic Highway and be a free-flowing movement to reduce congestion. The existing interchange ramp over the State Route 25 bridge would be relocated to widen the bridge and allow for this new southbound to eastbound ramp movement. The existing southbound off-ramp would be revised to be an option lane, improving the geometry and decision sight distance for drivers. The intersection control at Scenic Highway/Nightingale Road/Andy Oliva Drive would be provided by a single-lane roundabout. The new flyover ramp over Scenic Highway would provide a shared-use path and grade-separated crossing for pedestrians and bicyclists. The Scenic Highway Lane configuration would be reduced from four lanes to three lanes, which would provide additional space for multimodal accommodations. It would provide one continuous 12-foot-wide shared-use path along the south side of Scenic Highway connecting to Belmont Circle and a 6-foot-wide sidewalk along the north side of Scenic Highway.
Interchange Approach Network: Bourne South Quadrant	The selected interchange approach option for the Bourne South quadrant is: Diamond Interchange (BS-2). Option BS-2 would eliminate Bourne Rotary and replace it with a grade-separated diamond interchange, which would allow through movements on State Route 28 to bypass intersections with the non-mainline roadways. The two intersections within the diamond interchange would be a single-lane dogbone roundabout). Changes to the Trowbridge Road and Sandwich Road underpass in this option would consist of a roundabout at a relocated Upper Cape Cod Regional Technical High School driveway entrance. Option BS-2's shared-use path improvements would include providing connections to Trowbridge Road, Canal Service Road, and Bourne Recreation Area.

3.4 No Build Alternative

Sagamore Bridge and Bourne Bridge, as components of the Cape Cod Canal Federal Navigation Project, are federal assets that are managed by USACE's New England District. The Commonwealth of Massachusetts owns the connecting major highway corridors at the bridges, which consist of the State Route 3/U.S. Route 6 corridor at Sagamore Bridge and the State Route 25/State Route 28 corridor at Bourne Bridge.

In the No Build Alternative, Sagamore Bridge and Bourne Bridge would retain their current configuration of four 10-foot-wide travel lanes (two in each direction) with one 6-foot sidewalk and a 2-foot safety curb. USACE would continue to operate and maintain Sagamore Bridge and Bourne Bridges and would implement a maintenance and repair program as needed to maintain bridge operations and public safety. MassDOT would continue to own, operate, and maintain the state highway interchange approach networks at the two bridges.

The No Build Alternative would include recently completed and proposed Commonwealth of Massachusetts-sponsored and local transportation improvements projects in and near the Program as indicated in the Federal Fiscal Year 2026-2030 Transportation Improvement Program for the Cape Cod Metropolitan Planning Organization.[1] **Table 3.4-1** identifies the Transportation Improvement Program projects within and near the Program to be incorporated in the No Build Alternative.

The No Build Alternative represents the "Fix as Fails" Base Condition of USACE's MRER/EA. In the No Build Alternative, USACE would implement an ongoing program of continued inspections and maintenance and repair of both existing bridges as needed to maintain safety. No major rehabilitation efforts involving extensive repairs and replacement of major bridge components would occur. Structural components would be repaired, and critical elements would be replaced only when inspections indicate unsatisfactory reliability ratings. The MRER/EA indicates that both Sagamore Bridge and Bourne Bridge are in deteriorated condition and well beyond the state in which actions and funding from USACE's operations and maintenance program could correct the deficiencies and restore and sustain reliability. USACE has indicated that as the bridges continue to age, routine maintenance and minor component replacement would result in an unacceptable structural condition. As a result, it is likely that lower vehicle weights, traffic volume restrictions, and speed limits would be required and posted to maintain continued bridge safety.

[1] The Transportation Improvement Program for the Cape Cod Metropolitan Planning Organization was endorsed on May 19, 2025, and amended on November 17, 2025.

Table 3.4-1. Transportation Improvement Program Projects, 2026-2030 in the No Build Alternative

Project Number	Year	Transportation Project	Project Description	Status[2]
606900	2020	Belmont Circle Traffic and Multimodal Improvements	Traffic and multimodal improvements at Belmont Circle at U.S. Route 6 and State Route 25 and State Route 28	Completed
608422	2022	Trail Improvements – Sandwich	Shared-use path on Service Road (State Route 130 to Chase Road)	Completed
610542	2023	Bourne Rotary Improvements	• Restriping Bourne Rotary to two lanes and adding a channelized right-turn lane from State Route 28 northbound to Sandwich Road eastbound • Adding signs at Bourne Rotary • Installing flashing beacons at the Bourne Rotary approaches	Completed
613195	2024	Bridge Systematic Maintenance	Bridge deck replacement of the Quaker Meetinghouse Road Bridge over U.S. Route 6/Mid-Cape Highway as part of an overall bridge preservation strategy	Underway

[2] Status as of October 2025

Project Number	Year	Transportation Project	Project Description	Status[2]
609262	2025	Bourne Rail Trail, Phase 1	First phase of four planned phases of the Bourne Rail Trail connection to the Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 1 is approximately one-half mile long within the existing right-of-way of the Old Colony Railroad (Woods Hole branch line) from the Canal Service Road to Monument Neck Road.	Programmed
610673	—	Bourne Rail Trail, Phase 2	Phase 2 of four planned phases of the Bourne Rail Trail connection to Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 2 is approximately 2 miles long from Monument Neck Road to Monk's Park/ Valley Bars Road.	Not Programmed
613864	—	Bourne Rail Trail, Phase 3 and Phase 4A	Phase 3 and Phase 4A of four planned phases of the Bourne Rail Trail connection to Shining Sea Bikeway to the south in Falmouth	Not Programmed
607394/611998	—	Bourne Rail Trail, Phase 4B	Phase 4B of four planned phases of the Bourne Rail Trail connection to the Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 4B is approximately 1 mile long, extending the Shining Sea Bikeway from its current terminus in North Falmouth into the town of Bourne.	Not Programmed

Project Number	Year	Transportation Project	Project Description	Status[2]
606082	2025	U.S. Route 6 Scenic Highway Median Installation	• Resurfacing • Safety improvements, including a raised center median and expanded shoulders to separate eastbound and westbound travel lanes • Drainage improvements • Traffic signal improvements at two intersections • Shared-use path	Underway
612053	2025	Bourne/Sandwich, Resurfacing and Related Work on U.S. Route 6	Improvements to pavement serviceability, condition, and roadway safety on U.S. Route 6 from Sagamore Bridge to the Sandwich town line (8.55 miles)	Programmed
613200	—	Chase Road over U.S. Route 6 Bridge	Bridge deck replacement of Chase Road over U.S. Route 6 (Mid-Cape Highway) bridge structure in the town of Sandwich	Not Programmed
612063	2030	State Route 28 Resurfacing and Related Work	Improvements to pavement serviceability, condition, and roadway safety on MacArthur Boulevard (State Route 28) from Bourne Rotary to Otis Rotary	Programmed
613199	—	U.S. Route 6 over State Route 130 Bridge	Bridge deck replacement of U.S. Route 6 (Mid-Cape Highway) bridge structure over State Route 130 in the town of Sandwich	Not Programmed
613271	—	Shared-use path, State Route 130 to Canal Service Road	Shared-use path from State Route 130 to Canal Service Road in the town of Sandwich	Not Programmed

Source: Cape Cod Transportation Improvement Program for FFY 2026-2030

Notes:
— No date available.

Note: **Table 3.4-1** includes only those projects in the Federal Fiscal Year (FFY) 2026-2030 Transportation Improvement Program (TIP) within the Study Areas that are part of the No Build Alternative.

The No Build Alternative would not meet any of the Program's identified needs:

- It would not address the deteriorating structural condition and escalating maintenance demands of the existing bridges.
- It would not address the substandard design elements of the bridges, the immediate mainline approaches, and their adjacent interchanges and intersections.
- It would not improve vehicular traffic operations.
- It would not improve accommodations for pedestrians and bicyclists.

Per NEPA requirements, the No Build Alternative is included in the NEPA document as the base condition against which the Build Alternative is compared and evaluated.

4 Methods for Effect Evaluation

This report provides a qualitative assessment of the direct and indirect, and temporary and permanent effects of the No Build Alternative and Build Alternative on land use in the Sagamore Bridge and Bourne Bridge Study Areas (Study Areas). This includes a review of existing land use[3] and zoning policies[4] and the identification of local and regional master plans influencing land usage. Existing conditions for protected land uses,[5] land use growth assumptions, and community cohesion[6] are documented, and the effects of the No Build Alternative and Build Alternative on each of these categories are assessed. This report also identifies and assesses the potential for the Build Alternative to incorporate measures to avoid, minimize, and/or mitigate land alteration effects.

4.1 Regulatory Framework

The following resources provide the regulatory context and guidance for this analysis:

- **Federal**:
  - Safe Drinking Water Act of 1974 (Sole Source Aquifer Protection Program: Section 1424(e); Public Law 93-523, 42 USC et seq.)

[3] Land use describes the human use of land, and represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given.

[4] Zoning refers to the process of dividing land into designated areas, or "zones," where the use of land and buildings are regulated, and specific land uses are permitted or restricted.

[5] Protected land uses include federally owned and managed property; Town of Bourne-owned property; and lands acquired for conservation or recreational purposes by state agencies under the Massachusetts Executive Office of Energy and Environmental Affairs, as well as municipalities, boards and commissions, quasi-public agencies, and other public instrumentalities and subdivisions of the Commonwealth.

[6] Community cohesion refers to the strength of relationships and sense of connection among individuals and groups within a community.

- **State:**
  - Massachusetts Zoning Act (Massachusetts General Law [MGL] Chapter 40A)
  - Massachusetts Contingency Plan (MGL Chapter 21E: 310 CMR 40.00)
  - Areas of Critical Environmental Concern (ACEC) (Authorized under the Executive Office of Energy and Environmental Affairs: 301 CMR 12.00)
- **Local and Regional:**
  - Cape Cod Commission Regional Policy Plan. 2019.
  - Cape Cod Metropolitan Planning Organization. July 2015. Cape Cod 2016-2040 Regional Transportation Plan.
  - Town of Bourne Local Comprehensive Plan. 2019.
  - Town of Bourne. Open Space and Recreation Plan. February 2018.
  - Town of Bourne. Zoning Bylaw. October 2022.

4.2 Methodology

To determine the affected environment and understand existing land use conditions in the Study Areas, this assessment used geospatial zoning data from the Cape Cod Commission,[7] land use and zoning documents from the Town of Bourne,[8] and open space and protected land use geospatial data from MassGIS.[9] Local land use, zoning, and master plans in the Study Areas were identified using the Town of Bourne's Local Comprehensive Plan (LCP)[10] and the Cape Cod Regional Commission's Regional Policy Plan (RPP),[11] and growth assumptions, travel demand, and traffic forecasting were reviewed. To understand existing conditions for community cohesion, local planning documents were reviewed and local officials were interviewed to develop an understanding of community characteristics that contribute to or are detrimental to community cohesion.

