

# 4 Affected Environment, Environmental Consequences, and Mitigation

## 4.6 Land Use, Zoning, and Community Cohesion

### 4.6.1 Introduction

This section 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<sup>1</sup> and zoning policies<sup>2</sup> and the identification of local and regional master plans influencing land usage. Existing conditions for protected land uses,<sup>3</sup> land use growth assumptions, and community cohesion<sup>4</sup> are documented, and the effects of the No Build Alternative and Build Alternative on each of these categories are assessed. This section also identifies and assesses the potential for the Build Alternative to incorporate measures to avoid, minimize, and/or mitigate land alteration effects.

**Appendix 4.6, Land Use, Zoning, and Community Cohesion Technical Report**, provides additional details and information regarding the land use assessment. **Section 4.18, Solid and Hazardous Waste Material Management**, addresses potential effects on environmentally affected land uses and associated mitigation measures. **Section 4.8, Property Acquisition, Displacement, and Relocation**, addresses potential effects on property and associated mitigation measures.

#### 4.6.1.1 Regulatory Framework

**Table 4.6-1** details the resources providing the regulatory context and guidance for this analysis.

---

<sup>1</sup> 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 place.

<sup>2</sup> 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.

<sup>3</sup> 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 of Massachusetts.

<sup>4</sup> Community cohesion refers to the strength of relationships and sense of connection among individuals and groups within a community.

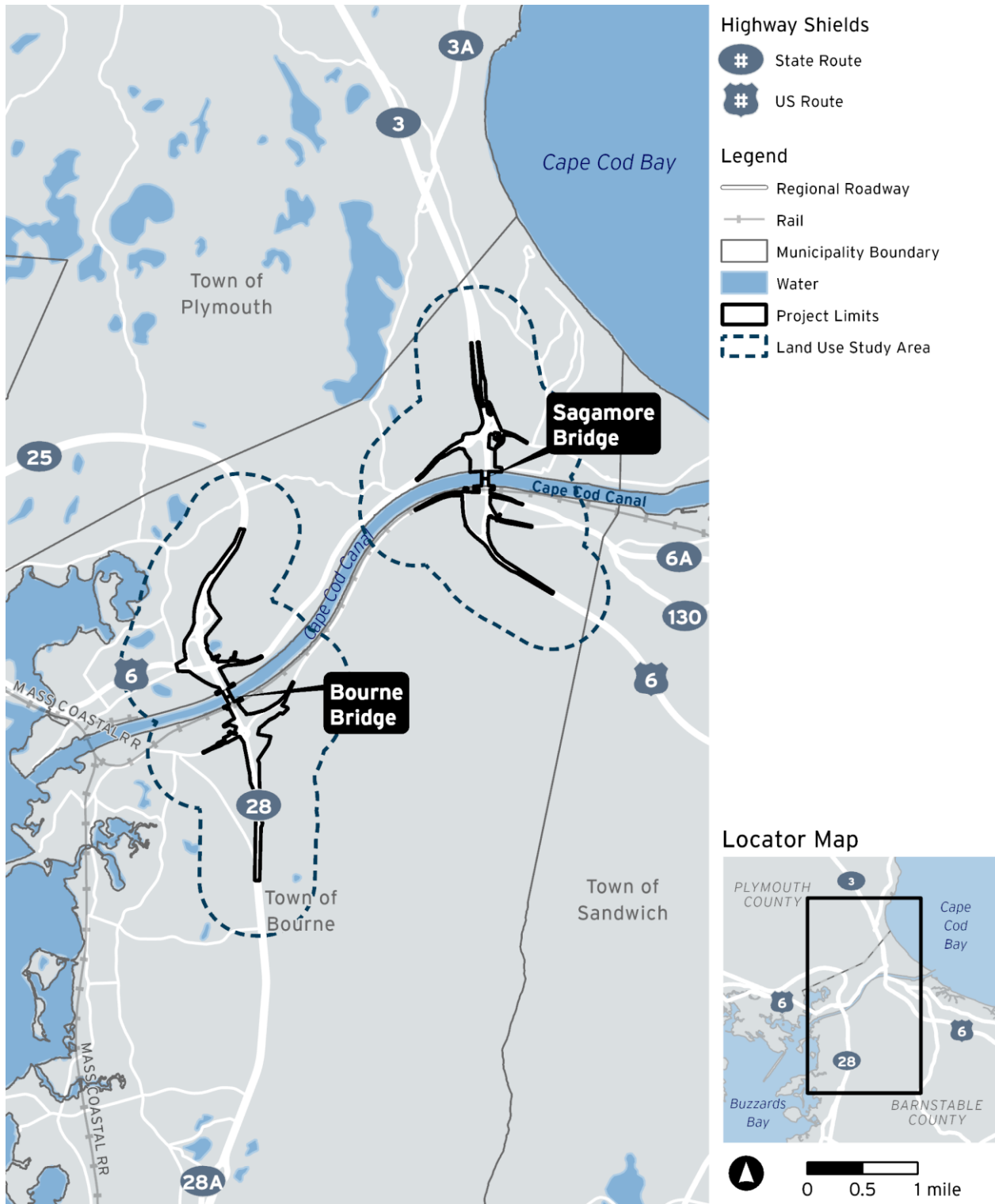
Table 4.6-1. Regulatory Framework for Land Use Assessment

Regulatory Jurisdiction	Regulatory Framework/Guidance
Federal	<ul style="list-style-type: none"> <li>• Safe Drinking Water Act of 1974 (Sole Source Aquifer Protection Program: Section 1424(e); Public Law 93-523, 42 United States Code [USC] et seq.)</li> </ul>
State	<ul style="list-style-type: none"> <li>• Massachusetts Zoning Act (Massachusetts General Law Chapter 40A)</li> <li>• Massachusetts Contingency Plan (Massachusetts General Law Chapter 21E: 310 CMR 40.00)</li> <li>• Areas of Critical Environmental Concern (Authorized under the Executive Office of Energy and Environmental Affairs: 301 Code of Massachusetts Regulations [CMR] 12.00)</li> </ul>
Local/Regional	<ul style="list-style-type: none"> <li>• Cape Cod Commission Regional Policy Plan. 2019.</li> <li>• Cape Cod Metropolitan Planning Organization. July 2023. Cape Cod 2024-2044 Regional Transportation Plan.</li> <li>• Town of Bourne Local Comprehensive Plan. 2019.</li> <li>• Town of Bourne. Open Space and Recreation Plan. February 2018.</li> <li>• Town of Bourne. Zoning Bylaw. October 2022.</li> </ul>

#### 4.6.1.2 Study Areas

The land use Study Areas consist of 0.5-mile buffers from the construction limits for the Build Alternative at Sagamore Bridge and Bourne Bridge ([Figure 4.6-1](#)). The Massachusetts Department of Transportation (MassDOT) defined these Study Areas to evaluate the direct and indirect effects of the Build Alternative on land use. “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.

Figure 4.6-1. Land Use Study Areas



Source: Massachusetts Department of Transportation, 2024

### 4.6.1.3 Methodology

To determine the affected environment and understand existing land use conditions in the Study Areas, this assessment used the following:

- Geospatial zoning data from the Cape Cod Commission<sup>5</sup>
- Land use and zoning documents from the Towns of Bourne, Sandwich, and Plymouth<sup>6</sup>
- Open space and protected land use geospatial data from MassGIS<sup>7</sup>

MassDOT identified local land use, zoning, and master plans in the Study Areas using the Town of Bourne’s Local Comprehensive Plan (LCP)<sup>8</sup> and the Cape Cod Regional Commission’s Regional Policy Plan (RPP),<sup>9</sup> and reviewed growth assumptions, travel demand, and traffic forecasting.

