ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT FOR MAJOR REHABILITATION EVALUATION

CAPE COD CANAL HIGHWAY BRIDGES MASSACHUSETTS

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1.0 INTRODUCTION

1.1 Background

The Bourne and Sagamore bridges are two high level, fixed span highway bridges owned, operated, and maintained by the U.S. Army Corps of Engineers (USACE). The bridges provide access across the Cape Cod Canal and are part of the authorized Cape Cod Canal Federal Navigation Project (FNP). These two steel truss bridges were constructed in the 1930s and are now more than 83 years old.

The USACE, New England District, is conducting a multi-year Major Rehabilitation Evaluation Study (Study) of the Bourne and Sagamore highway bridges to evaluate whether continued repair and maintenance, major rehabilitation, or replacement of the bridges with new structures will provide safe, efficient transit for vehicular traffic across the Cape Cod Canal. The Study includes engineering, economic and environmental analyses, and evaluates alternatives to address deficiencies of bridge components that impact their structural and operational reliability. The study will result in a Major Rehabilitation Evaluation Report (MRER), a decision document that will provide the basis of decision-making for the USACE and Congress on the most cost-effective, safe alternative for providing critical public transportation access across Cape Cod Canal.

As part of the MRER, the USACE has developed an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) to examine the potential effects associated with the alternatives examined within the MRER.

2.0 AUTHORIZATION AND REGULATORY HISTORY

2.1 Congressional Authorizations

The Cape Cod Canal, which connects Cape Cod Bay and Buzzards Bay, was privately owned and built during the early 1900s. In 1919, Congress authorized the purchase of the Cape Cod Canal and in 1927 directed the USACE to operate and improve the canal under the authority of the Rivers and Harbors Act of 1927. The Rivers and Harbors Act of 1935 gave the authority for the USACE to operate and maintain the two highway bridges, Bourne and Sagamore, as part of the Cape Cod Canal Federal Navigation Project (P.L. 74-409). The Federal navigation project consists of:

- A 32-foot deep channel linking Buzzards Bay to Cape Cod Bay
- Dikes, revetments, jetties and other features to maintain functionality (that help keep the channel open)
- Mooring areas and small boat harbors in Sandwich and Bourne
- Buzzards Bay Railroad Bridge
- Access and recreation areas surrounding the canal
- Canal visitor center, Headquarters, traffic control and other operation and maintenance facilities

- Two high span highway bridges, the Bourne and Sagamore.

2.2 National Environmental Policy Act (NEPA) Compliance

NEPA requires Federal Agencies to assess the environmental effects of their proposed actions prior to making decisions. The USACE is preparing this Environmental Assessment (EA) pursuant to the White House Council on Environmental Quality (CEQ) Implementing Procedures for NEPA (40 CFR Parts 1500-1508) and USACE Procedures for Implementing NEPA (Engineering Regulation ER-200-2-2).

CEQ regulations direct Federal agencies to commence its NEPA process at the earliest possible stage and states that an EA may be supplemented at a later stage so an agency can focus on the issues which are ripe for decision and exclude from consideration issues not yet ripe (1508.28). Phase I of the bridge replacement project is the Cape Cod Canal Bridges Major Rehabilitation Evaluation Report (MRER) decision document. This EA has been prepared to support the Phase I, MRER decision document. A supplemental EA will be prepared during Phase II of the project (design and construction phase).

This EA describes existing conditions within the project area and analyzes potential direct, indirect and cumulative environmental effects associated with the project including alternatives to either repair or replace the Bourne and Sagamore Bridges and fulfills NEPA documentation requirements.