To determine the potential effects of the No Build and Build Alternative on land use and community cohesion, a qualitative analysis was performed. The Project Limits and Study Areas were overlaid with

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[7] Cape Cod Commission. 2014. Zoning. April (updated August 2024). https://gis.data.mass.gov/datasets/CCCommission::zoning/about

[8] Town of Bourne. 2011. Zoning Map. October. https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning_map_102511.pdf; Town of Bourne. 2022. Zoning Bylaw. October. https://www.townofbourne.com/sites/g/files/vyhlif12841/f/uploads/zoning_bylaw_2022_for_website_1.pdf

[9] MassGIS Data. 2024. Protected and Recreational OpenSpace. June. https://www.mass.gov/info-details/massgis-data-protected-and-recreational-openspace Mass.gov. ACEC Program Overview. https://www.mass.gov/info-details/acec-program-overview

[10] Town of Bourne. 2019. Bourne Local Comprehensive Plan. https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan

[11] Cape Cod Regional Commission. 2019. Cape Cod Regional Policy Plan. https://www.capecodcommission.org/our-work/rpp/

land use, zoning, and open space geospatial layers to estimate anticipated effects. Property acquisition and environmentally affected land effects were referenced from respective chapter analyses, and effects on land use were summarized. Effects on community cohesion were qualitatively assessed and summarized based on the anticipated effects of the Build Alternative on neighborhood connectivity and access to heritage sites, recreational areas, and community facilities.

5 Affected Environment

5.1 Land Use Overview

This section provides a detailed overview of the existing land use conditions and zoning districts within the Study Areas and identifies local and regional master plans, along with their associated goals and policies, relevant to the land use assessment. Protected open space, environmentally affected land use, and potentially affected property in the affected environment are identified and described in **Section 4.17, Public Parks, Recreational Facilities, and Open Space; Section 4.18, Solid and Hazardous Waste Material Management;** and **Section 4.8, Property Acquisition, Displacement, and Relocation, respectively.**

5.1.1 Existing Land Use

The Sagamore Bridge and Bourne Bridge Study Areas consist of a variety of land uses, as illustrated in **Figure 5.1-1** and **Figure 5.1-2**, and listed in **Table 5.1-1** and **Table 5.1-2**. For the purposes of the land use categorization, "Parks/Open Space" refers to land that is undeveloped or preserved for environmental, recreational, or aesthetic purposes, including parks, natural areas, greenways, farmland, forests, conservation land, wetlands, and other landscapes that provide ecological, social, and recreational benefits.

The Sagamore Bridge Study Area primarily comprises park/open space (44.1% of the Study Area), followed by residential (24.5%), and transportation/impervious land uses (13.6%). Water comprises 7.2% of the Study Area (inclusive of the canal), institutions/public facilities comprise 6.1%, while commercial land uses comprise 2.9%, and the remaining land uses (mixed commercial/residential, industrial, and agriculture) collectively consist of less than 2% of the Study Area (**Table 5.1-1**).

Table 5.1-1. Land Use Classifications (Sagamore Bridge Study Area)

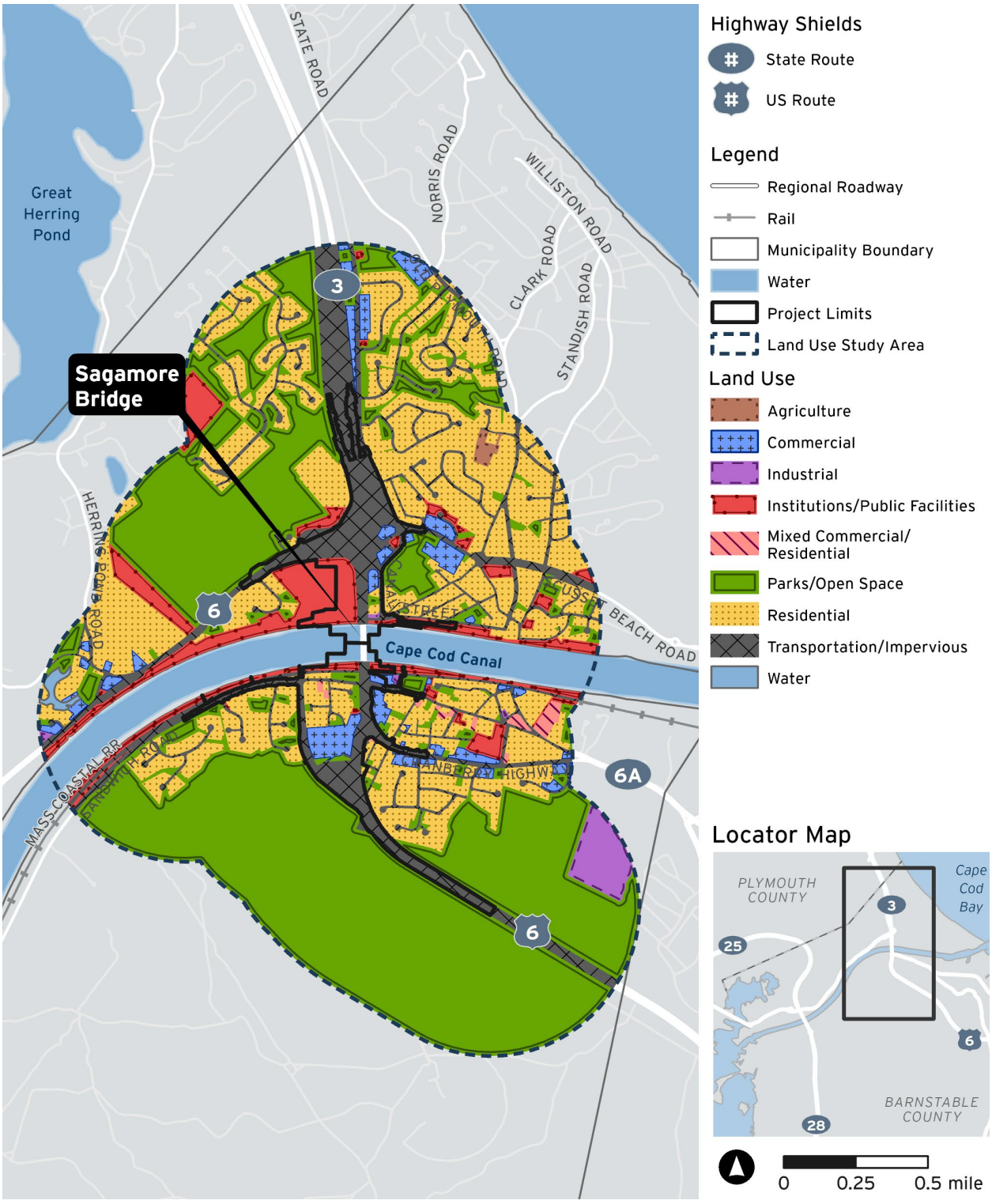
Land Use Category	Acres in Sagamore Bridge Study Area	Percentage of Study Area (%)
Parks/Open Space	1,116.30	44.1%
Residential	616.36	24.4%
Transportation/Impervious	343.41	13.6%
Water	181.93	7.2%
Institutions/Public Facilities	153.07	6.1%

Land Use Category	Acres in Sagamore Bridge Study Area	Percentage of Study Area (%)
Commercial	73.86	2.9%
Industrial	30.80	1.2%
Mixed Commercial/Residential	8.94	0.4%
Agriculture	4.53	0.2%
Total	**2,529.20**	**100.0%***

*Note: Land Use category subtotals may not add to total due to rounding.

The Sagamore Bridge Study Area is within the Sagamore Beach and Sagamore communities of the town of Bourne (**Figure 5.1-1**). North of Cape Cod Canal, land uses east and west of State Route 3 consist of medium-density residential development, with commercial development around the Canal Street and Meetinghouse Lane intersection, and along the eastern side of State Route 3. Institution and public facility uses are concentrated north of and adjacent to Cape Cod Canal, while park and open space uses are primarily found west of State Route 3 and north of U.S. Route 6.

Figure 5.1-1. Land Use Classifications (Sagamore Bridge Study Area)



Source: Massachusetts Department of Transportation, 2025

South of the canal, large commercial developments are interspersed among low-density residential development east of the Mid-Cape Connector to Cranberry Highway. Extending south on U.S. Route 6 from Sagamore Bridge, land uses include a portion of the Camp Edwards Wildlife Management Area (part of Joint Base Cape Cod) to the west of U.S. Route 6 and to the east of U.S. Route 6, medium-density residential development and a portion of the 624-acre Shawme-Crowell State Forest.[12] Riprap embankments mark the Cape Cod Canal shoreline, and service roads run along both sides of the canal, which are used for canal maintenance and public recreational access.[13]

The Bourne Bridge Study Area primarily comprises institutions/public facilities (26.9% of Study Area), park/open space (23.0% of Study Area), residential (18.1%), and transportation/impervious land uses (13.2%). Commercial land uses amount to 6.0%, water comprises 7.3% (inclusive of the canal), and agricultural uses amount to 4.2% of the Study Area. Lastly, mixed commercial/residential and industrial land uses collectively consist of less than 1.5% of the Study Area (**Table 5.1-2**).

Table 5.1-2. Land Use Classifications (Bourne Bridge Study Area)

Land Use Category	Acres in Bourne Bridge Study Area	Percentage of Study Area (%)
Institutions/Public Facilities	859.18	26.9%
Parks/Open Space	734.16	23.0%
Residential	580.43	18.1%
Transportation/Impervious	422.70	13.2%
Water	234.10	7.3%
Commercial	190.47	6.0%
Agriculture	133.89	4.2%
Mixed Commercial/Residential	32.70	1.0%
Industrial	11.20	0.4%
Total	**3,198.83**	**100.0%***

*Note: Land Use category subtotals may not add to total due to rounding.

[12] MassDOT. 2023. Cape Cod Bridges Program Environmental Notification Form. April.