To understand existing conditions for community cohesion, MassDOT reviewed local planning documents and interviewed local officials to develop an understanding of community characteristics that contribute to, or that have adverse effects on, community cohesion.

To determine the potential effects of the No Build Alternative and Build Alternative on land use and community cohesion, MassDOT performed a qualitative analysis by overlaying the Project Limits and Study Areas with land use, zoning, and open space geospatial layers. Property acquisition and environmentally affected land effects were referenced from respective chapter analyses, and effects on land use were summarized. MassDOT qualitatively assessed and summarized the effects on community cohesion based on the anticipated effects of the Build Alternative on neighborhood connectivity and access to heritage sites, recreational areas, and community facilities.

---

<sup>5</sup> [Cape Cod Commission. 2014. Zoning](https://gis.data.mass.gov/datasets/CCCommission::zoning/about). April (updated August 2024).  
<https://gis.data.mass.gov/datasets/CCCommission::zoning/about>

<sup>6</sup> [Town of Bourne. 2011. Zoning Map](https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning_map_102511.pdf). October.  
[https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning\\_map\\_102511.pdf](https://www.townofbourne.com/sites/g/files/vyhlif12841/f/file/file/zoning_map_102511.pdf);  
[Town of Sandwich. 2017. Zoning Map](https://www.sandwichmass.org/DocumentCenter/View/3830/November-2017-Zoning-Map). <https://www.sandwichmass.org/DocumentCenter/View/3830/November-2017-Zoning-Map>;  
[Town of Plymouth. 2012. Zoning Map](https://www.plymouth-ma.gov/DocumentCenter/View/1435/Standard-Zoning-PDF). <https://www.plymouth-ma.gov/DocumentCenter/View/1435/Standard-Zoning-PDF>  
[Town of Bourne. 2022. Zoning Bylaw](https://www.townofbourne.com/sites/g/files/vyhlif12841/f/uploads/zoning_bylaw_2022_for_website_1.pdf). October.  
[https://www.townofbourne.com/sites/g/files/vyhlif12841/f/uploads/zoning\\_bylaw\\_2022\\_for\\_website\\_1.pdf](https://www.townofbourne.com/sites/g/files/vyhlif12841/f/uploads/zoning_bylaw_2022_for_website_1.pdf)  
[Town of Sandwich. 2024. Zoning Bylaw](https://www.sandwichmass.org/DocumentCenter/View/9660/May-2024-Zoning-Bylaw). <https://www.sandwichmass.org/DocumentCenter/View/9660/May-2024-Zoning-Bylaw>  
[Town of Plymouth. 2024. Zoning Bylaw](https://www.plymouth-ma.gov/DocumentCenter/View/7334/Zoning-Bylaw-10-2024). <https://www.plymouth-ma.gov/DocumentCenter/View/7334/Zoning-Bylaw-10-2024>

<sup>7</sup> [MassGIS Data. 2024. Protected and Recreational OpenSpace](https://www.mass.gov/info-details/massgis-data-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). <https://www.mass.gov/info-details/acec-program-overview>

<sup>8</sup> [Town of Bourne. 2019. Bourne Local Comprehensive Plan](https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan). <https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan>

<sup>9</sup> [Cape Cod Regional Commission. 2019. Cape Cod Regional Policy Plan](https://www.capecodcommission.org/our-work/rpp/).  
<https://www.capecodcommission.org/our-work/rpp/>

## 4.6.2 Affected Environment

### 4.6.2.1 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.

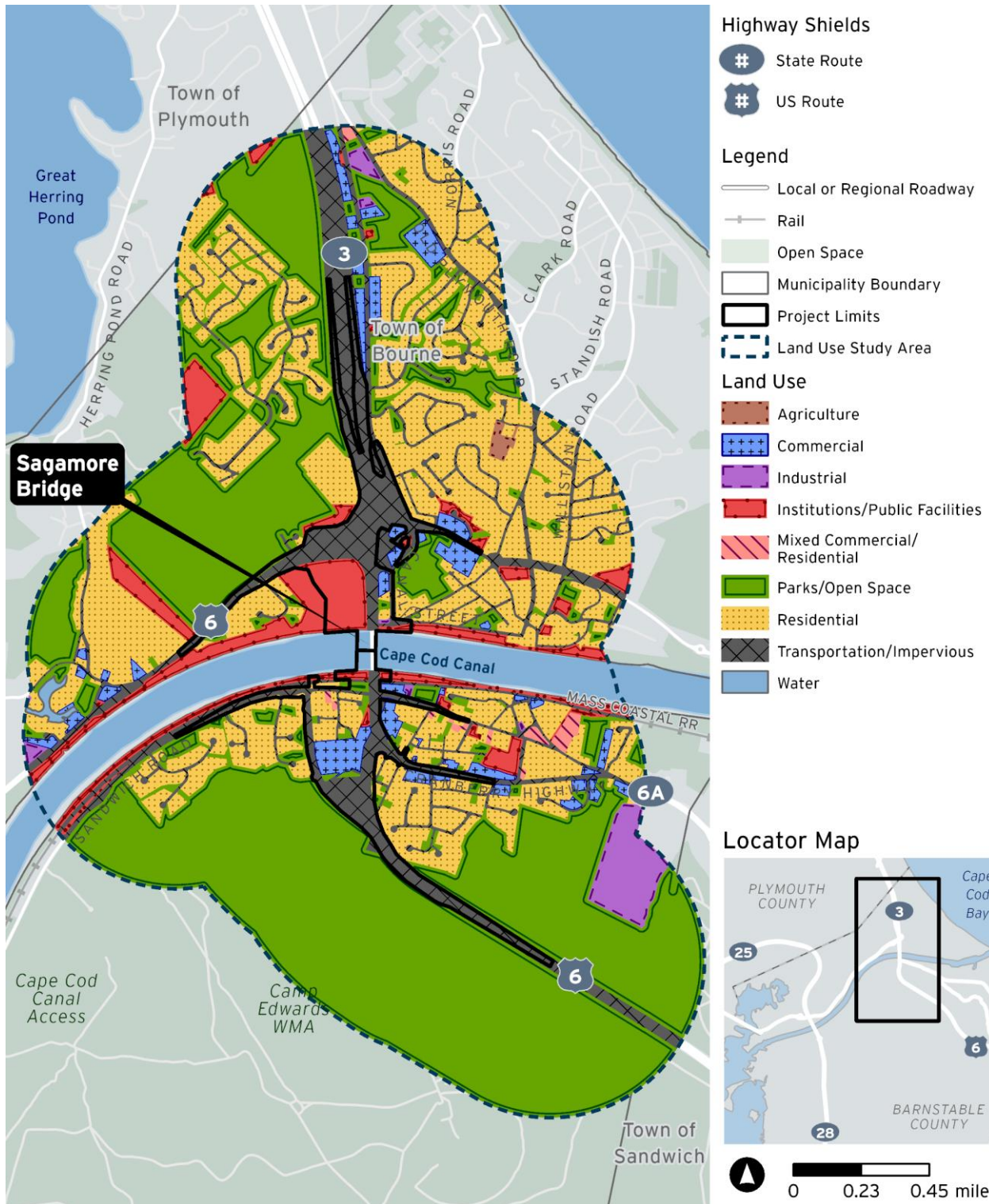
### 4.6.2.2 Existing Land Use

The Study Areas consist of a variety of land uses, as illustrated in [Figure 4.6-2](#) and [Figure 4.6-3](#), and listed in [Table 4.6-2](#) and [Table 4.6-3](#). The land use assessment excludes the Cape Cod Canal area featured in each bridge's Study Area when calculating total land use acreage. 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 (45.1%), followed by residential (25.0%), and transportation/impervious land uses (13.3%). Water comprises 6.2% of the Study Area (inclusive of the canal), institutions/public facilities comprise 5.4%, while commercial land uses comprise 2.9%, and the remaining land uses (mixed commercial/residential, industrial, and agriculture) consist of 2% or less of the Study Area ([Table 4.6-2](#)).