3.0 PROJECT SCOPE AND STUDY AREA

3.1 Scope

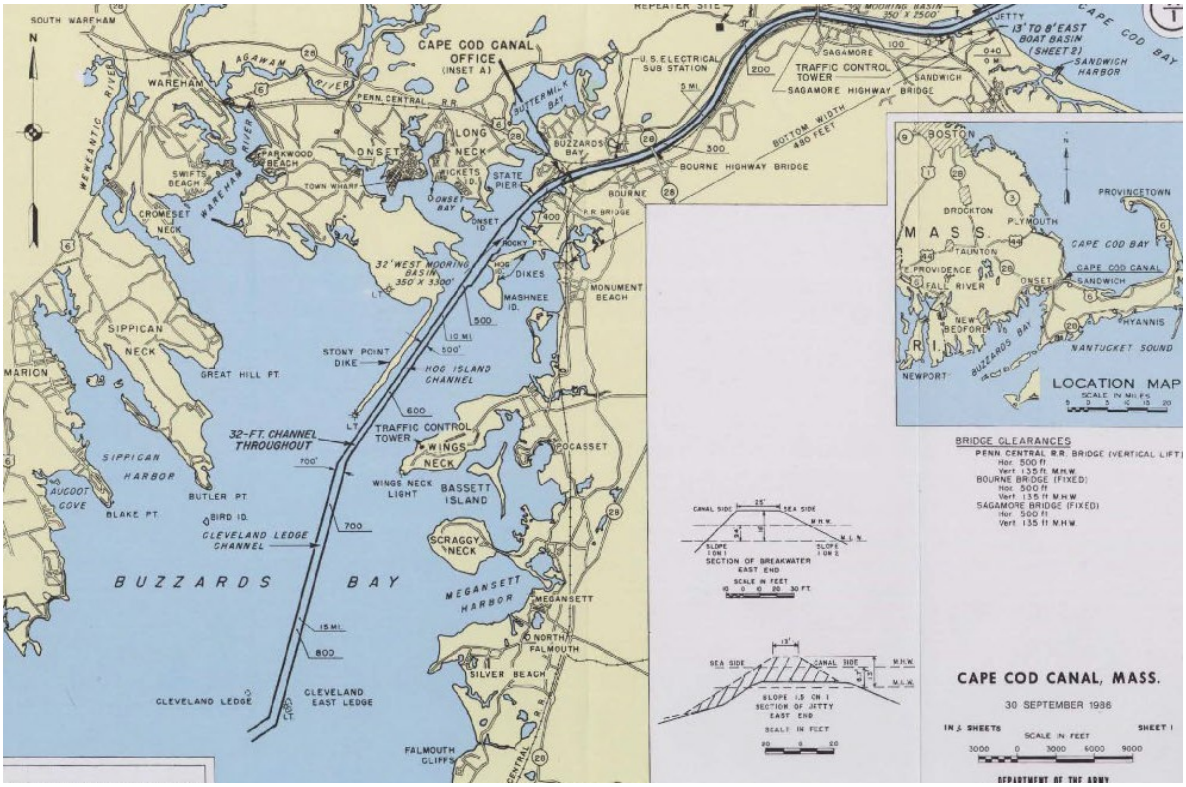
This EA accompanies the MRER as the first phase in determining the future of the Cape Cod Canal Highway bridges. This phase examines potential alternatives including major rehabilitation or replacement and recommends the most feasible measures for meeting future needs. The alternatives developed and evaluated in the MRER and accompanying EA are at a conceptual level until a more definitive design is determined in the next phase of the analysis. Some alternatives will be screened out from future consideration. Assumptions have been made for the purposes of conducting the evaluations presented at this phase. No decisions will be made at this phase on issues such as: future limits on traffic over the existing bridges, the specific alignment of any new crossing, any specific type of new bridge, the fate of the existing bridges should new crossings be built, the extent of any real estate acquisition, and other design details such as types and extent of pedestrian and bicycle crossings, roadway grades, utility relocations, construction methods, and navigation clearances.

The MA Department of Transportation (MassDOT) has completed a Cape Cod Canal Transportation Study, which includes several proposed conceptual road infrastructure improvement projects based on the assumption that the USACE will replace both the Bourne and Sagamore Bridges. These MassDOT conceptual project areas will be discussed in greater detail in the *Cumulative Impacts* section of this EA.

3.2 Location and Description

The Cape Cod Canal is located within the towns of Bourne, Sandwich, and Wareham in southeastern MA (Barnstable and Plymouth Counties) and is approximately 47 miles south of Boston and 190 miles northeast of New York City (EA Figure 1). The canal connects Buzzards Bay to the southwest with Cape Cod Bay in the northeast, and provides a shorter, inshore, more protected route between eastern New England ports and those of southern New England, New York, and points further south along the Atlantic coast. The Canal is part of the Atlantic Intracoastal Waterway that runs from Boston, MA to Key West, Florida and provides access to both commercial and recreational vessels.