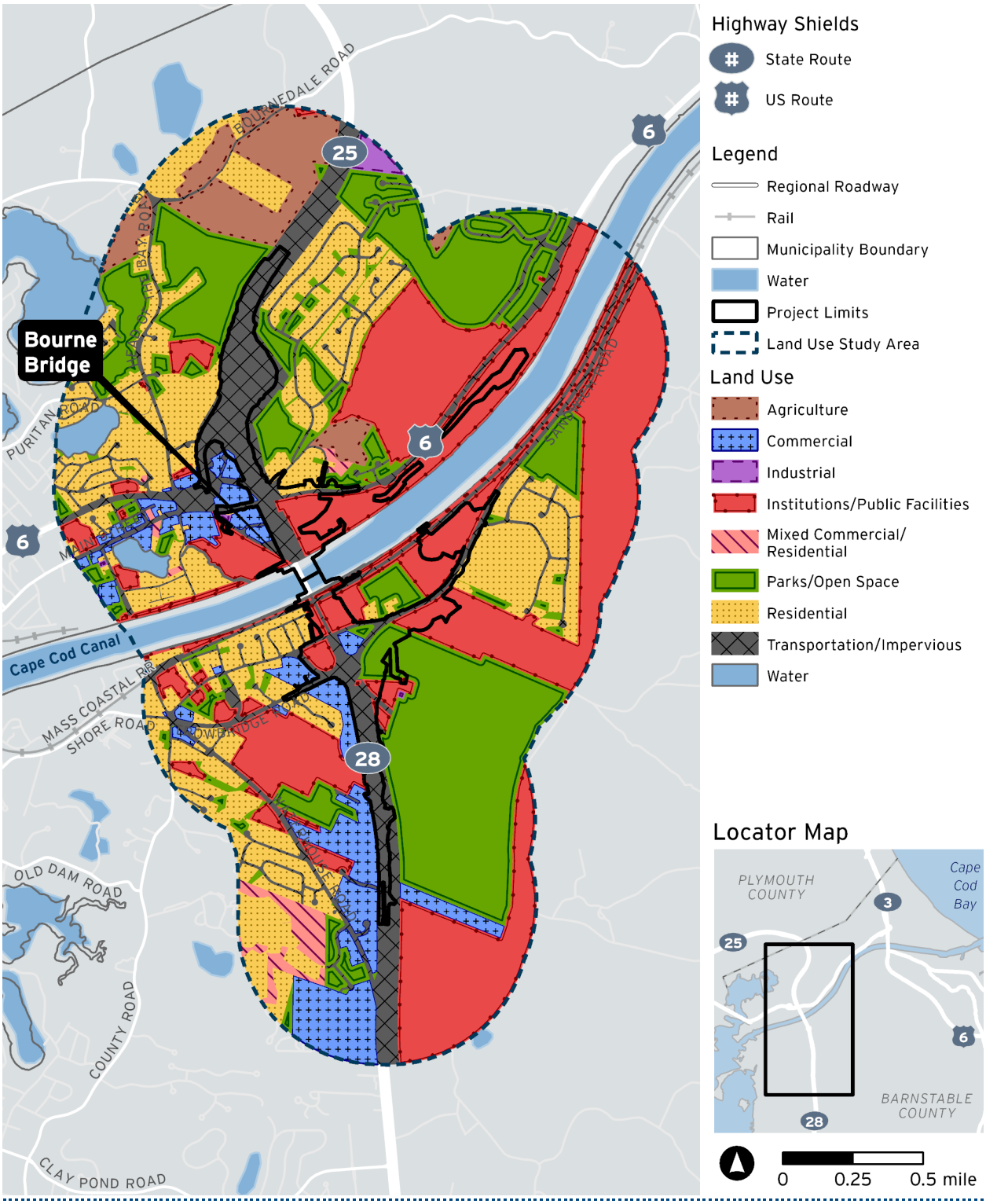
[13] U.S. Army Corps of Engineers. 2022. Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges, Massachusetts. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

The Bourne Bridge Study Area is within the Buzzards Bay community of the town of Bourne, which is characterized by medium- to high-density residential development and commercial development (**Figure 5.1-2**). North of Cape Cod Canal, land uses along State Route 25 consist of parks/open space including forested areas, Nightingale Pond Conservation Area, and natural areas, interspersed with protected open space and institutions/public facilities. Agricultural land uses are concentrated northwest of State Route 25, and institutions and public facility land uses are northeast of State Route 25 and north of and adjacent to the canal. Bournedale Elementary School is directly north of U.S. Route 6 on the eastern side of the Bourne North quadrant. Commercial development is centered around Belmont Circle, which includes retail businesses, restaurants, and the Main Street commercial area.

South of the canal, land uses include higher-density residential, institutional, and commercial development. Commercial land uses adjacent to the Bourne Rotary include restaurant and retail establishments. The Massachusetts State Police barracks are adjacent to the northwest side of the Bourne Rotary. Extending south from the Bourne Rotary, State Route 28 is bordered to the west by the Bourne High School, flanked on both sides by commercial development; and to the area east by portions of the Massachusetts Military Reservation (Camp Edwards), on Joint Base Cape Cod.[14] The Upper Cape Cod Regional Vocational Technical School, municipal canal access, and skating rink form a concentration of institutions/public facilities in the northeast portion of the Bourne South quadrant.

[14] Massachusetts Department of Transportation. 2023. Cape Cod Bridges Program Environmental Notification Form. April.

Figure 5.1-2. Land Use Classifications (Bourne Bridge Study Area)



Source: Massachusetts Department of Transportation, 2025

5.1.2 Zoning

According to the Bourne zoning maps[15] and zoning bylaws,[16] the Sagamore Bridge Study Area comprises approximately 1,012.28 acres of Residential Districts (43.0% of the Sagamore Bridge Study Area), 631.36 acres of Government Districts (26.8%), 317.58 acres of Scenic Development Districts (13.5%), 222.54 acres of Business Districts (9.5%), and 27.30 acres of Village Business Districts (1.2%). The remaining approximately 141.06 acres in the Study Area comprise unclassified right-of-way (6.0%).[17]

The Bourne Bridge Study Area comprises 1,453.27 acres of Residential Districts (48.5% of the Bourne Study Area), 608.80 acres of Business Districts (20.3%), 193.12 acres within the Downtown District (6.5%), 393.59 acres of Scenic Development Districts (13.1%), and 6.85 acres of Village Business Districts (<1%). The remaining approximately 239.92 acres in the study area comprises unclassified right-of-way (7.1%).

The Downtown District comprises Downtown Core, Gateway, Neighborhood, and Waterfront classifications.[18] In the Bourne Bridge Study Area, 80.73 acres (2.7%) are classified as Downtown Neighborhood, 76.21 acres (2.5%) are classified as Downtown Gateway, 35.14 acres (1.2%) are classified as Downtown Core, and 1.04 acres (<1%) are classified as Downtown Waterfront.

The Downtown Overlay District is zoned for several uses, including higher-density public works, landscaping, construction, and retail. In the eastern section of downtown, the historic Bourne Village is zoned to preserve the character of the town, featuring compact buildings with traditional architecture. Other sections of downtown are zoned to protect the waterfront, and much of the area along the canal is zoned for scenic development.[19]

The Study Areas' zoning districts are provided in **Figure 5.1-3** and **Figure 5.1-4**.[20]

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[15] Town of Bourne. 2011. Zoning Map. October. https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning_map_102511.pdf

[16] Town of Bourne. 2022. Zoning Bylaw. October. https://www.townofbourne.com/sites/g/files/vyhlif12841/f/uploads/zoning_bylaw_2022_for_website_1.pdf

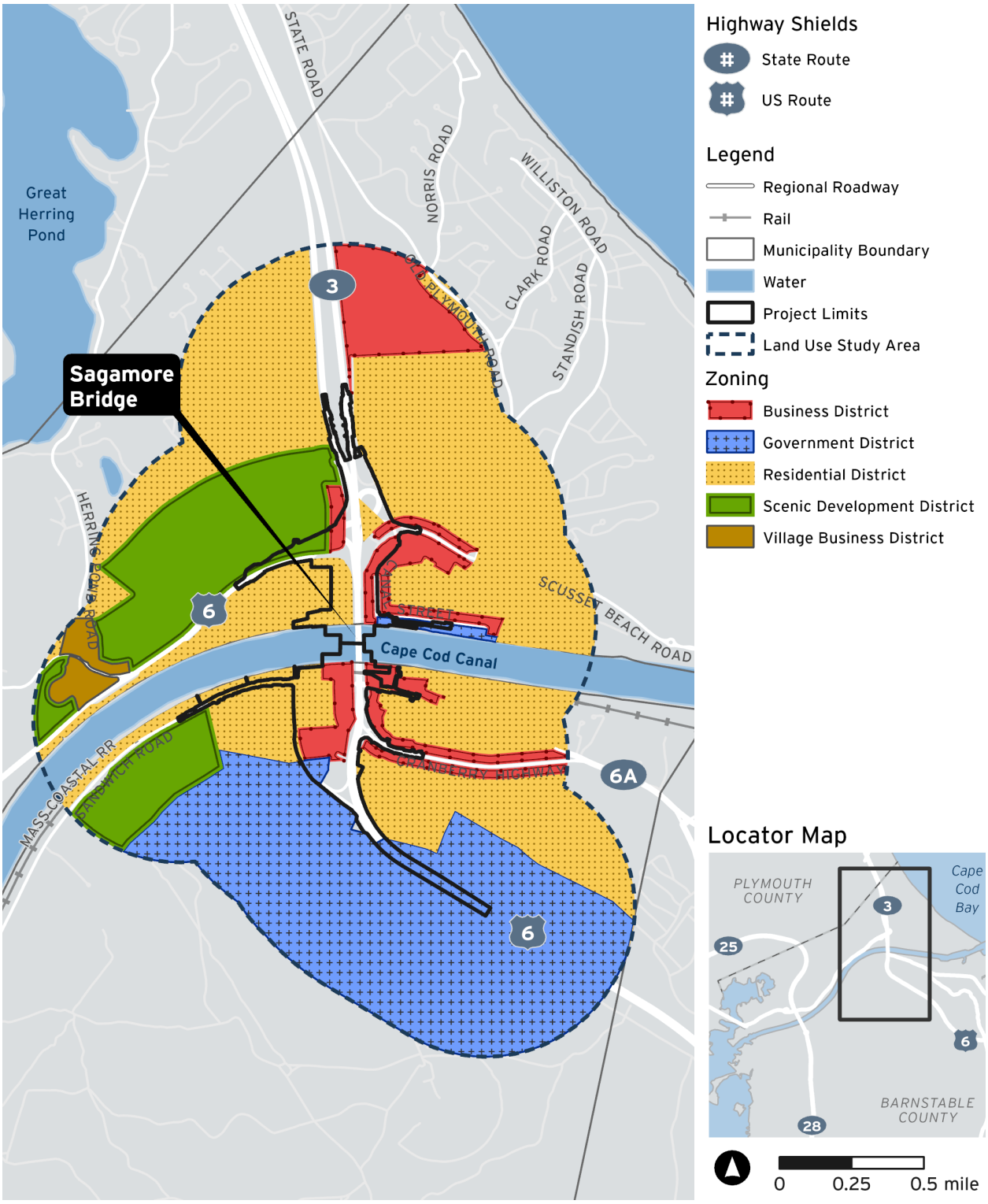
[17] The canal is excluded from zoning, so it is not included in the total Study Area acreage for the zoning calculations.