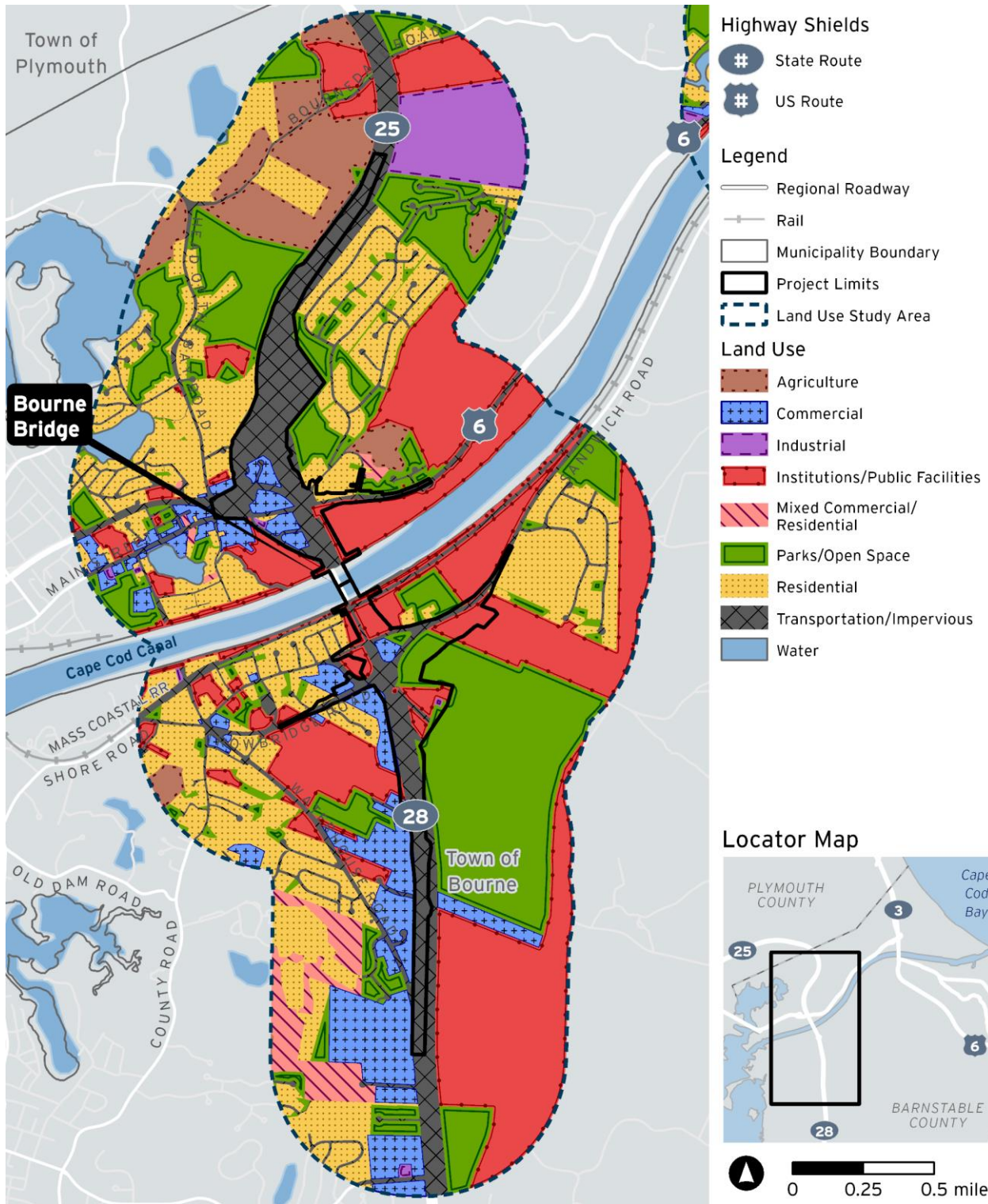
The Bourne Bridge Study Area primarily comprises institutions/public facilities (23.9%), park/open space (21.5%), residential (19.9%), and transportation/impervious land uses (13.1%). Commercial land uses amount to 6.7%, water comprises 5.2% (inclusive of the canal), and agricultural uses amount to 4.8% of the Study Area. Lastly, industrial consists of 2.8% and mixed commercial/residential consists of 2.0% of the Study Area ([Table 4.6-3](#)).

Figure 4.6-2. Land Use Classifications (Sagamore Bridge Study Area)



Source: Massachusetts Department of Transportation, 2024

Figure 4.6-3. Land Use Classifications (Bourne Bridge Study Area)



Source: Massachusetts Department of Transportation, 2024

Table 4.6-2. Land Use Classifications (Sagamore Bridge Study Area)

Land Use Category	Acres in Sagamore Bridge Study Area	Percentage of Study Area
Agriculture	4.53	0.2%
Commercial	87.72	2.9%
Industrial	48.02	1.6%
Institutions/Public Facilities	162.77	5.4%
Mixed Commercial/Residential	10.04	0.3%
Parks/Open Space	1,349.69	45.1%
Residential	748.29	25.0%
Transportation/Impervious	397.20	13.3%
Water	185.84	6.2%
<b>Total</b>	<b>2,994.11*</b>	<b>100.0%</b>

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

Table 4.6-3. Land Use Classifications (Bourne Bridge Study Area)

Land Use Category	Acres in Bourne Bridge Study Area	Percentage of Study Area
Agriculture	168.92	4.8%
Commercial	237.19	6.7%
Industrial	99.71	2.8%
Institutions/Public Facilities	840.11	23.9%
Mixed Commercial/Residential	71.43	2.0%
Parks/Open Space	755.49	21.5%
Residential	698.82	19.9%
Transportation/Impervious	460.40	13.1%
Water	182.47	5.2%
<b>Total</b>	<b>3,514.55*</b>	<b>100.0%</b>

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

### 4.6.2.3 Zoning

According to the Bourne,<sup>10</sup> Sandwich, and Plymouth zoning maps<sup>11</sup> and zoning bylaws,<sup>12</sup> the Sagamore Bridge Study Area comprises approximately 1,348.29 acres of Residential Districts (47.9% of the Sagamore Bridge Study Area), 689.44 acres of Government Districts (24.5%), 326.92 acres of Scenic Development Districts (11.6%), 261.71 acres of Business Districts (9.3%), and 27.54 acres of Village Business Districts (1%). The remaining approximately 160.79 acres in the Study Area comprise unclassified right-of-way (5.7%).<sup>13</sup> Within the Sagamore Bridge Study Area, land abutting the Project Limits is primarily zoned for residential or business use, with some sections zoned for scenic development and governmental use.

The Bourne Bridge Study Area comprises 1,808.09 acres of Residential Districts (53.8% of the Bourne Study Area), 706.99 acres of Business Districts (21.0%), 215.86 acres within the Downtown District (6.4%), 205.61 acres of Scenic Development Districts (6.1%), 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%). Within the Bourne Bridge Study Area, land abutting the Project Limits is primarily zoned for residential or business use, with some sections zoned for scenic development, and some zoned under the Downtown District.

**Figure 4.6-4** and **Figure 4.6-5** illustrate the Study Areas' zoning districts.<sup>14</sup>

---

<sup>10</sup> The Sagamore Bridge Study Area primarily overlaps Bourne, but small portions of the Study Area also overlap Sandwich and Plymouth. The Bourne Bridge Study Area only overlaps Bourne.