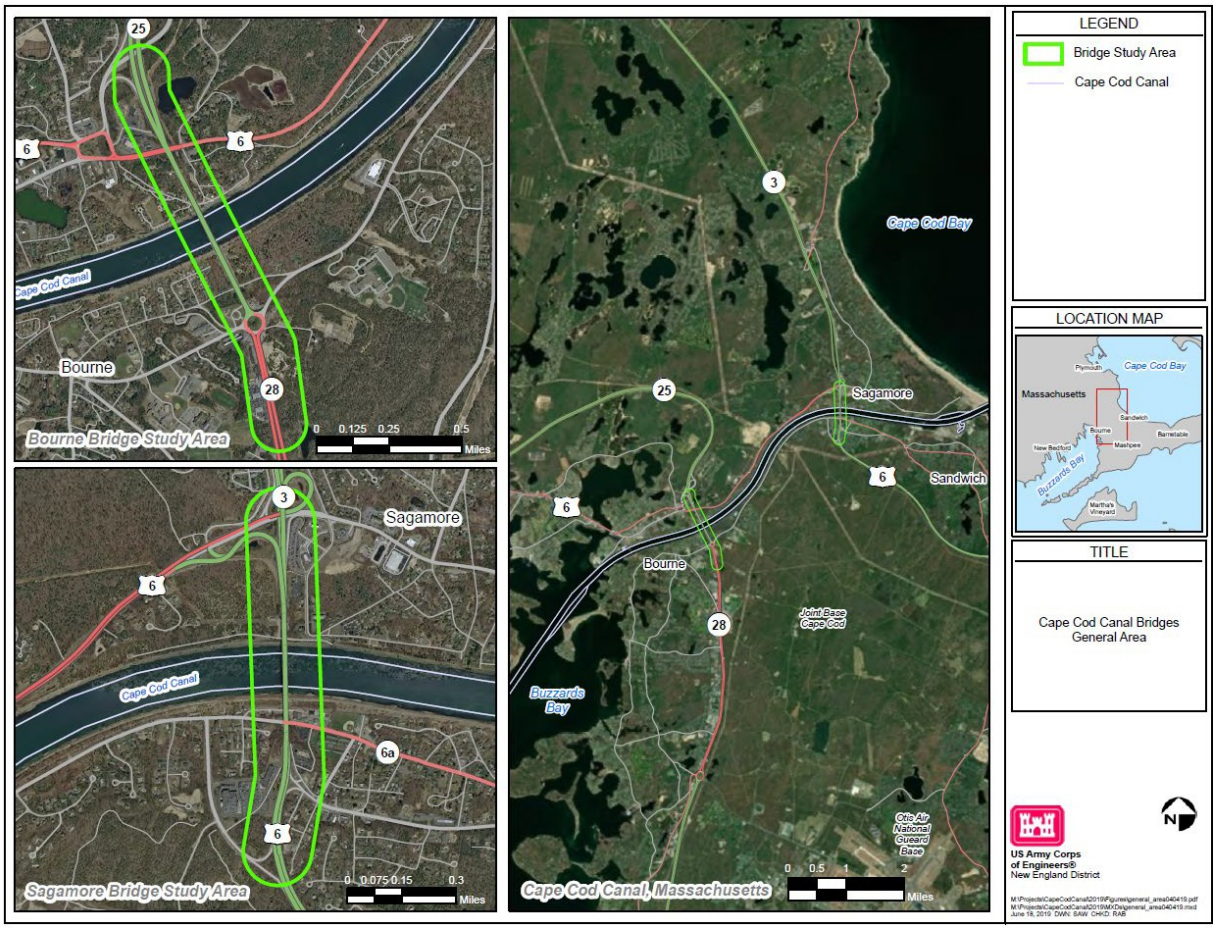
EA Figure 1- Cape Cod Canal



3.3 Study Area

For the purposes of this analysis, the study area is defined within an area consisting of 500 foot buffer zones around each potential bridge location including approaches for a total of 177 acres surrounding the Bourne Bridge and 128 acres surrounding the Sagamore Bridge, for a total of 305 acres. This total area includes land area on both sides of the Canal as well as the Canal itself. The Bourne study area extends from the highway overpass for the on/off ramp of Rt. 25 North to the north of the Canal and past the Bourne Rotary to Rt. 28 on the south side. The Sagamore study area extends from the intersection of Routes 3 and 6 to the north, and the Rt. 6 confluence with the Mid Cape Connector to the south (EA Figure 2).