[18] Town of Bourne. 2011. Zoning Map. October. https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning_map_102511.pdf

[19] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

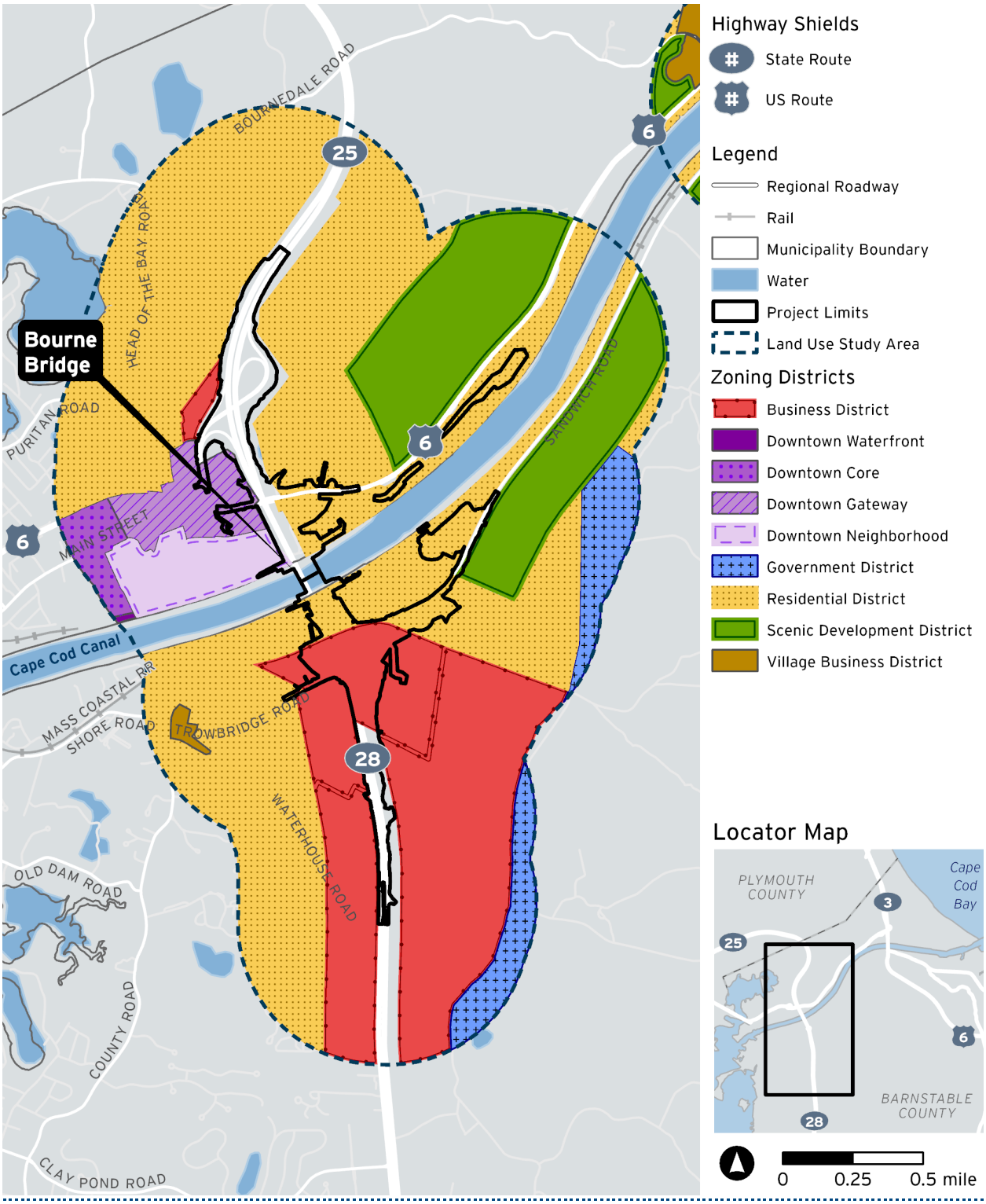
[20] Cape Cod Commission. 2014. Zoning. Updated August 2024. https://gis.data.mass.gov/datasets/CCCommission::zoning/about

Figure 5.1-3. Zoning Classifications (Sagamore Bridge Study Area)



Source: Massachusetts Department of Transportation, 2025

Figure 5.1-4. Zoning Classifications (Bourne Bridge Study Area)



Source: Massachusetts Department of Transportation, 2025

5.1.3 Identification of Master Plans

The Town of Bourne LCP (revised in 2019) was approved by Town Meeting on October 29, 2019 and certified by the Cape Cod Commission in December 2019.[21] Of relevance to land use, the LCP's open space policy is to protect the public rights for recreation, enhance public access to existing conservation land, and to establish green corridors and/or connections. The LCP's cultural heritage goal is to protect and preserve historical and cultural features of the town's landscape and to ensure that future development respects the town's historical traditions.

The Cape Cod RPP, prepared by the Cape Cod Commission in December 2018, was approved by Barnstable County Ordinance #19-01, effective March 30, 2021.[22] Of relevance to land use, the RPP's open space goal is to conserve, preserve, or enhance a network of open space that contributes to the region's natural and community resources and systems. The RPP's community design goal is to protect and enhance the unique character of the region's built and natural environment based on the local context. Lastly, the RPP's cultural heritage goal is to protect and preserve the significant cultural, historical, and archaeological values and resources of Cape Cod.

5.2 Protected Land Uses

This section provides an overview of protected land uses in the Study Areas.

5.2.1 Open Space

The Land Use Study Areas feature multiple publicly owned and designated protected open space parcels. For the purposes of this assessment, "open space" refers to publicly owned, undeveloped lands including parks, recreation areas, greenways, forests, or other land uses that may be accessible for public use, and protect and preserve the environment and/or scenic and cultural resources.[23] **Section 4.17, Public Parks, Recreational Facilities, and Open Space**, provides a detailed identification and review of protected open space parcels near and adjacent to Sagamore Bridge and Bourne Bridge, including details regarding ownership, applicable regulatory protections, and relevant mitigation measures to offset adverse effects to protected open space as a result of the Build Alternative.

5.2.2 Areas of Critical Environmental Concern and Sole Source Aquifers

5.2.2.1 Areas of Critical Environmental Concern

An ACEC is a designation used in Massachusetts to identify and protect areas of significant environmental importance. These areas are recognized for their critical natural resources, which may

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[21] Town of Bourne. 2019. Bourne Local Comprehensive Plan. December https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan

[22] Cape Cod Regional Commission. 2021. Cape Cod Regional Policy Plan. https://www.capecodcommission.org/our-work/rpp/

[23] American Planning Association. 2000. Parks, Recreation, and Open Space: A Twenty-first Century Agenda. PAS Report Number 497/498. https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/PAS-Report-497-498.pdf

include wildlife habitats, wetlands, estuaries, rivers, coastal areas, or other ecosystems that play an essential role in maintaining environmental quality.[24]

The designation is intended to preserve these areas by ensuring careful land use and development practices. It encourages the protection of water resources, biodiversity, cultural and historical sites, and other key environmental features. ACECs are managed in partnership between state agencies, municipalities, and local communities to balance conservation with sustainable development. ACECs are designated by the Secretary of Energy and Environmental Affairs, and the ACEC program is administered by the Department of Conservation and Recreation.[25]

In the Land Use Study Areas, there are two ACECs (**Figure 5.2-1**):

- Herring River Watershed
- Bourne Back River

The Herring River Watershed ACEC—a 4,450-acre area comprising open space, lakes and ponds, freshwater wetlands, and cranberry bogs—is north of Sagamore Bridge and west of State Route 3. Approximately 529.18 acres of the ACEC are within the Sagamore Bridge Study Area, representing about 20.9% of the Study Area.[26]

The Bourne Back River ACEC, a 1,850-acre area comprising salt marshes, tidal flats, and coastal habitats is south of Bourne Bridge and west of State Route 28. Approximately 255.51 acres of the ACEC is within the Bourne Bridge Study Area, representing about 7.6% of the Study Area.[27]

Section 4.9, Wetlands and Floodplains, includes additional details about ACECs within the Study Areas, including an assessment of potential effects of the Build Alternative on ACECs, and relevant mitigation measures to offset any adverse effects.

5.2.2.2 Sole Source Aquifers

Sole source aquifers (SSA) are designated by the U.S. Environmental Protection Agency (EPA) as aquifers that supply at least 50% of the drinking water consumed in the area overlying the aquifer. The SSA protection program is designed to protect drinking water supplies in areas with few or no alternative sources to the groundwater resource that could "physically, legally, and economically" supply all those who depend on the aquifer for drinking water. The SSA designation protects an area's

[24] MassGIS. 2009. Areas of Critical Environmental Concern. April. https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern

[25] Mass.gov. ACEC Program Overview. https://www.mass.gov/info-details/acec-program-overview

[26] MassGIS. 2009. Areas of Critical Environmental Concern. April. https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern

[27] MassGIS. 2009. Areas of Critical Environmental Concern. April. https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern

groundwater resource by requiring EPA to review proposed projects receiving federal funds within the designated area to ensure that they do not endanger the water source.[28]

There are two SSAs in the Study Areas (**Figure 5.2-1**):

- North of Cape Cod Canal: Plymouth/Carver SSA, designated by EPA in 1990, is a critical groundwater resource that supplies drinking water to approximately 200,000 residents across several towns, including Plymouth, Carver, Plympton, Wareham, Kingston, Middleboro, Halifax, and Brockton. As the second largest aquifer in the state, the SSA covers about 128,000 acres and is characterized by its highly permeable sand and gravel deposits, making it vulnerable to saltwater intrusion and susceptible to contamination. It supports local ecosystems, including lakes, ponds, wetlands, and cranberry bogs. Approximately 1,215.16 acres of the SSA are within the Sagamore Bridge Study Area, representing about 51.7% of the Study Area, and approximately 1,427.90 acres are within the Bourne Bridge Study Area, representing about 47.7% of the Study Area.[29]

- South of Cape Cod Canal: Cape Cod SSA, designated by EPA in 1982, serves as the primary drinking water source for the entire Cape Cod region, supporting approximately 230,000 permanent residents as of 2023 and upwards of 500,000 seasonal residents,[30] and it sustains the region's freshwater ponds, wetlands, and open spaces. It is the largest SSA in the state, and encompasses the entire Cape Cod peninsula, covering an area of about 281,600 acres. Composed of unconsolidated sand and gravel deposits from glacial outwash plains, it is highly susceptible to contamination from development and septic systems. Approximately 1,164.01 acres of the SSA are within the Sagamore Bridge Study Area, representing about 49.5% of the Study Area, and approximately 1,616.55 acres of the SSA are within the Bourne Bridge Study Area, representing about 54.0% of the Study Area.[31]

Section 4.10, Water Quality and Stormwater, includes additional details about the SSAs within the Study Areas, including an assessment of potential effects of the Build Alternative on these aquifers, and relevant mitigation measures to offset any adverse effects.