<sup>11</sup> [Town of Bourne. 2011. Zoning Map.](#) October.

[https://www.townofbourne.com/sites/g/files/vyhlf12841/f/file/file/zoning\\_map\\_102511.pdf](https://www.townofbourne.com/sites/g/files/vyhlf12841/f/file/file/zoning_map_102511.pdf);

[Town of Sandwich. 2017. Zoning Map.](#) <https://www.sandwichmass.org/DocumentCenter/View/3830/November-2017-Zoning-Map>;

[Town of Plymouth. 2012. Zoning Map.](#) <https://www.plymouth-ma.gov/DocumentCenter/View/1435/Standard-Zoning-PDF>

<sup>12</sup> [Town of Bourne. 2022. Zoning Bylaw.](#) October.

[https://www.townofbourne.com/sites/g/files/vyhlf12841/f/uploads/zoning\\_bylaw\\_2022\\_for\\_website\\_1.pdf](https://www.townofbourne.com/sites/g/files/vyhlf12841/f/uploads/zoning_bylaw_2022_for_website_1.pdf);

[Town of Sandwich. 2024. Zoning Bylaw.](#) <https://www.sandwichmass.org/DocumentCenter/View/9660/May-2024-Zoning-Bylaw>;

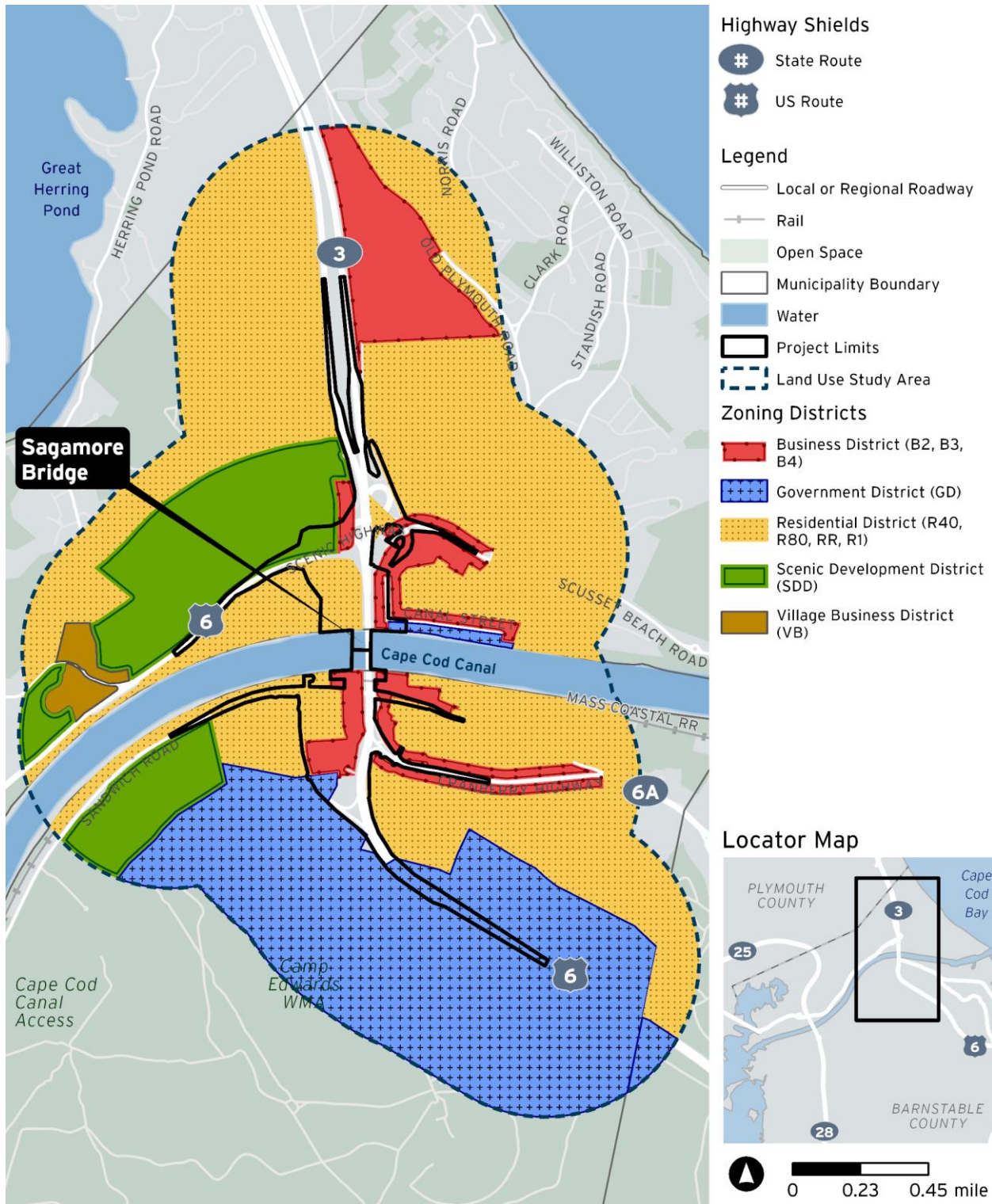
[Town of Plymouth. 2024. Zoning Bylaw.](#) <https://www.plymouth-ma.gov/DocumentCenter/View/7334/Zoning-Bylaw-10-2024>;

<sup>13</sup> The canal is excluded from zoning, so it is not included in the total Study Area acreage for the zoning calculations.

<sup>14</sup> [Cape Cod Commission. 2014. Zoning.](#) Updated August 2024.

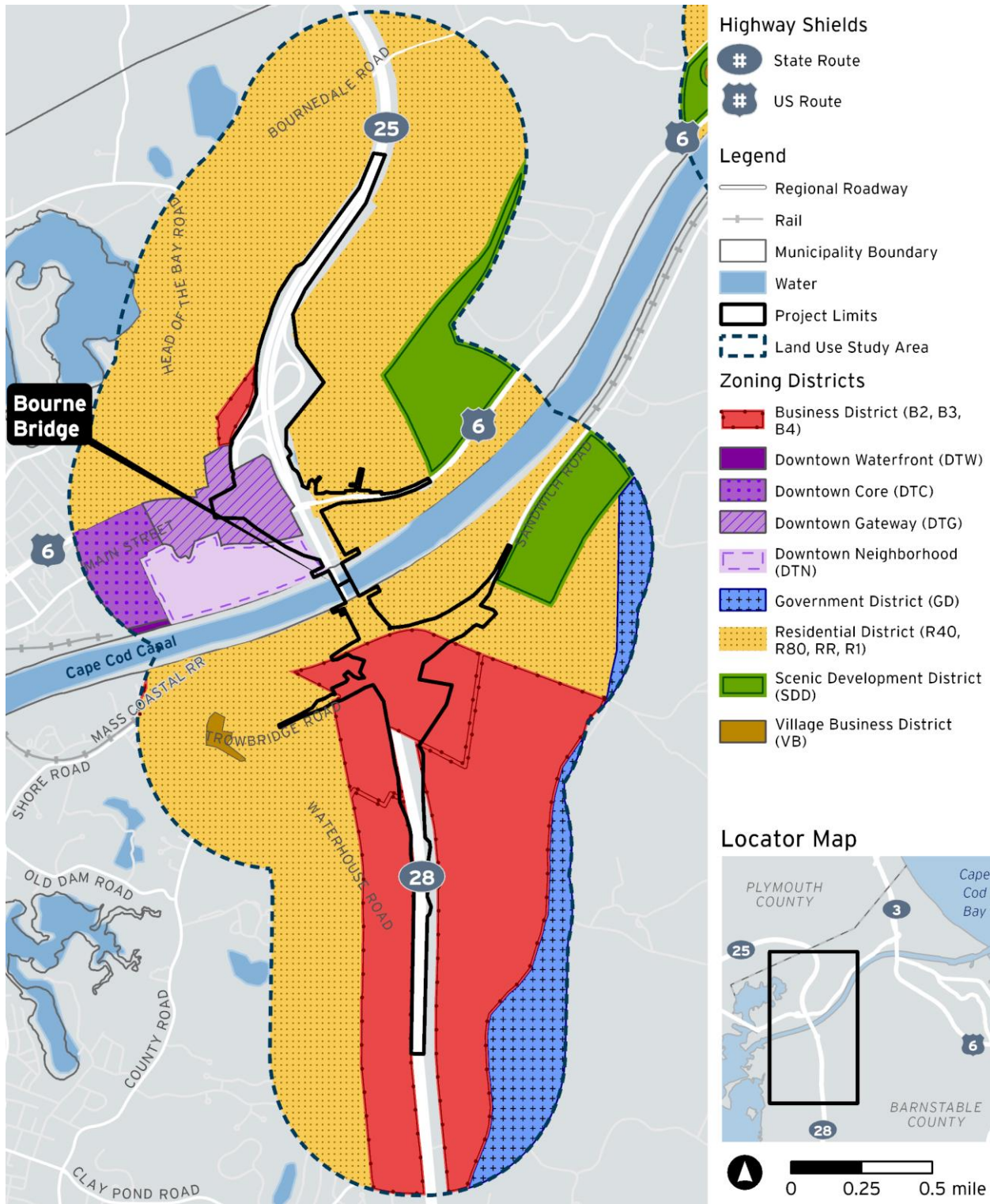
<https://gis.data.mass.gov/datasets/CCCommission::zoning/about>