EA Figure 2 – Project Study Area



4.0 PURPOSE AND NEED

4.1 Purpose

The purpose of the Cape Cod Canal Bourne and Sagamore Bridges project is to restore or replace the existing deteriorated bridges to provide structures which will maintain reliability of service, improve safety and ease of maintenance, and provide safe, secure, and cost effective access across the Cape Cod Canal.

4.2 Need

The existing Bourne and Sagamore bridges were constructed in 1933. Both bridges are now over 80 years old and despite ongoing maintenance, they have deteriorated over time and require increasingly more frequent repairs. Routine bridge maintenance will not extend the useful life or improve the reliability of the bridges.

The Bourne and Sagamore bridges provide the only vehicular access to 15 towns and nearly 215,000 full time residents and millions of annual visitors to Cape Cod. The bridges also

provide access to eight offshore island municipalities through the ferry terminals located on Cape Cod. Routine and emergency maintenance activities require lane closures causing significant restrictions of each bridge's carrying capacity during these maintenance/repair events. While some maintenance can be performed outside of normal commuting hours, other emergency repairs cannot. Without major rehabilitation or replacement, travelers will experience more frequent delays and lane closures and the bridges may reach a point where load restrictions need to be imposed; adversely impacting traffic over both bridges.

The existing bridges were designed and built in the 1930s and do not meet current highway safety standards or adequately reflect modern-day traffic conditions. Traffic volumes have increased since the bridges were originally constructed, leading to significant increased loading and demands on the bridges' infrastructure. Routine maintenance will not be able to keep pace with current and projected traffic and loading demands.

5.0 ALTERNATIVES ANALYSIS

CEQ regulations require federal agencies to consider a reasonable range of alternatives that meet the purpose and need of a proposed action in their NEPA review. Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint. A No Action alternative sets a baseline for existing human and natural environmental conditions to allow comparison between future without and with-project conditions, and to determine potential environmental effects of proposed with-project alternatives.

Numerous alternatives have been proposed for the future of the Cape Cod Canal highway bridges. Public comments were submitted during a series of five information meetings held in surrounding towns and municipalities in early December 2018 including Bourne, Plymouth, Nantucket, Martha's Vineyard, and Hyannis, Massachusetts. In addition, the public was able to submit written comments via the USACE Cape Cod Canal Bridges Project website established specifically for this project (Appendix F). The following sections describe various alternatives considered.

5.1 Alternatives Considered but Not Carried Forward in Detailed Analysis

5.1.1 Replacement of Both Bridges with a Single Bridge

A single bridge canal crossing has been proposed as early as 1931, when the USACE prepared a report that included a recommendation for a single highway bridge in the Bournedale vicinity to replace two existing draw span bridges. Before the single bridge project could be implemented, the Public Works Administration funded the design and construction of two bridges beginning in 1933.

Any new single crossing bridge would require substantial and significant infrastructure construction and involve extensive redesign and major realignment of local surface roads and regional highway connections on both the Cape and mainland sides of the Canal. Required changes in bridge approach grades and elevation for navigation clearance would compound these challenges. A new single crossing bridge would likely involve real estate takings, including lands

from the Massachusetts Military Reservation as well as environmental and historical areas of concern identified in other "Alternatives Considered and Not Carried Forward" sections.

5.1.2 Construction of a New Third Highway Bridge

Construction of a third highway bridge, in addition to the two existing bridges, would require the same infrastructure construction considerations as the single bridge alternative as well as new MassDOT highways on either side of the canal. MassDOT initially studied the concept of a mid-canal crossing, but determined there were significant resource impact issues and this alternative was not carried forward in the MassDOT *Cape Cod Canal Transportation Study* (2019). Additionally, a third bridge alternative does not provide a solution for the existing Bourne and Sagamore Bridges that are in need of major rehabilitation or replacement.

5.1.3 Replacement of One or Both Highway Bridges with Tunnels or a Single Tunnel

For several decades, replacing or augmenting the existing bridges with a tunnel or several tunnels has been proposed. Tunnels are typically not cost effective when compared to bridge spans that are under a mile in length. Both the Sagamore and Bourne bridges are less than this distance. Associated costs are driven by tunnel design parameters including depth, grade, surrounding topography, existing natural foundation conditions, number of traffic lanes and top elevation of the tunnel with respect to the dredged navigation channel above it.

A key aspect of designing a Cape Cod Canal tunnel would involve consideration of the Canal's future as a deep draft waterway. If the navigation channel was widened or deepened in the future, a tunnel could pose a constraint to improving the Canal as a commercial waterway.