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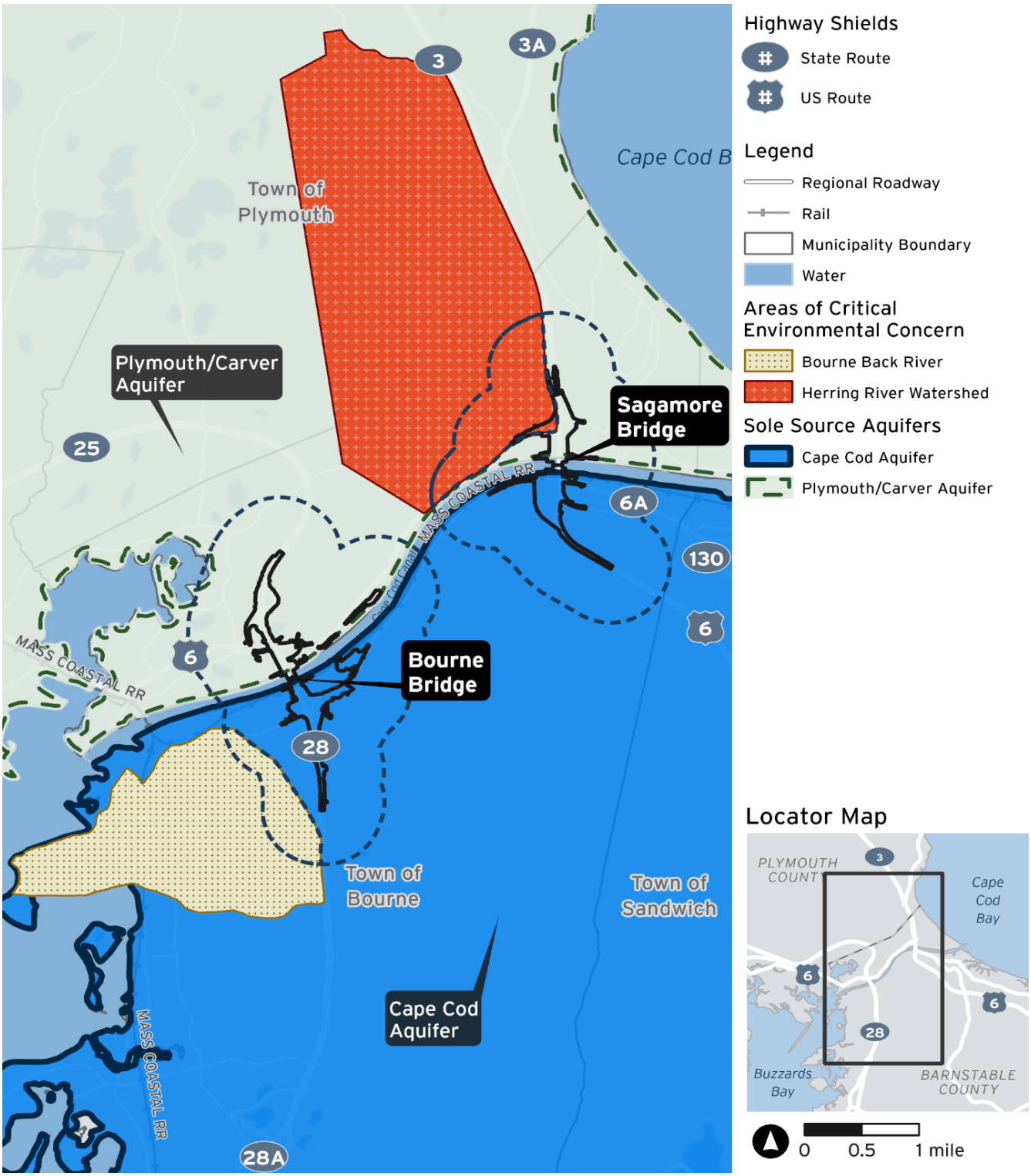
[28] MassGIS. 2020. EPA Designated Sole Source Aquifers. September. https://www.mass.gov/info-details/massgis-data-epa-designated-sole-source-aquifers

[29] U.S. Environmental Protection Agency. EPA Region 1 - Sole Source Aquifer Program: Plymouth/Carver. https://www3.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html

[30] Data Cape Cod. 2023. Year-Round Population. https://datacapecod.org/pf/barnstable-county-year-round-population/

[31] U.S. Environmental Protection Agency. EPA Region 1 – Sole Source Aquifer Program: Cape Cod. https://www.epa.gov/ma/cape-cod-sole-source-aquifer

Figure 5.2-1. Areas of Critical Environmental Concern and Sole Source Aquifers (Land Use Study Areas)



Source: Massachusetts Department of Transportation, 2025

5.3 Growth Assumptions

This section reviews regional development trends and growth assumptions of Barnstable County. **Section 4.22, Indirect Effects**, includes a list of existing and proposed developments in the Study Areas and also provides an assessment of future travel demand, traffic forecasting, and the potential for induced demand.

According to Decennial Census estimates, in Barnstable County, from 2000 to 2010, population decreased 2.9% over the 10-year period, and from 2010 to 2020, population increased 5.8% over the same duration. According to the Census's yearly county population estimates, from 2020 to 2021, during the COVID-19 pandemic, population growth in Barnstable County increased 1.89%, likely resulting from flexible remote work policies and the associated influx of city-dwellers into suburban areas.[32] From 2021 to 2024, the Barnstable County population remained steady, increasing or decreasing by less than 0.1% per year.[33]

The decrease in population growth seen in Barnstable County from 2000 to 2010 can likely be attributed to the historical pattern of retirees moving to Cape Cod, countered by younger adults leaving Cape Cod for work or school. Although the population increased 5.8% from 2010 to 2020, as of 2020, Barnstable County's median age was 55 years, significantly higher than Massachusetts median age of 40 years. Additionally, as of 2023, 34.0% of the population is aged 65 and over (compared to 18.5% of the Massachusetts population), while only 13.7% are under 18 (compared to 19.2% of the Massachusetts population).[34]

Although population grew over 1% in Barnstable County from 2020 to 2021, in all other years from 2000 to 2024, population growth grew at a rate of <1% per year. An average annual growth rate of less than 1% per year is expected to have little to no potential for land use change in the Study Areas,[35] and can likely be attributed to limited and seasonal employment opportunities on Cape Cod combined with the high cost of living and housing.

When considering estimated housing growth, a 2012 Cape Cod Commission buildout analysis determined that 27,842 units were available for development in Barnstable County, and a 2017 UMass Donahue Institute housing market analysis estimated potential future demand for 26,000 residential units over a 10-year period. An updated housing market analysis was released in 2023 by the UMass Donahue Institute's analysis which predicted housing unit demand and supply in Barnstable County for

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[32] U.S. Census Bureau. More Exurban Communities Now Among Nation's Fastest Growing Places. May 2024. https://www.census.gov/library/stories/2024/05/exurbs-city-population.html#:~:text=Multiple%20factors%20are%20likely%20behind,from%20home%20also%20likely%20contributed.

[33] U.S. Census Bureau. County Population Totals and Components of Change: 2020-2024.; U.S. Census Bureau. County Population Totals and Components of Change: 2010-2019 ; U.S. Census Bureau. County Population Totals and Components of Change: 2000-2010

[34] U.S. Census Bureau. QuickFacts: Barnstable County, MA. https://www.census.gov/quickfacts/fact/table/barnstablecountymassachusetts/AGE295221?utm_

[35] ECONorthwest & Portland State University. 2001. A Guidebook For Evaluating the Indirect Land Use and Growth Impacts of Highway Improvements: Final Report. April. Prepared for Oregon Department of Transportation. https://www.oregon.gov/odot/Programs/ResearchDocuments/AGuidebookforUsingIndirLand.pdf

2030, 2040, and 2050. The updated analysis determined that the demand for housing in Barnstable County is projected to exceed housing supply through 2050. Based on a projection of 2020 population figures, the gap between supply and demand for housing units in Barnstable County is estimated at 13,273 units in 2025 and 13,436 in 2030.[36] As a result, residential housing in Barnstable County is expected to be at or above capacity,[37] and any near-term housing growth is expected to consume the remaining supply of developable land regardless of the addition of the bridge projects. Residential development in Barnstable County is further stymied by high construction costs,[38] wastewater infrastructure limitations,[39] water supply constraints,[40] and municipal service capacity constraints.

In addition to these housing growth limitations, the existing Barnstable County road network has several bottlenecks that would limit the impact of bridge replacement on future growth and development. According to the 2024-2044 Cape Cod Metropolitan Planning Organization Regional Transportation Plan,[41] and the 2018 Cape Cod Emergency Traffic Plan,[42] there has been a steady increase in traffic throughout Barnstable County, and a proliferation of challenges managing these traffic conditions due to restrictions in route options and capacity.

5.4 Community Cohesion

This section identifies the existing community characteristics that contribute to community cohesion and features that currently divide neighborhoods. MassDOT developed this section based on a review of local planning documents and interviews with local officials to describe community characteristics and identify aspects that contribute to or detract from community cohesion in the town of Bourne.

For the purposes of this assessment, "community cohesion" refers to the strength of relationships and sense of connection among individuals and groups within a community. It reflects the extent to which

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[36] Cape Cod Commission. Cape Cod Housing Needs. UMass Donahue Institute. 2023. https://capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/housing/CC-Housing-Needs-Assessment-2023.pdf&_gl=1*a51bx9*_ga*NzA5NzU0NDAzLjE3Mjk1NDAwMzc.*_ga_LTW77CPM1M*MTc0MTE5NDYwNi4yNC4xLjE3NDExOTYyOTUuMC4wLjA.

[37] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

[38] County of Barnstable. 2023. Barnstable County HOME Consortium Program Year 2023 Annual Action Plan. July. https://www.capecod.gov/wp-content/uploads/2022/03/AAP-2023-Approved.pdf

[39] Cape Cod Commission. Our Work: Wastewater. Accessed December 2024. https://www.capecodcommission.org/our-work/wastewater/

[40] Cape Cod Commission. 2015. Cape Cod Area Wide Water Quality Management Plan Update. June. https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/208/208%20Final/Cape_Cod_Area_Wide_Water_Quality_Management_Plan_Update_June_15_2015.pdf

[41] Cape Cod Commission. Cape Cod Regional Transportation Plan 2024-2044. https://www.capecodcommission.org/our-work/rtp

[42] Commonwealth of Massachusetts. 2018. Cape Cod Emergency Traffic Plan. July. https://www.mass.gov/doc/cape-cod-emergency-traffic-plan/download

community members are able to connect, interact, and spend time with one another, and feel a shared sense of belonging based on shared community characteristics. Community cohesion is an important component of sustainable urban planning, community development, and social policy, because it strengthens the fabric of society and fosters resilience in the face of social, economic, and environmental challenges.

Community cohesion in the town of Bourne neighborhoods is influenced by the physical divide resulting from Cape Cod Canal. Existing gaps in local and regional transportation networks and congestion and travel delays resulting from increased seasonal traffic volume also present challenges to community cohesion. Drivers of and contributing elements for community cohesion in town of Bourne neighborhoods are defined by access and connectivity to recreation and natural resources, leisure activities, and historical sites and architecture, and is enabled by the existing connectivity provided by Sagamore Bridge and Bourne Bridge.