Figure 4.6-4. Zoning Classifications (Sagamore Bridge Study Area)



Source: Massachusetts Department of Transportation, 2024

Figure 4.6-5. Zoning Classifications (Bourne Bridge Study Area)



Source: Massachusetts Department of Transportation, 2024

#### 4.6.2.4 Identification of Master Plans

The Town of Bourne LCP, revised 2019, was approved by Town Meeting on October 29, 2019, and certified by the Cape Cod Commission in December 2019.<sup>15</sup> 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.<sup>16</sup> 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.

#### 4.6.2.5 Protected Land Uses

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

##### Open Space

The 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.<sup>17</sup> **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 Bourne Bridge and Sagamore 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.

##### Areas of Critical Environmental Concern

An Area of Critical Environmental Concern (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 include wildlife habitats, wetlands, estuaries, rivers, coastal areas, or

---

<sup>15</sup> [Town of Bourne. 2019. Bourne Local Comprehensive Plan](https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan). December. <https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan>

<sup>16</sup> [Cape Cod Regional Commission. 2021. Cape Cod Regional Policy Plan](https://www.capecodcommission.org/our-work/rpp/). <https://www.capecodcommission.org/our-work/rpp/>

<sup>17</sup> American Planning Association. 2000. [Parks, Recreation, and Open Space: A Twenty-first Century Agenda](https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/PAS-Report-497-498.pdf). PAS Report Number 497/498. [https://planning-org-uploaded-media.s3.amazonaws.com/publication/download\\_pdf/PAS-Report-497-498.pdf](https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/PAS-Report-497-498.pdf)

other ecosystems that play an essential role in maintaining environmental quality.<sup>18</sup> The designation is intended to preserve these areas by ensuring careful land use and development practices.<sup>19</sup>

The Study Areas comprise two ACECs (**Figure 4.6-6**):

- **Sagamore Bridge Study Area:** The Herring River Watershed ACEC, a 4,450-acre area comprising open space, lakes and ponds, freshwater wetlands, and cranberry bogs, is north of the Sagamore Bridge and west of State Route 3. Approximately 686.47 acres of the ACEC are within the Sagamore Bridge Study Area, representing about 22.9% of the Study Area.<sup>20</sup>
- **Bourne Bridge Study Area:** 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 451.12 acres of the ACEC are within the Bourne Bridge Study Area, representing about 12.8% of the Study Area.<sup>21</sup>

**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.

---

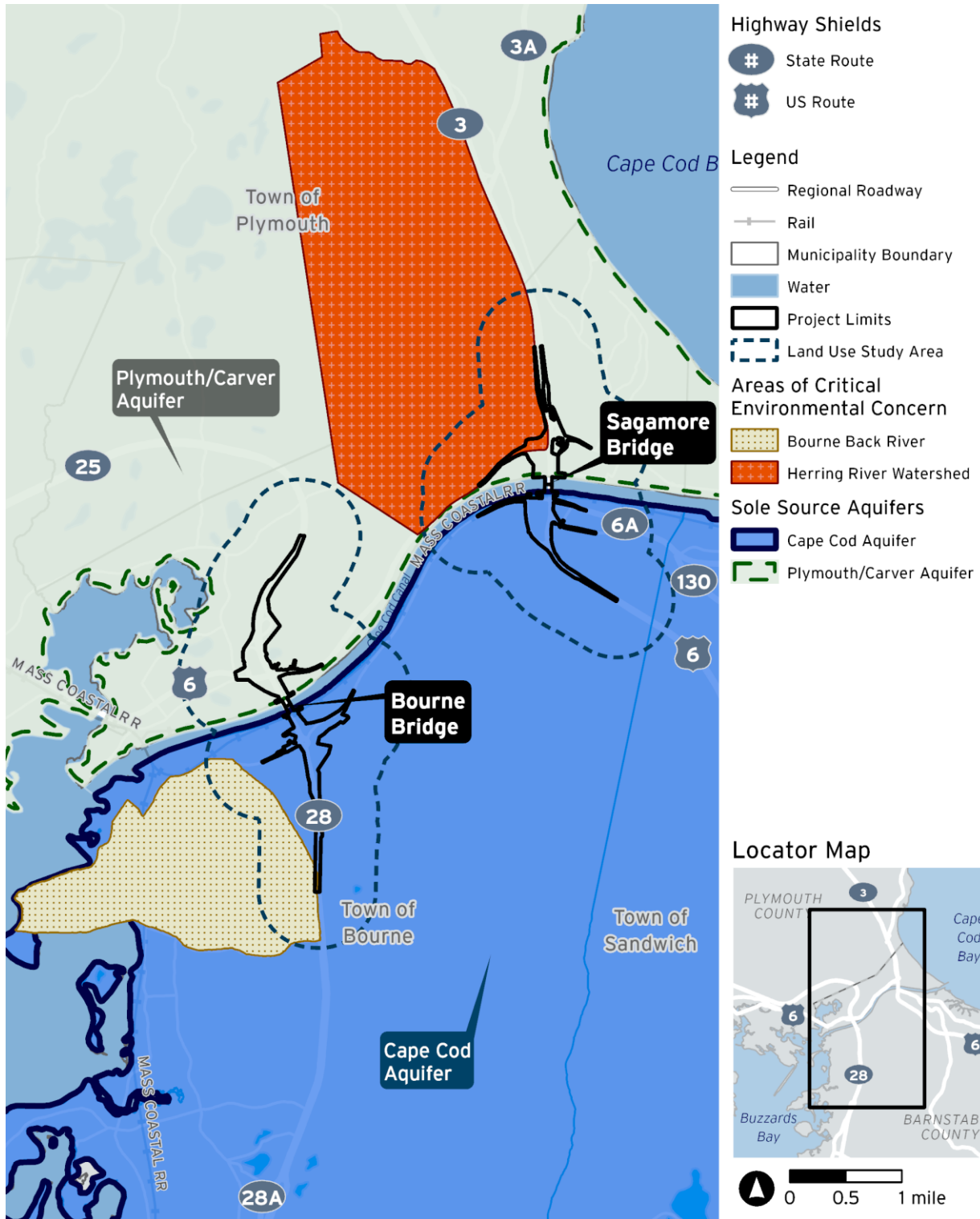
<sup>18</sup> [MassGIS. 2009. Areas of Critical Environmental Concern](https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern). April. <https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern>