A tunnel alternative would also require extensive reconfiguration of existing approach highways to meet the required tunnel entrance and exit slopes as well as existing land elevations on either side of the canal.

Tunnels have a higher capital cost and require additional levels of maintenance. The crossing of major transportation corridors, waterways, and other buried infrastructure also adds significant costs to a tunnel project.

Maintenance of a tunnel is more complicated than maintaining a bridge and must include structural as well as mechanical systems such as ventilation fans, dewatering pumps (both during and post-construction), and fire suppression systems.

Based on historic soil boring logs for the existing bridges and depth to bedrock in this area, a tunnel would likely be located within sandy soils creating significant dewatering and stability issues during construction, and would require continued dewatering and waterproofing issues post-construction. There would be excessive costs associated with reaching bedrock.

Tunnels require venting plants that are built to accommodate airflow from the venting shafts inside the tunnel. These venting structures are expensive to build, require above ground land for

construction, and could be aesthetically unpleasing in the Cape Cod environment.

Other considerations include the fact that tunnels have significant height restrictions which limit oversized vehicles and bicycle and pedestrian travel is generally not permitted within tunnels of any length due to air quality and safety concerns.

Based upon all of these factors, the use of a tunnel is not a cost effective or practicable alternative to rehabilitation or replacement of the existing bridges.

5.1.4 Replacement of One or Both Bridges with Low Level Draw Spans or Low Level Causeways

During the December 2018 public information meetings for this study, some members of the public suggested that present-day use of the Canal for navigation might allow for a return to low-level bridge crossings that pre-dated the 1930's high-level bridge designs. These crossings would only allow small craft traffic to pass beneath the bridges at limited tidal stages.

Public comment in the initial information meetings also included suggestions that new crossings could be constructed by replacing the existing bridges with causeways. These would either be culverts that would permit tidal exchange, effectively converting the Canal to an estuary, or they would be low level bridge openings that would permit limited navigation access for small craft at certain tidal stages.

As the Canal is still actively transited by large commercial vessels including cruise ships, training vessels, cargo carriers, and barges, low level crossings would not be feasible due to the height of these vessels.

5.1.5 Deauthorization and Closure of the Canal

Members of the pubic have suggested that the Canal has outlived its purpose due to limited deep-draft navigation utility and should be deauthorized and abandoned. These commenters believe that filling in the Canal and restoring surface highways would save significant public funds.

The canal is 480 feet wide, 32 feet deep and 17.4 miles long. It saves commercial and recreational vessels 65 to as much as 150 miles of travel between Cape Cod Bay and Buzzards Bay along a route known as the Atlantic Intracoastal Waterway which is better protected and less risky than the open Atlantic side of Cape Cod. Approximately 14,000 vessels use the canal each year.

The canal has been in service since 1914 and was widened in 1940 creating suitable habitat for bass, flounder, cod, and mackerel, which provides recreational fishing opportunities along the Canal. Other wildlife species including migratory birds utilize the canal, and on occasion, the North Atlantic Right Whale, one of the world's most critically endangered species, transits through the canal.

Filling in even a portion of the canal would eliminate navigational benefits and significantly

impact the existing aquatic environment which includes a two-way reversing tidal current that creates a unique coastal environment. Filling in the canal would require 3 million cubic yards of material per mile as well as additional material for crossings to meet grade levels at existing banks. This could potentially impact the availability of suitable fill for a large area of southeastern Massachusetts. A partial filling of the canal (only at the crossings), while lower in cost, would still result in navigation and environmental impacts. Multiple small bridges or culverts would be needed to maintain water exchange between canal crossings. The USACE has considered the potential impacts of filling in the canal and has determined this is not a practicable alternative due to the significance of these impacts.

5.1.6 Alternative C - Replacement of Both Highway Bridges with New Bridges – 4 Lanes

Under this alternative, new bridges would be constructed adjacent to the existing bridges, and the old bridges would be removed upon project completion. This alternative involves moving the bridge abutments further north and south on each side of the Canal in order to produce approach grades consistent with modern federal highway standards. The piers would be moved from in-water to the Canal shoreline.

In order to minimize impacts to connecting roads, other non-Federal highways, and local roadways, each new bridge would be placed along approximately the same alignment as the existing bridges, parallel to them, and offset by the width of the new bridges. This would minimize the real estate takings needed for the new bridges and connecting road modifications.