5.4.1 Challenges to Community Cohesion

Despite the connectivity enabled by Sagamore Bridge and Bourne Bridge, community cohesion is directly affected by Cape Cod Canal, which divides the town of Bourne into two distinct segments. The only vehicle access on or off Cape Cod and over the canal is via the bridges, which creates a bottleneck due to capacity limitations and seasonal volume increases. Residents are required to regularly cross the canal via the two bridges in order to access key destinations, such as places of employment, medical facilities, grocery stores, schools, places of worship, and recreational facilities. According to the 2020 Census, approximately 31,000 off-Cape jobs are filled by workers living on Cape Cod, and 21,500 on-Cape jobs are filled by people living off Cape Cod who must commute over the bridges daily. This results in over 50,000 workers who rely on the bridges for daily commuting.[43] Town of Bourne school children travel to school by bus across the bridges, and the Cape Cod Regional Transit Authority's Bourne Run route crosses both bridges as part of its seasonal operating route. In summary, town of Bourne residents and workers are regularly required to cross the bridges as a part of daily life, which serves as a constant challenge to community cohesion.[44, 45]

Cohesion is further hindered by the locations of town of Bourne services in relation to the canal, which has implications for disaster and emergency response. The Bourne Police Department is north of the canal, while the state police has a station south of the canal. Two fire stations are on either side of the bridges. As of 2017, the fire and police departments required 10 to 12 daily trips across the bridges on average for supplies, fuel, to conduct inspections and training, and to respond to emergencies.[46]

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[43] Cape Cod Commission. 2023. Cape Cod Bridges Replacement: An Urgent Need. October.

[44] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

[45] Town of Bourne. Virtual Interviews: Local Officials. August 2024.

[46] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

Summer congestion on the bridges results in delayed emergency responses, limitations in terms of hospital access, altered work schedules, and the hiring of additional staff on overtime to accommodate for traffic delays.[47, 48]

As the number of older adults moving to Cape Cod increases, an additional community concern is the low number of primary care providers serving Barnstable County, which is 30% lower than the Massachusetts average. This may cause retirees who moved to Cape Cod to stay with their prior primary care providers, resulting in the need to travel off Cape Cod for appointments. There are no Veterans Administration hospitals on Cape Cod, and veterans must rely on the bridges to travel off Cape Cod to Providence, RI, or Jamaica Plain, MA, for Veterans Administration services. Additionally, no Level I or II medical trauma centers are on Cape Cod, so most trauma patients are transported to Boston.[49] Considering that many older residents travel off Cape Cod for medical appointments or emergencies, bottlenecks on the bridge from seasonal road congestion can hinder access to essential care, creating significant barriers in elder-care support and challenging community cohesion.[50]

The impact of the Cape Cod Canal on community cohesion is exacerbated by existing gaps in local and regional transportation networks. There is a need for road network fortification and expansion to handle seasonal volume increases in traffic, as well as the creation and expansion of sidewalks, road shoulders, and shared-use paths (SUP) throughout Cape Cod to enable safe and connected pedestrian and bike travel opportunities. Congestion and travel delays resulting from seasonal traffic prohibit efficient and reliable vehicular travel across the bridges, whether travel is to access essential services or for recreation. Through travelers use local roads to try to bypass bottlenecks on state highways, which interrupts local traffic by town of Bourne residents. This creates barriers to community cohesion, because residents and workers are unable to reach essential destinations and services in a timely manner, must alter their travel behavior in response to these traffic patterns, and may choose not to travel at all as a result.[51, 52]

5.4.2 Drivers of Community Cohesion

The town of Bourne is split by Cape Cod Canal but connected by Sagamore Bridge and Bourne Bridge. All cars, trucks, buses, bikes, and pedestrians traveling onto Cape Cod must pass over Sagamore Bridge or Bourne Bridge, which serve as the physical foundation for community cohesion.[53] Physical cohesion

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[47] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

[48] Town of Bourne. Virtual Interviews: Local Officials. August 2024.

[49] Cape Cod Healthcare is actively working towards Level III trauma certification.

[50] Town of Bourne. Virtual Interviews: Local Officials. August 2024.

[51] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

[52] Town of Bourne. Virtual Interviews: Local Officials. August 2024.

[53] Town of Bourne. 2019. Bourne Local Comprehensive Plan. https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan

is further enabled through the town of Bourne's 190 miles of roadway, including 120 miles of local roads and three major arteries (U.S. Route 6, and State Routes 28 and 6A) that residents and visitors use to travel within the town of Bourne and to connect with the rest of Cape Cod. The Canal Service Roads (Cape Cod Canal bike paths) connect pedestrians and bicyclists with 7 miles of SUP with seven roadway crossings on the northern side, and 6.5 miles of SUP with two roadway crossings on the southern side. The bridges' approaches feature segments of SUPs for bikes and pedestrians, although roads in the Study Areas generally lack sidewalks, and are prohibited on U.S. Route 6, and State Routes 3 and 25. The Cape Cod Line rail service travels through and stops in the town of Bourne, while the Cape Cod Regional Transit Authority and Greater Attleboro-Taunton Regional Transit Authority operate bus transit routes that travel in and around Bourne.[54] Specifically, the Cape Cod Regional Transit Authority operates the Bourne Run and Sandwich Line bus routes that travel over the bridges, and circulate in and around the town of Bourne (more information provided in **Section 4.2, Transportation, Traffic, and Safety**). These routes and paths serve as the existing transportation network in the town of Bourne, which connect residents to key destinations and promote neighborhood cohesion.

Within the Study Areas, the Cape Cod Canal bike paths connect community members to bridge-adjacent recreation areas, including Sagamore Bridge and Bourne Bridge Recreation Areas, Sagamore Bridge and Bourne Bridge Areas, Bourne Scenic Park, Bourne High School Recreational Fields, and Sandwich Road Conservation Area. The Shawme-Crowell State Forest and the Nightingale Pond Conservation Area are additionally accessible by vehicle within the Study Areas. According to the Town of Bourne's Open Space and Recreation Plan, all municipally owned open space in the Bourne Bridge Study Area is accessible to the public.[55] The conservation of and access to ample recreation area in the town of Bourne illustrates the value the town places on preserving natural resources and in ensuring recreational access.

Beyond the Study Areas, Bourne's transportation network links communities and neighborhoods with Cape Cod's plethora of recreational opportunities and leisure activities. Access and connectivity to beaches, hiking trails, and biking/walking facilities are valued as community assets by Cape residents. Rail trails and multi-use paths throughout Cape Cod enable safe and protected recreational opportunities for bikes and pedestrians. Connectivity to accessible leisure activities is particularly valued as a community characteristic by older adults who relocated to Cape Cod for retirement.[56] According to a 2013 survey by the Chesapeake Group, communal activities including live music concerts, theater performances, and spending time at the beach are reported to be the most popular recreational activities that residents participate in. Additional leisure activities that foster community

[54] Cape Cod Regional Commission. 2019. Cape Cod Regional Policy Plan. https://www.capecodcommission.org/our-work/rpp/

[55] Town of Bourne Open Space and Recreation Plan. Prepared for the Bourne Open Space Committee. Prepared by Worsley Witten Group, Inc. February 8, 2018.

[56] Town of Bourne. Virtual Interviews: Local Officials. August 2024.

cohesion include water sports, fishing, boating, golfing, camping, picnicking, shopping, and dining out.[57] Providing access and connections to these activities is essential in supporting cohesion.

In addition to recreation opportunities and leisure activities, the preservation of and access to historical architecture is valued and prioritized by the Town of Bourne as a defining community characteristic. Historic Bourne Village is zoned to preserve the character of the town and features compact buildings with traditional architecture. The Massachusetts Cultural Resource Information System has cited 866 buildings, structures, burial grounds, and areas in the town of Bourne as having potential historical significance.[58] To preserve the town of Bourne's cultural heritage and continue fostering a sense of community, the town's LCP advocates that historic sites and buildings should be protected, new development should complement historical development, and the importance of traditional cultural events (e.g., the Main Street Festival and the County Fair) should be recognized and strengthened.[59] **Section 4.16, Cultural Resources**, provides additional information on cultural resources and historical places of significance in and near the Study Areas.

6 Environmental Consequences

6.1 No Build Alternative

This section considers the direct and indirect operational effects of the No Build Alternative on land use in the Study Areas. For the No Build Alternative, the bridges would be maintained in their current alignments. Existing easements would be used to access and maintain the current structures, and no additional property would be required for staging or construction of the new structures or interchange approaches. No changes to land use or development patterns would occur.

The No Build Alternative would not result in direct changes to land use or development patterns but may have indirect effects on quality of life and community cohesion for existing neighborhoods in the Study Areas. Since the No Build Alternative would result in the maintenance of the existing bridges, traffic congestion and challenges in travel access would continue due to reduced travel network connectivity and a lack of multimodal options. This would impede existing residents' abilities to travel freely across Cape Cod Canal to access community facilities and essential services, affecting the physical cohesion of existing neighborhoods.

The No Build Alternative would not further the goals and objectives identified in local and regional land use policies and plans, which call for the enhancement of public access to conservation land, establishing green corridors/connections, and enhancing the open space network. The No Build Alternative would continue to hinder public access to existing conservation land and would not create

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[57] 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. March. https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MREREnvAssessment.pdf

[58] https://mhc-macris.net/queryresults

[59] Town of Bourne. 2019. Bourne Local Comprehensive Plan. https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan

new connections or green corridors. The No Build Alternative would not further the conservation, preservation, or enhancement of the open space network.

For the No Build Alternative, existing neighborhoods would continue to rely heavily on the aging Sagamore Bridge and Bourne Bridge as key links to access cross-canal services and destinations. Existing access, and community cohesion, would continue to be hindered by traffic congestion and travel-flow impediments caused by roadway capacity limitations and increases in seasonal traffic volume as described by the No Build Alternative traffic analysis results in **Section 4.2, Transportation, Traffic, and Safety**. Travel congestion on the bridges would continue to result in delayed emergency responses, limitations in terms of hospital access, scheduling medical appointments during off-peak travel hours, and altering work schedules and commute times to accommodate for traffic delays. The lack of multimodal accommodations and network connectivity throughout the Study Areas would result in reduced community connectivity, and diminished access to recreational opportunities, leisure activities, cultural events, and historical sites, hindering community cohesion in the town of Bourne.

6.2 Build Alternative

This section assesses the direct and indirect operational and construction-period effects of the Build Alternative on land use in the Study Areas and evaluates its consistency with master plans. Assessed land use effects include land alteration effects and neighborhood and community cohesion effects. ACECs, SSAs, protected open space, environmentally affected land use, and property effects along with associated mitigation measures are evaluated and assessed in **Section 4.9, Wetlands and Floodplains; Section 4.10, Water Quality and Stormwater; Section 4.17, Public Parks, Recreational Facilities, and Open Space; Section 4.18, Solid and Hazardous Waste Material Management;** and **Section 4.8, Property Acquisition, Displacement, and Relocation**, respectively.

For the Build Alternative, the new alignment and the areas needed for construction staging and the demolition of the existing bridges and interchange improvements would result in unavoidable temporary and permanent property effects, resulting in permanent land use changes. MassDOT proposes to mitigate these effects by providing a buffer area to separate residential areas from the transportation land uses. In addition, the Build Alternative would strengthen overall community cohesion and provide quality-of-life benefits for existing neighborhoods through improved access, mobility, and connectivity throughout the Study Areas. Refer to **Section 7, Mitigation Measures,** for additional details.