<sup>19</sup> [Mass.gov. ACEC Program Overview](https://www.mass.gov/info-details/acec-program-overview). <https://www.mass.gov/info-details/acec-program-overview>

<sup>20</sup> [MassGIS. 2009. Areas of Critical Environmental Concern](https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern). April. <https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern>

<sup>21</sup> [MassGIS. 2009. Areas of Critical Environmental Concern](https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern). April. <https://www.mass.gov/info-details/massgis-data-areas-of-critical-environmental-concern>

Figure 4.6-6. Areas of Critical Environmental Concern and Sole Source Aquifers (Land Use Study Areas)



Source: Massachusetts Department of Transportation, 2024

## Sole Source Aquifers

The U.S. Environmental Protection Agency (EPA) designates sole source aquifers (SSA) as aquifers that supply at least 50% of the drinking water consumed in the area overlying the aquifer. The SSA protection program protects drinking water supplies in areas with few or no alternative sources to the ground water 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 groundwater resource by requiring the EPA to review proposed projects receiving federal funds within the designated area to ensure that they do not endanger the water source.<sup>22</sup>

The Study Areas comprise two SSAs (**Figure 4.6-6**):

- North of Cape Cod Canal: Plymouth/Carver SSA, designated by the 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 Plymouth/Carver 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. The SSA supports local ecosystems, including lakes, ponds, wetlands, and cranberry bogs. Approximately 1,565.26 acres of the Plymouth/Carver SSA are within the Bourne Bridge Study Area, representing about 44.6% of the Study Area, and approximately 1,523.24 acres are within the Sagamore Bridge Study Area, representing about 50.9% of the Study Area.<sup>23</sup>
- South of Cape Cod Canal: Cape Cod SSA, designated by the 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.<sup>24</sup> The SSA is the largest 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. The SSA sustains the region’s freshwater ponds, wetlands, and open spaces. Approximately 1,836.37 acres of the SSA are within the Bourne Bridge Study Area, representing about 52.3% of the Study Area, and approximately 1,318.29 acres are within the Sagamore Bridge Study Area, representing about 44.0% of the Study Area.<sup>25</sup>

**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 SSAs, and relevant mitigation measures to offset any adverse effects.

---

<sup>22</sup> MassGIS. 2020. [EPA Designated Sole Source Aquifers](https://www.mass.gov/info-details/massgis-data-epa-designated-sole-source-aquifers). September. <https://www.mass.gov/info-details/massgis-data-epa-designated-sole-source-aquifers>

<sup>23</sup> U.S. Environmental Protection Agency. [EPA Region 1 - Sole Source Aquifer Program: Plymouth/Carver](https://www3.epa.gov/region1/eco/drinkwater/plymcarv.html). <https://www3.epa.gov/region1/eco/drinkwater/plymcarv.html>

<sup>24</sup> [Data Cape Cod. 2023. Year-Round Population](https://datacapecod.org/pf/barnstable-county-year-round-population/). <https://datacapecod.org/pf/barnstable-county-year-round-population/>

<sup>25</sup> [U.S. Environmental Protection Agency. 1982. Cape Cod Aquifer Determination](https://www3.epa.gov/region1/eco/drinkwater/solecape.html). <https://www3.epa.gov/region1/eco/drinkwater/solecape.html>

#### 4.6.2.6 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' yearly county population estimates, from 2020 to 2021, during the COVID-19 pandemic, population growth in Barnstable County increased 1.9%, likely resulting from flexible remote work policies and the associated influx of city-dwellers into suburban areas.<sup>26</sup> From 2021 to 2024, the Barnstable County population remained steady, increasing or decreasing by less than 0.1% per year.<sup>27</sup>

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).<sup>28</sup>

Although the 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,<sup>29</sup> 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

---

<sup>26</sup> U.S. Census Bureau. [More Exurban Communities Now Among Nation's Fastest Growing Places](https://www.census.gov/library/stories/2024/05/exurbs-city-population.html#:~:text=Multiple%20factors%20are%20likely%20behind,from%20home%20also%20likely%20contributed). 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>.

<sup>27</sup> 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](#)

<sup>28</sup> U.S. Census Bureau. [QuickFacts: Barnstable County, MA](#). [https://www.census.gov/quickfacts/fact/table/barnstablecountymassachusetts/AGE295221?utm\\_](https://www.census.gov/quickfacts/fact/table/barnstablecountymassachusetts/AGE295221?utm_)

<sup>29</sup> 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.<sup>30</sup> As a result, residential housing in Barnstable County is expected to be at or above capacity,<sup>31</sup> 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,<sup>32</sup> wastewater infrastructure limitations,<sup>33</sup> water supply constraints,<sup>34</sup> 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,<sup>35</sup> and the 2018 Cape Cod Emergency Traffic Plan,<sup>36</sup> 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.

#### 4.6.2.7 Community Cohesion

This section identifies the existing community characteristics that contribute to community cohesion and features that currently divide neighborhoods.

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. 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.

---

<sup>30</sup> Cape Cod Commission. [Cape Cod Housing Needs](https://capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/housing/CC-Housing-Needs-Assessment-2023.pdf&_gl=1*a51bx9*_ga*NzA5NzU0NDZlE3Mjk1NDAwMzc.*_ga_LTW777CPM1M*MTc0MTE5NDYwNi4yNC4xLjE3NDExOTYyOTUuMC4wLjA). 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\\*NzA5NzU0NDZlE3Mjk1NDAwMzc.\\*\\_ga\\_LTW777CPM1M\\*MTc0MTE5NDYwNi4yNC4xLjE3NDExOTYyOTUuMC4wLjA](https://capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/housing/CC-Housing-Needs-Assessment-2023.pdf&_gl=1*a51bx9*_ga*NzA5NzU0NDZlE3Mjk1NDAwMzc.*_ga_LTW777CPM1M*MTc0MTE5NDYwNi4yNC4xLjE3NDExOTYyOTUuMC4wLjA).

<sup>31</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>32</sup> County of Barnstable. 2023. [Barnstable County HOME Consortium Program Year 2023 Annual Action Plan](https://www.capecod.gov/wp-content/uploads/2022/03/AAP-2023-Approved.pdf). July. <https://www.capecod.gov/wp-content/uploads/2022/03/AAP-2023-Approved.pdf>

<sup>33</sup> [Cape Cod Commission. Our Work: Wastewater](https://www.capecodcommission.org/our-work/wastewater/). Accessed December 2024. <https://www.capecodcommission.org/our-work/wastewater/>

<sup>34</sup> Cape Cod Commission. 2015. [Cape Cod Area Wide Water Quality Management Plan Update](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). 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](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)

<sup>35</sup> Cape Cod Commission. [Cape Cod Regional Transportation Plan 2024-2044](https://www.capecodcommission.org/our-work/rtp). <https://www.capecodcommission.org/our-work/rtp>

<sup>36</sup> Commonwealth of Massachusetts. 2018. [Cape Cod Emergency Traffic Plan](https://www.mass.gov/doc/cape-cod-emergency-traffic-plan/download). July. <https://www.mass.gov/doc/cape-cod-emergency-traffic-plan/download>

## Challenges To Community Cohesion

Community cohesion is directly affected by the Cape Cod Canal, which divides the town of Bourne into two distinct segments. The only vehicle access on/off Cape Cod and over the canal is through 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 to access key destinations, such as places of employment, medical facilities, grocery stores, schools, places of worship, and recreational facilities.<sup>37, 38</sup> This regular crossing poses a continuous challenge to community cohesion.