A new bridge would need to account for changes in highway and bridge engineering design standards since the original bridges were built in the early 1930s. For example: standard safe travel lanes are now generally 12 feet wide compared to 10 ft. widths currently on the existing bridge decks; pedestrian and bicycle lanes now require a separation barrier from the vehicle lanes; a median should exist between the two directions of vehicular travel; and shoulders to accommodate breakdowns would be needed.

Any new high-level bridge must also take into account the requirements for navigation of the Canal beneath the bridges. Currently the 1930s bridges have a vertical clearance of 135 feet above mean high water (MHW). The largest ships using the Canal today are auto carriers and cruise ships, many of which have designs that include 135-foot clearances.

Piers for the existing bridges are currently located within the Canal. New bridge piers would be relocated out of the water and onto land by approximately 50 feet on each side of the canal, which would require lengthening of the spans over the waterway.

The current bridges would remain open and continue to be inspected and maintained in a safe and reliable state while construction of the new bridges was underway. The current bridges would be dismantled after the new bridges have been opened to traffic.

The actual type, design and location of any proposed new bridge(s) will be determined and evaluated in Phase II of the Cape Cod Canal Bridges Project.

The Draft MRER/EA included this alternative among the alternatives considered in the detailed evaluation. Based on comments on the Draft MRER/EA provided by the FHWA and MassDOT, replacement of the Bourne and Sagamore bridges in-kind with respect to the number of through traffic lanes would not conform to current design guidance for bridges and highways and is therefore not a reasonable alternative. For this reason, providing new bridges without auxiliary lanes would not be consistent with best practices for traffic safety, and Plan C will not be carried forward into detailed analysis in the final EA.

FHWA and MassDOT reviewed the Draft MRER and EA and stated the following in their response letter:

"Based on the close proximity of the interchanges and intersections at the end of each bridge, current standards for this type of facility include acceleration and deceleration lanes (also known as auxiliary lanes) going onto the bridges in most, if not all, four ends of the bridges. In final design, analysis will need to be done to determine if the auxiliary lanes should be continuous across each bridge for operational weaving and structural efficiency needs pending on the structure type, long span bridges such as these may gain cost efficiency with a uniform width."

MassDOT stated the following with respect to the need for auxiliary lanes:

The design requirements used for the roadways, intersections, and interchanges shall be in accordance with and the 2006 MassDOT Project Development and Design Guide as well as 2018 American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design of Highway and Streets ("the Green Book"). See Chapter 10 of The Green Book which includes Tables 10-4 Minimum Acceleration Lane Lengths for Entrance Terminals…, Table 10-5 Speed Change Lane adjustment factors as a function of grade…, and Table 10-6 Minimum deceleration lane lengths for exit terminals…; these dictate the required lengths for this type of facility include acceleration and deceleration lanes (also known as auxiliary lanes).

5.2 Alternatives Evaluated

This EA presents a detailed analysis and comparison of three alternatives: Alternative (A) No Action; Alternative (B) Major Rehabilitation; and Alternative (D) Preferred Alternative - Bridge Replacement - 4 Lanes and 2 Auxiliary Lanes.
Detailed analysis of these alternatives including existing conditions and environmental consequences is provided in subsequent sections.

5.2.1 Alternative A – No Action (Without Project Condition

The No Action Alternative is the baseline against which the other alternatives can be evaluated.

Under the No Action Alternative, the USACE would continue to repair and maintain the two

highway bridges as needed to maintain safety. Major rehabilitation efforts would not be conducted and components of the structures would be repaired and critical elements replaced as they deteriorate and before they fail. Under this option, without major rehabilitation, each bridge would ultimately reach a point where routine maintenance and minor component replacement would no longer yield acceptable design performance. At such a point, the bridges would need to be posted to limit the loaded weight of heavy vehicles in order to assure continued bridge safety. Lower vehicle load and speed limits would be posted in the future as the bridges continue to age.

Over time, this alternative would have escalating and significant impacts on vehicle traffic and the economy of the Cape and Islands as large trucks would need to be replaced by smaller ones. The cost of transporting goods onto and off the Cape would rise over time. More trucks and lower speeds would result in more frequent and lengthier traffic delays. Vehicle emissions would increase due to traffic delays and tourism would be impacted by these conditions.

5.2.2 Alternative B - Major Rehabilitation for Both Bridges

This alternative consists of major repairs and ongoing maintenance to both Canal bridges.