6.2.1 Land Use, Zoning, and Master Plan Effects

The Build Alternative would be designed to minimize effects to adjacent land uses during construction and operation, and to maintain consistency with the goals and policies of local and regional master plans. This section summarizes these effects, and additional details are provided in later sections.

Direct land use impacts from the Build Alternative would include an estimated 328.10 acres of land alteration, including 146.77 acres of tree clearing to allow for temporary roadways, permanent roadways, SUP installation, and Section 4(f) mitigation areas (**Table 6.2-1**). This would result in a

52.29-acre increase in impervious area comprising new roadway and SUP areas, which represents a permanent land use change to right-of-way/transportation (**Table 6.2-2**).

The Build Alternative would be consistent with the open space policy of the LCP to protect public rights for recreation, enhance public access to existing conservation land, and establish green corridors and/or connections. The Build Alternative would also be consistent with the open space goal of the RPP to conserve, preserve, or enhance a network of open space that contributes to the region's natural and community resources and systems. This consistency is evidenced through the incorporation of a pedestrian and bicycle SUP for each highway bridge that would include connections to the local roadway network and existing rail trails on both sides of the canal. The Build Alternative will also minimize effects to open space, including the USACE-leased property on the canal, to the greatest extent practicable.

The Build Alternative would be consistent with the LCP's cultural heritage goal to protect and preserve historical and cultural features of the town of Bourne's landscape and to ensure that future development respects the town's historical traditions. The Build Alternative would also be consistent with the RPP's cultural heritage goal to protect and preserve the significant cultural, historical, and archaeological values and resources of Cape Cod. To ensure consistency, MassDOT will develop and execute a Programmatic Agreement with the State Historic Preservation Office and other consulting parties to mitigate adverse effects associated with the demolition of the National Register-eligible Sagamore and Bourne Bridges in accordance with Section 106 of the National Historic Preservation Act.

6.2.2 Land Alteration Effects

The Build Alternative would result in permanent land alteration effects in the Study Areas, as outlined in **Table 6.2-1** and **Table 6.2-2**. Land alteration would result in additional impervious areas due to new or reconfigured roadways, additional paved areas associated with SUP, and additional altered areas due to grading and best management practices, such as vegetated strips, water quality swales, and infiltration basins. The Build Alternative would result in approximately 328.10 acres of total land alteration, including 146.77 acres of tree clearing (including 18.45 acres for Section 4(f) mitigation areas), 76.33 acres of alteration to existing pavement (e.g., mill and overlay, roadway reconstruction), and 105 acres of alteration to previously disturbed areas (e.g., grassy areas, stormwater best management practices). **Table 6.2-1** provides a breakdown of the proposed land alteration effects.

Table 6.2-1. Land Alteration (Sagamore Bridge and Bourne Bridge Study Areas)

Study Area Quadrant	Tree Clearing (acres)	Alterations to Existing Pavement (acres)	Alterations to Previously Disturbed Areas (acres)	Total Land Alteration (acres)	Total Land Alteration as Percentage of Study Areas (%)
Sagamore North	31.31	18.00	18.33	67.64	2.7%
Sagamore South	19.74	20.80	17.13	57.67	2.3%
Bourne North	39.29	21.70	41.46	102.45	3.2%

Study Area Quadrant	Tree Clearing (acres)	Alterations to Existing Pavement (acres)	Alterations to Previously Disturbed Areas (acres)	Total Land Alteration (acres)	Total Land Alteration as Percentage of Study Areas (%)
Bourne South	56.43	15.83	28.08	100.34	3.1%
Total	**146.77**	**76.33**	**105.00**	**328.10**	**5.7%***

Note: Limits of land alteration will be refined as design progresses. Calculations based on analysis of land alteration associated with Build Alternative bridge design.

*Percentage of total Sagamore Bridge and Bourne Bridge Study Areas.

Of the 146.77 acres (2.6% of the total Sagamore Bridge and Bourne Bridge Study Areas) of tree cover that would be removed as a result of the Build Alternative, the majority would comprise forested land cover (98.92 acres), but the affected land would also contain right-of-way (18.48 acres), scrub-shrub (12.02 acres), grassland (5.69 acres), impervious surface (3.79 acres), tax exempt (2.48 acres), and open land (1.36 acres) cover types.[60] Tree clearing would be required to allow for new roadways to be constructed and temporary roadways to facilitate construction phasing operations, to construct Section 4(f) mitigation areas, and to ensure proper sightlines are achieved for safety. Furthermore, approximately 15.7% of the total clearing would be associated with the installation of a SUP to improve public access to and from Cape Cod Canal, as well as to improve multimodal connectivity and safety in the Study Areas. This would provide safe and accessible mobility opportunities for residents of the town of Bourne to exercise, access recreation areas, visit cultural heritage sites, travel to community facilities, and access essential services. Refer to **Attachment 3** of **Appendix 3.2, Construction Approach Technical Report**, for plans that identify the limits of tree clearing in relation to the proposed work.

Of the land affected by tree clearing for the Build Alternative, 69.51 acres—or 47.2% of the total area to be affected by tree clearing—is currently used for transportation purposes. Tree cover within these designated transportation land use areas is typically found along major thoroughfares. Due to harsh growing conditions of these areas—such as increased air pollution, decreased water quality from stormwater runoff, and elevated surface temperatures—invasive species often outcompete native species and trees of all species tend to be in poorer health compared to those in traditional forest environments, which can reduce ecosystem benefits and lower the overall quality of the forest. As discussed in **Section 7.1**, the Build Alternative would provide approximately 185.83 acres of new landscaping and vegetation, which would include reforestation, restoration, and street tree plantings. Primarily native plantings would be used to restore and enhance habitat, reinforcing the unique landscape character of the region.

The Build Alternative would result in a 52.29-acre increase in impervious area comprising new roadway area (28.81 acres) and new sidewalk/SUP area (23.48 acres), which represents a permanent change in

[60] These classifications are based on a combination of MassGIS data and a review of aerials. A forest inventory has not been conducted. The remaining land use cover types that would comprise 1 acre or less include the following: Bare Land, Forested Wetland, Pasture/Hay, Non-forested Wetland, Water, Industrial, Residential, and Commercial.

land use for affected areas to transportation and right-of-way (**Table 6.2-2**). The Build Alternative would minimize new impervious area to the maximum extent practicable while still meeting the Program's purpose and need, with approximately 44.9% of the new impervious area associated with new sidewalk and SUP installation. Furthermore, the approximate 52.29-acre increase in impervious area would represent <1% of the total Study Areas.

Table 6.2-2. Change in Impervious Area (Sagamore Bridge and Bourne Bridge Study Areas)

Study Area Quadrant	Existing Impervious Area (acres)	Proposed Impervious Area (acres)	Impervious Area Increase (acres)	Increase as Percentage of Study Areas (%)
Sagamore North	25.29	34.78	9.49	0.4%
Sagamore South	19.80	34.22	14.42	0.6%
Bourne North	23.82	38.19	14.37	0.4%
Bourne South	21.80	35.81	14.01	0.4%
Total	**90.71**	**143.00**	**52.29**	**0.9%***

Note: Calculations based on analysis of changes in impervious surface in **Section 4.10, Water Quality and Stormwater**.

*Percentage of total Sagamore Bridge and Bourne Bridge Study Areas.

The Build Alternative's stormwater management system, which would implement best management practices (as described in **Section 4.10, Water Quality and Stormwater**) to collect and treat stormwater, would mitigate indirect effects from this increase in impervious surface. The Build Alternative's stormwater management system will prioritize the use of low-impact, green infrastructure, such as rain gardens and infiltration basins, and will improve the treatment and quality of the runoff that is eventually discharged to Cape Cod Canal and the Plymouth/Carver and Cape Cod sole source aquifers. During construction, MassDOT will implement measures to reduce adverse effects according to the Program's Construction Stormwater General Permit and will prepare and implement a Storm Water Pollution Prevention Plan in accordance with EPA's 2022 National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities.

6.2.3 Neighborhood and Community Cohesion Effects

For the Build Alternative, during construction, existing neighborhoods would continue to rely heavily on the existing Sagamore Bridge and Bourne Bridge, and post-construction, on the new bridges, as a key link to access cross-canal services and destinations.

MassDOT has determined that portions of the Canal Service Roads on both sides of each bridge within the bridge construction zone boundary would be closed due to safety concerns during the proposed bridge and mainline construction. The duration of closures would depend on location and proximity to the main span structure construction zones and the contractor's means and methods. In coordination with USACE, MassDOT is developing measures to minimize impacts to the Canal Service Roads, including keeping the Canal Service Roads open, when possible, during construction and creating turnaround areas with clear signage on the service roads at both sides of the bridge sites, when not

possible. MassDOT is also developing temporary connections to maintain east-west continuity of pedestrian and bicyclist routes within the Project Limits, allowing pedestrians to travel to and from either side of the bridge as they do in the existing condition.

Section 4.3, Pedestrian and Bicycle Facilities, provides additional details of construction mitigation measures, and **Attachment 4, Construction Schematics of Appendix 3.2, Construction Approach Technical Report,** provides graphics on proposed temporary conditions of pedestrian and bicycle facilities during construction. Construction sequencing would be finalized during the design-build process, and the design-build entity would determine the means and methods to ensure efficiency and safety.

As described in **Section 4.2, Transportation, Traffic, and Safety**, post-bridge construction, travel congestion on the bridges would decrease and local travel flow would improve for existing neighborhoods accessing medical facilities and appointments, community facilities, places of employment, and schools. Community service providers and emergency responders would experience reduced travel delays, which would result in improved quality-of-life benefits for existing residents.

The inclusion of Americans with Disabilities Act-compliant sidewalks and SUPs throughout the Study Area would enable access to community facilities and would improve accessibility and safety for all community members, including those with disabilities. The provision of active transportation accommodations in the Sagamore South quadrant would provide east-west connectivity along Cranberry Highway, as well as more direct access between the neighborhoods on the east side of U.S. Route 6 and Market Basket on the west side of U.S. Route 6. An additional SUP extension is proposed along Sandwich Road to Keith Field Recreation Area in Sagamore South, which would also include a rail crossing to the Canal Service Road. In addition to reducing the volume of regional traffic on Adams Street and Ben Abbey Road, the Build Alternative would include the Sandwich Road Extension, which would allow drivers to directly access Sandwich Road and avoid the Cranberry Highway Extension and the Market Basket Plaza driveways on Factory Outlet Road. This would improve local neighborhood navigability and accessibility, resulting in enhanced cohesion.