Cohesion is further hindered by the locations of Bourne town services in relation to the canal, which has implications for disaster and emergency response. The Town of Bourne Police Department is north of the canal. The Massachusetts State Police Bourne Barracks are south of the canal. The Town of Bourne Fire and Police Departments require several daily trips across the bridges for supplies and fuel, to conduct inspections and training, and to respond to emergencies.<sup>39</sup> Summer congestion on the bridges results in delayed emergency responses, limitations in terms of hospital access, altered work schedules, and the need to hire additional staff on overtime to accommodate for traffic delays.<sup>40, 41</sup>

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. Considering that many older residents travel off Cape Cod for medical appointments or emergencies, bridge bottlenecks from seasonal road congestion can hinder access to essential care, creating significant barriers in elder care support and challenging community cohesion.<sup>42</sup>

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. 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

---

<sup>37</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>38</sup> Town of Bourne. 2024. Virtual Interviews: Local Officials. August.

<sup>39</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>40</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>41</sup> Town of Bourne. Virtual Interviews: Local Officials. August 2024.

<sup>42</sup> Town of Bourne. Virtual Interviews: Local Officials. August 2024.

services in a timely manner, must alter their travel behavior in response to these traffic patterns, and as a result may choose not to travel at all.<sup>43</sup>

### Drivers of Community Cohesion

All vehicles, bikes, and pedestrians traveling onto Cape Cod must pass over Sagamore Bridge or Bourne Bridge.<sup>44</sup> Physical community cohesion is enabled by the town of Bourne’s 190 miles of roadway that residents and visitors use to travel within the town of Bourne and to connect with the rest of Cape Cod. The Cape Cod Canal Service Roads connect pedestrians and bicyclists with SUPs, the Cape Cod Line rail service travels through and stops in the town of Bourne, and 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. (**Section 4.2, Transportation, Traffic, and Safety**, provides more information.)<sup>45</sup> These routes and paths serve as the existing transportation network in the town of Bourne and connect residents to key destinations and promote neighborhood cohesion.

Within the Study Areas and throughout the Upper Cape, the town of 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 town of Bourne residents. Connectivity to accessible leisure activities is particularly valued as a community characteristic by older adults who relocated to Cape Cod for retirement.<sup>46, 47</sup> Providing access and connections to these activities is essential in supporting cohesion.

In addition to recreation opportunities and leisure activities, the Town of Bourne values and prioritizes the preservation of and access to historical architecture 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.<sup>48</sup> **Section 4.16, Cultural Resources**, provides information on cultural resources and historical places of significance in and near the Study Areas.

---

<sup>43</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>44</sup> [Town of Bourne. 2019. Bourne Local Comprehensive Plan](https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan). <https://www.townofbourne.com/planning/news/local-comprehensive-final-certified-plan>

<sup>45</sup> [Cape Cod Regional Commission. 2019. Cape Cod Regional Policy Plan](https://www.capecodcommission.org/our-work/rpp/). <https://www.capecodcommission.org/our-work/rpp/>

<sup>46</sup> U.S. Army Corps of Engineers. 2022. [Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation. Cape Cod Canal Highway Bridges](https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf), Massachusetts. March. <https://www.nae.usace.army.mil/Portals/74/docs/Topics/Cape%20Cod%20Canal%20Bridges/Reports/MRREnvAssessment.pdf>

<sup>47</sup> Town of Bourne. Virtual Interviews: Local Officials. August 2024.

<sup>48</sup> Massachusetts Historical Commission. n.d. [MACRIS: Massachusetts Cultural Resource Information System](https://mhc-macris.net/queryresults). <https://mhc-macris.net/queryresults>

### 4.6.3 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.

For the No Build Alternative, routine travel on, off, and within Cape Cod, 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**. 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.

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

### 4.6.4 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. Property effects, ACECs, SSAs, protected open space, and environmentally affected land use—along with associated mitigation measures—are evaluated and assessed, respectively, in the following sections:

- **Section 4.8, Property Acquisition, Displacement, and Relocation**
- **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**

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. 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 4.6.5](#) for additional details. For additional information regarding permanent property effects, refer to [Section 4.8, Property Acquisition, Displacement, and Relocation](#).

#### 4.6.4.1 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 effects from the Build Alternative include an estimated 306.39 acres of land alteration ([Table 4.6-4](#)), including 132.14 acres of tree clearing to allow for temporary roadways, permanent roadways, and SUP installation. This will result in a 50.84-acre increase in impervious area comprising new roadway and SUP area, which represents a permanent land use change to right-of-way/transportation ([Table 4.6-5](#)).

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 to 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 would 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.

#### 4.6.4.2 Land Alteration Effects

The Build Alternative would result in approximately 306.39 acres of total land alteration, including 132.14 acres of tree clearing, 74.77 acres of alteration to existing pavement (e.g., mill and overlay, roadway reconstruction, etc.), and 99.48 acres of alteration to previously disturbed areas (e.g., grassy areas, stormwater best management practices, etc.). To mitigate these effects, MassDOT will implement a landscaping plan that will provide new landscaping and vegetation for over 200 acres within the Study Areas through landscape restoration and reforestation; street tree, buffer, and roundabout planting; lawn re-seeding; and the creation of stormwater basins and rain gardens. [Table 4.6-6](#) outlines the landscaping plan in greater detail. [Table 4.6-4](#) provides a breakdown of the proposed land use alteration effects by Study Area quadrant.

Table 4.6-4. 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	38.77	18.04	17.98	74.79	2.7%
Sagamore South	23.83	20.76	17.27	61.87	2.2%
Bourne North	23.83	21.70	41.20	86.73	2.6%
Bourne South	45.71	14.27	23.03	83.00	2.5%
<b>Total</b>	<b>132.14</b>	<b>74.77</b>	<b>99.48</b>	<b>306.39</b>	<b>5.0%*</b>

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 132.14 acres (2.8% 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 (76.01 acres), but the affected land would also contain right-of-way (22.06 acres), scrub-shrub (13.02 acres), grassland (6.74 acres), impervious surface (5.19 acres), bare land (2.24 acres), and tax exempt (2.10 acres) land cover types.<sup>49</sup> Tree clearing would be required to allow new roadways to be constructed and temporary roadways to facilitate construction phasing operations, and to ensure proper sightlines are achieved for safety. Furthermore, approximately 13.8% 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, 75.07 acres—or 57.1% 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—such as increased air pollution, decreased water quality from stormwater runoff, and elevated surface temperatures—invasive species often outcompete native species. In these areas, 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.

<sup>49</sup> 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 less than 1 acre include the following: Forested Wetland, Pasture/Hay, Non-forested Wetland, Water, Industrial, Residential, Open Land, and Commercial.

The Build Alternative would result in a 50.84-acre increase in impervious area comprising new roadway (32.80 acres), sidewalk (2.06 acres), and SUP area (16.04 acres), which would represent a permanent change in land use for affected areas to transportation and right-of-way (Table 4.6-5). The Build Alternative would minimize new impervious area to the maximum extent practicable while still meeting the Cape Cod Bridges Program’s (Program) purpose and need, with approximately 35% of the new impervious area associated with new sidewalk and SUP installation. Furthermore, the approximate 50.84-acre increase in impervious area would represent <1% of the total Study Areas.

Table 4.6-5. 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	23.91	34.11	10.20	0.4%
Sagamore South	19.00	34.05	15.05	0.5%
Bourne North	23.27	36.70	13.43	0.4%
Bourne South	20.74	32.90	12.16	0.4%
<b>Total</b>	<b>86.92</b>	<b>137.76</b>	<b>50.84</b>	<b>0.8%*</b>

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 SSAs. 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 the EPA’s 2022 National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities.