To maintain bridge safety and performance, and to avoid the need for future restrictions through vehicle weight postings and other safety measures, each bridge would need to undergo a major rehabilitation cycle within the next six years, and at least every 45 years thereafter. The ongoing program of continual inspection, maintenance, and repairs would also continue throughout the remaining life of the bridges.

Major rehabilitation involves significant repairs and replacement of major bridge components such as connections between the spans and the piers/abutments, hangers that help connect deck and truss sections, gusset plates that tie truss members together, and substructure members of the decks themselves. Each of these are major actions that would require partial or full closure of the bridges to traffic.

Major rehabilitation programs were undertaken for both highway bridges in the early 1980s and involved extensive repair and replacement of major bridge components such as cables, plates, and decking. These actions required partial closures of each bridge for significant periods resulting in traffic congestion and delays.

Each major bridge rehabilitation would be expected to take approximately 3 ½ years to complete and work would be performed in the off-season (late October through mid-May), as much as feasible.

5.2.3 Alternative D (Preferred Alternative) - Replacement of Both Highway Bridges with New Bridges – 4 Lanes and 2 Auxiliary Lanes

Under this alternative, new bridges would be constructed as described in Alternative C, next to existing bridges and to modern standards. The bridge decks would be widened to include two through lanes and one auxiliary lane each way.

6.0 AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

The Phase I Major Rehabilitation Evaluation Study is a decision document that analyzes current bridge conditions and compares major rehabilitation and replacement alternatives for the Bourne and Sagamore Bridges. This EA documents resources within the project area and considers potential impacts based solely on a conceptual bridge design and a preliminary estimated project area. Resources and potential impacts will be more fully defined and analyzed when the project moves to the design and construction phase (Phase II).

This chapter describes the resources located within the proposed project area as well as potential impacts to these resources by the proposed action.

6.1 Physical Resources

6.1.1 Land Use

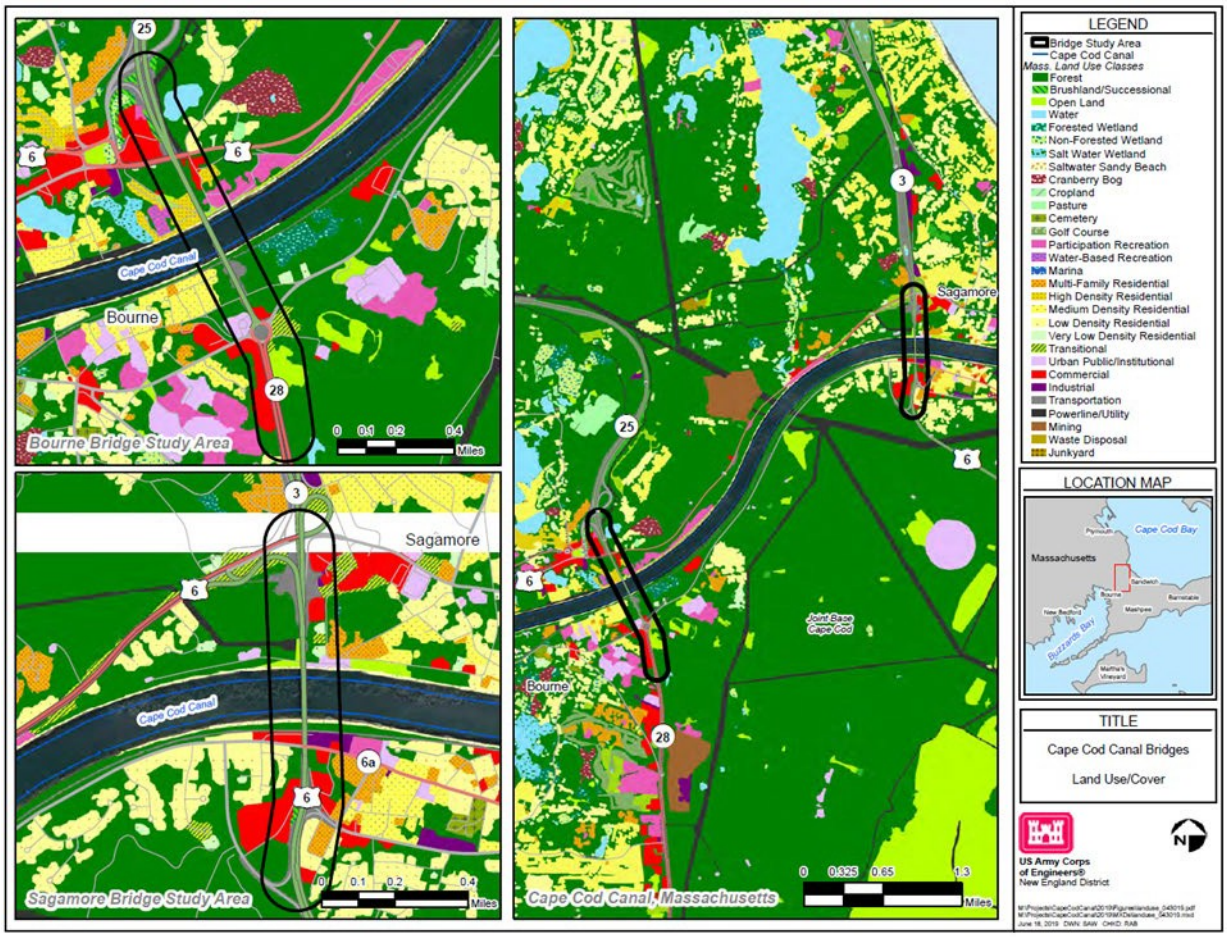
Property owned by the U.S. Government and administered by the USACE at the Cape Cod Canal includes a total of 1,153 acres; of which 982 acres of land is situated along the 7.7 mile land cut of the Canal. Approximately 20% of the government-owned property is developed. Within the developed areas are ten USACE-operated recreation areas.