The Build Alternative at the Bourne North quadrant would provide grade separation over Scenic Highway for pedestrians and bicyclists, as well as a sidewalk and SUPs on Scenic Highway. By providing SUPs along Scenic Highway and from the Cape Cod Canal crossing to Belmont Circle, the Build Alternative would provide more opportunities to improve neighborhood accessibility to community facilities and services, specifically to the Nightingale Pond subdivision. In Bourne South, an extended SUP is proposed along Sandwich Road to Gallo Ice Arena, including a rail crossing connection from Gallo Ice Arena to the Canal Service Road. In addition to the pedestrian and bicycle facilities, the Build Alternative would substantially improve neighborhood cohesion by fully removing mainline State Route 28/State Route 25 traffic from the local roadway network.

The addition of pedestrian and bicycle accommodations and improved network connectivity throughout the Study Areas would result in enhanced community connectivity, and improved access to recreational opportunities, leisure activities, cultural events, and historical sites. The replacement bridges would feature outlooks and benches that would encourage use by bicyclists and pedestrians

and serve as informal gathering spaces or places for community members to interact and spend time together that would help strengthen community cohesion in the town of Bourne.

Furthermore, the Build Alternative would not permanently eliminate any critical connections that contribute to community connectivity, and access to community facilities would be maintained during and after bridge construction (refer to **Section 4.7, Community Facilities**, for more details). The existing bridges would remain to provide critical connections until the new bridges are in place. **Section 4.15, Visual Resources**, provides additional details regarding visual changes to communities. **Section 4.14, Noise and Vibration**, describes the temporary and permanent noise effects of the Build Alternative on existing neighborhoods.

7 Mitigation Measures

This section summarizes mitigation measures that will be employed to minimize detrimental land use effects resulting from the Build Alternative. Relevant mitigation measures are provided for each section included in the land use assessment, including land alteration, environmentally affected land use, and potential property effects. Additional details on subject-specific mitigation measures can be found in the following:

- **Section 4.3, Pedestrian and Bicycle Facilities**
- **Section 4.8, Property Acquisition, Displacement, and Relocation**
- **Section 4.10, Water Quality and Stormwater**
- **Section 4.14, Noise and Vibration**
- **Section 4.15, Visual Resources**

7.1 Land Alteration

MassDOT will mitigate the land alteration effects of the Build Alternative—including the increase in impervious surface and decrease in tree cover—by implementing an SWPPP for construction effects, providing stormwater management improvements, and implementing a substantial landscaping plan that will provide for approximately 185.83 acres of new landscaping and vegetation to repair, restore, and enhance temporarily disturbed land for operational effects. Additional information regarding the proposed landscape plan will be provided in subsequent environmental review documents. Mitigation methods will be as follows:

- MassDOT will incorporate multiple strategies to minimize deforestation and impervious surface creation during design and construction. These include optimizing the roadway footprint to reduce clearing and grading by using steeper side slopes where safe, using existing disturbed corridors wherever feasible during construction, and implementing tree preservation protocols, such as protection zones and selective clearing. Additionally, low-impact development stormwater features, such as vegetated swales and infiltration basins, will be integrated to offset impervious surface impacts. All proposed maintenance and inspection access roadways for MassDOT and USACE will use gravel pervious surfaces to further reduce impervious surface.

- As the design progresses, opportunities to further minimize land alteration and tree clearing will continue to be evaluated through iterative design reviews with environmental specialists. Measures under consideration include alternative construction techniques (e.g., retaining walls to reduce slope grading), utility corridor consolidation, and habitat connectivity enhancements. Early planting of fast-growing native species will be prioritized to accelerate canopy recovery and provide interim ecological benefits.
- MassDOT will implement a substantial landscaping plan that will provide new landscaping and vegetation for approximately 185.83 acres within the Study Areas to repair, restore, and enhance the landscape flanking the mainline highways, bridges, and local roads and connections. The landscape plan will include the following landscape types to restore disturbed sites and integrate the new infrastructure into the landscape:
  - **Landscape restoration** will consist of open meadow with scattered groupings of shrubs and clusters of trees. This landscape will stabilize highway edges and slopes, will blend with the edges of stormwater basins and forested areas, and will require minimal maintenance. Landscape restoration areas will be attractive to pollinators (such as birds and insects), which will aid in progressing the succession of this landscape.
  - **Reforestation** will consist of areas that are intended at maturity to have greater than 25% tree canopy coverage and will aim to establish a tree canopy and understory in the more immediate future following construction.
  - **Street tree planting** will be proposed where pedestrians, bicyclists, and motorists occupy the streetscape in order to shade pedestrian pavements, the SUP, and other hardscape surfaces.
  - **Lawn** will be placed along sidewalks and SUPs, in median strips, along Canal Service Roads, and in front of businesses and residences to blend with existing lawn.
  - **Stormwater basins and rain gardens** will be areas that allow the proposed stormwater basins to blend with the landscape in as naturalistic a way as possible while still maintaining their stormwater function.
  - **Buffer planting** will be areas intended to be an evergreen screen for abutters whose properties are adjacent to new infrastructure (such as walls, bridges, and roadways). This planting type is typically used along residential properties in a project area and is proposed mainly where space may be too limited for reforestation and immediate visual screening is desired. Buffer planting will consist of a mix of evergreen trees of varying heights and sizes.
  - **Roundabout planting** will comply with MassDOT's Guidelines for the Planning and Design of Roundabouts planting recommendations outlined in Chapter 13 of the MassDOT Project Development and Design Guide and will be adapted to the specific site conditions and context for each proposed roundabout.
  - **Special planting** will be reserved for highly visible areas in proximity to pedestrians, bicyclists, and motorists on local roads and where access is easy for regular maintenance. Special planting will consist of trees, shrubs, perennials, grasses, and groundcovers.

- The landscaping plan includes reforesting 23.24 acres of the 73.27 acres within the Sagamore Bridge Study Area and 19.23 acres of the 112.56 acres of proposed landscaping within the Bourne Bridge Study Area. In total, the combined Study Areas would include 42.47 acres of reforestation out of 185.83 acres of proposed landscaping.
- The landscape plan will be responsive to site conditions, the unique landscape and cultural history of the region, and the needs and requirements of the Federal Highway Administration and USACE. The following will be considered for the landscape design and will be tailored to the specific quadrants as appropriate:
  - Revegetate all areas disturbed by construction around the new Sagamore Bridge and Bourne Bridge, adjacent highways, local roadways, SUPs, stormwater and utility infrastructure, and construction staging areas.
  - Develop landscape zones that restore and/or enhance existing habitats and reinforce the unique landscape character of the region.
  - Screen undesirable views for both users of the project area as well as abutters. Improve sight lines and views while mitigating the appearance of undesirable areas within and beyond the bridge sites.
  - Provide shade in hardscape areas, including along local streetscapes and over the SUPs. This will improve the experience for site users while reducing the Urban Heat Island Effect.
  - Use landscape to create gateways as visitors approach Cape Cod.
  - Enhance pedestrian zones with planting at trailheads, in medians, and in roundabouts in lieu of impervious surfaces.
  - Integrate stormwater basins with the surrounding restored landscapes so they appear natural and contribute to the creation of habitat as much as possible.
  - Maintain site visibility for safety along highways and roadways and around pedestrian zones and off-road areas for site security.
  - Planting will provide primarily native, site appropriate planting throughout the Study Areas through the following actions:
    - Use low maintenance planting that is self-sustaining to improve the longevity of the new landscape.
    - Diversify the plant material to reduce possible mass devastation from future pests.
    - Propose hardy, coastal tolerant and urban tolerant plant material to survive the site conditions.
    - Use species that are attractive to pollinators and wildlife.
    - Propose drought-tolerant plant species for adaptability and suitability for minimally maintained areas of the Project Limits.

    - Account for sun/wind exposure – The availability of sunlight adjacent to and below bridges will dictate the appropriate plant species at certain locations around the site.

- Implement measures intended to reduce adverse effects from construction according to the Cape Cod Bridges' Construction Stormwater General Permit.
- Stabilize disturbed areas immediately when construction has ceased and not resume for more than 14 days.
- For trees that will not be cleared, plant protection fencing will be implemented for public places and staging or other construction activity for the purposes of tree preservation.
- As applicable, MassDOT will use plant protection fencing to minimize impacts to visual natural resources.
- Following completion of the land-based construction activities, acquired areas that are not used for the State Highway Layout will be restored to pre-existing conditions to the maximum extent practicable.
- Maintain adequate provisions for stormwater management during construction to prevent safety and maintenance issues by maintaining the drainage system during interim conditions, keeping catch basin inlet grates free of debris and sediment, and installing temporary features as necessary to prevent flooding after storm events.
- Prepare and implement an SWPPP in accordance with EPA's 2022 National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities. The SWPPP will describe the specific best management practices, installation methods and inspection requirements for temporary and permanent erosion and pollution prevention and sediment control practices.
- The minimum practices required in the SWPPP will include the following:
  - Installation of sediment controls along the top of the bank of Cape Cod Canal and inland wetland resource areas, such as silt fence and/or compost filter tubes.
  - Stabilized construction exits to prevent sediment tracking from the work area onto public ways.
  - Site-specific construction phasing plans to minimize the extent of the disturbance at any one time.
  - Catch basin inlet protection, including geotextile filter fabric.
  - Soil stockpile protection, including temporary erosion measures and perimeter controls.
  - Dust suppression, including watering.
  - Good housekeeping pollution prevention measures, including secondary containment.
  - Maintenance requirements.
  - Temporary and permanent stabilization requirements.

  - Recordkeeping/inspection requirements.
- Implement a stormwater treatment system for Build Alternative operations that prioritizes the use of low-impact, green infrastructure, such as rain gardens and infiltration basins.
- Install bioretention areas/rain gardens adjacent to proposed sidewalks and paths for treatment of pavement runoff when feasible.
- Treat stormwater runoff from the replacement bridges and roadway approaches using infiltration basins.

7.2 Neighborhood and Community Cohesion

The potential temporary and permanent effects of the Build Alternative on neighborhood and community cohesion will be mitigated using the following strategies:

- Provide clear signage and mapping for alternative routes to reduce confusion, ensuring accessibility for community members during the temporary closure of the Canal Service Road.
- Maintain all existing pedestrian and bicycle accommodations and routes in the Study Area.
- Maintain access to community facilities during and after bridge construction.
- Reduce regional traffic on local roads (e.g., Adams Street, Ben Abbey Road) and improve neighborhood accessibility through the following:
  - Improve access between the neighborhoods on the east side of U.S. Route 6 and Market Basket on the west side of U.S. Route 6.
  - Include the Sandwich Road Extension, which will allow drivers to directly access Sandwich Road and avoid the Cranberry Highway Extension and the Market Basket Plaza driveways on Factory Outlet Road.
  - Remove mainline State Route 28/State Route 25 traffic from the local roadway network.
- Provide Americans with Disabilities Act-compliant pedestrian and bicycle accommodations throughout the Study Area to improve community connectivity, provide multimodal travel options to community facilities, and improve the accessibility of existing neighborhoods.
- Install outlooks and benches along the replacement bridges that will encourage use by bicyclists and pedestrians and serve as informal gathering spaces and/or places for community members to interact and spend time together.