#### 4.6.4.3 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. During construction, the construction zone designated for the crane placement for bridge demolition and construction would affect the Canal Service Road and Bourne Recreation Area in the Bourne South quadrant, and Sagamore Recreation Area in the Sagamore North quadrant. The temporary closure of the Canal Service Road would affect approximately 0.31 acres, including the parking lot along the Canal Service Road (additional discussion of construction-period effects and associated mitigation measures is included in Chapter 5, Draft Section 4(f) Evaluation). However, the Build Alternative would minimize construction-period effects

upon local communities, and during construction would maintain the existing pedestrian and bicycle connections with detours or temporary connections as needed. All existing vehicular traffic movements would be maintained throughout construction without the requirement of detours.

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 Areas would enable access to community facilities and 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. 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, which would result in enhanced cohesion.

The Build Alternative in the Bourne North quadrant would provide grade separation over Scenic Highway for pedestrians and bicyclists, as well as a sidewalk and SUP on Scenic Highway. By providing SUPs along Scenic Highway and from the canal crossing to Belmont Circle, the Build Alternative would provide more opportunity to improve neighborhood accessibility to community facilities and services, specifically to the Nightingale Pond subdivision. In addition to the pedestrian and bicycle facilities, the Build Alternative would substantially improve neighborhood cohesion by fully removing mainline State Route 28/25 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 and/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 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 temporary and permanent noise effects of the Build Alternative on existing neighborhoods.

## 4.6.5 Mitigation

**Table 4.6-6** summarizes mitigation measures that will be employed to minimize adverse land use effects resulting from the Build Alternative. Relevant mitigation measures are provided for each section included in the land use assessment, but 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**
- **Appendix 3.2, Construction Approach Technical Report**

Table 4.6-6. Land Use Mitigation Measures

Land Use Effect	Mitigation Measures
Land Alteration	<ul style="list-style-type: none"> <li>• MassDOT will implement a landscaping plan that will provide new landscaping and vegetation for over 200 acres within the Study Areas to repair, restore, and enhance the landscape flanking the mainline highways, bridges, and local roads and connections to compensate for the disturbance and clearing required as part of the Build Alternative, including bridge replacements and connections to the local roadway networks on the mainland and on Cape Cod. The landscape plan will include the following landscape types to restore disturbed sites and integrate the new infrastructure into the landscape: landscape restoration and reforestation, street tree planting, lawn, stormwater basins and rain gardens, buffer planting, roundabout planting, special planting, and community open space.</li> <li>• 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 the U.S. Army Corps of Engineers. The following will be considered for the landscape design and will be tailored to the specific Study Area quadrants as appropriate:             <ul style="list-style-type: none"> <li>– Revegetate all areas disturbed by construction around the new Sagamore Bridge and Bourne Bridge, adjacent highways, local roadways, shared-use paths, stormwater and utility infrastructure, and construction staging areas.</li> <li>– Develop landscape zones that restore and/or enhance existing habitats and reinforce the unique landscape character of the region.</li> <li>– Screen undesirable views for both users of the Project Limits as well as abutters. Improve sight lines and views while mitigating the appearance of undesirable areas within and beyond the bridge sites.</li> <li>– Provide shade in hardscape areas, including along local streetscapes and over the shared-use paths. This will improve the experience for site users while reducing the Urban Heat Island Effect.</li> <li>– Use landscape to create gateways as visitors approach Cape Cod.</li> </ul> </li> </ul>

Land Use Effect	Mitigation Measures
	<ul style="list-style-type: none"> <li>– Enhance pedestrian zones with planting at trailheads, in medians, and in roundabouts in lieu of impervious surfaces.</li> <li>– Integrate stormwater basins with the surrounding restored landscapes so they appear natural and contribute to the creation of habitat as much as possible.</li> <li>– Maintain site visibility for safety along highways and roadways and around pedestrian zones and off-road areas for site security.</li> <li>– Planting: Provide primarily native, site-appropriate planting throughout the Project Limits through the following actions: <ul style="list-style-type: none"> <li>i) Use low maintenance planting that is self-sustaining to improve the longevity of the new landscape.</li> <li>ii) Diversify the plant material to reduce possible mass devastation from future pests.</li> <li>iii) Propose hardy, coastal tolerant and urban tolerant plant material to survive the site conditions.</li> <li>iv) Use species that are attractive to pollinators and wildlife.</li> <li>v) Propose drought tolerant plant species for adaptability and suitability for minimally maintained areas of the project site.</li> <li>vi) 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.</li> </ul> </li> <li>• Implement measures intended to reduce adverse effects from construction according to a Construction Stormwater General Permit.</li> <li>• Stabilize disturbed areas immediately when construction has ceased and resume for no more than 14 days.</li> <li>• Implement plant protection fencing for trees that will not be cleared for public places and staging or other construction activity to preserve trees.</li> <li>• Utilize plant protection fencing to minimize impacts to visual natural resources as applicable.</li> <li>• Restore acquired areas that are not used for the State Highway Layout to pre-existing conditions to the maximum extent practicable following completion of the land-based construction activities.</li> <li>• Maintain adequate provisions for stormwater management during construction to prevent safety and maintenance issues.</li> <li>• Prepare and implement a Storm Water Pollution Prevention Plan in accordance with the U.S. Environmental Protection Agency’s 2022 National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities.</li> <li>• The minimum practices required in the Storm Water Pollution Prevention Plan will include the following: <ul style="list-style-type: none"> <li>– Install sediment controls (such as silt fence and/or compost filter tubes) along the top of Cape Cod Canal bank and inland wetland resource areas.</li> </ul> </li> </ul>

Land Use Effect	Mitigation Measures
	<ul style="list-style-type: none"> <li>- Stabilize construction exits to prevent sediment tracking from the work area onto public ways.</li> <li>- Provide site-specific construction phasing plans to minimize the extent of the disturbance at any one time.</li> <li>- Provide catch basin inlet protection, including geotextile filter fabric.</li> <li>- Provide soil stockpile protection, including temporary erosion measures and perimeter controls.</li> <li>- Provide dust suppression, including watering.</li> <li>- Provide good housekeeping pollution prevention measures, including secondary containment.</li> <li>- Adhere to maintenance requirements.</li> <li>- Adhere to temporary and permanent stabilization requirements.</li> <li>- Adhere to recordkeeping/inspection requirements.</li> <li>• Implement a stormwater treatment system for Build Alternative operations, which will prioritize the use of low-impact, green infrastructure (such as rain gardens and infiltration basins).</li> <li>• Install bioretention areas/rain gardens adjacent to proposed sidewalks and paths for treatment of pavement runoff when feasible.</li> <li>• Treat stormwater runoff from the replacement bridges and roadway approaches using infiltration basins.</li> </ul>

Land Use Effect	Mitigation Measures
<p>Neighborhood and Community Cohesion</p>	<ul style="list-style-type: none"> <li>• Provide clear signage and mapping for alternative routes to reduce confusion, which will ensure accessibility for community members during the temporary closure of the Canal Service Road.</li> <li>• Maintain existing pedestrian and bicycle accommodations and routes in the Study Areas.</li> <li>• Ensure access to community facilities will be maintained during and after bridge construction.</li> <li>• Reduce regional traffic on local roads (e.g., Adams Street, Ben Abbey Road) and improve neighborhood accessibility through the following: <ul style="list-style-type: none"> <li>– 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.</li> <li>– 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.</li> <li>– Fully remove mainline State Routes 28/25 traffic from the local roadway network.</li> </ul> </li> <li>• 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.</li> <li>• 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.</li> </ul>