The affected area is covered by transportation infrastructure, residential and commercial properties, and forested land (refer to Land Use Map – EA Figure 3). There is a large forested area east of the Bourne Bridge (Rt. 28) on the south side of the Canal bordered by Sandwich Rd., and both residential and commercial properties to the east bounded by Trowbridge Road. Immediately east of the Bourne Rotary are several commercial properties, including a gas station and hotel, and forested land on the eastern side of the rotary. On the northern side of the Canal, Nightingale Conservation Area and Nightingale Pond are located to the east of Rt. 25/Rt. 28, and are bordered by residential properties. There are commercial properties located to the west of Rt. 28 between the Bourne Rotary Approach and Rt. 6 which include Bourne Crossing Shopping Center and other businesses. There are a mix of residential properties and public conservation land adjacent to the Canal on either side of the bridge.

Around the Sagamore Bridge, there are commercial properties located east of Rt. 3 on the northern side of the Canal with a mix of land uses extending south of those commercial properties to the Canal. There is a forested area to the west of Rt. 3 on the northern side with several residential properties and a power line right-of-way. The southern shore of the Sagamore study area is a mix of residential and commercial properties on both sides of Rt. 6, which bisects this portion of the project area.

The Canal has riprap embankments along the shoreline with service roads running along both sides of the canal. This USACE property is used for Canal maintenance access as well as public recreational access.

EA Figure 3 – Land Use



Environmental Consequences

Alternative A – No Action

No changes would occur to existing land uses because with routine and emergency maintenance bridge alignments would remain the same, and no other changes to the bridges footprint would occur. There are no other foreseeable changes to land use or land cover related to the bridges remaining in their current position with no major changes to their configuration and function.

Alternative B – Major Rehabilitation for Both Bridges

Major rehabilitation of the bridges would cause temporary localized impacts from construction and maintenance activities, but the permanent bridge structures would all continue to occupy the same footprint. Past maintenance and rehabilitation efforts were completed without adverse effects to land use and physical resources. For example the 1981 major rehabilitation included bridge deck, side walk, steel, and concrete repairs, pavement replacement, and painting of the steel structure. Construction activities associated with major rehabilitation would require equipment storage and lay-down areas. The total acreage of potential temporarily impacted areas

will be determined during the design and construction phase (Phase II) of the bridge project. The right-of-ways underneath the bridges are used in this capacity for the current joint replacement activities, and could continue to be used for construction equipment during a major rehabilitation. Any disturbed sites would be returned to pre-project conditions following the completion of major rehabilitation. All related activities would be fully evaluated once specific rehabilitation activities have been determined. Best management practices will be incorporated to avoid and minimize impacts whenever possible. Therefore, there would no significant adverse impacts to land use under Alternative B.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Localized, permanent impacts adjacent to the existing highway bridges would occur where the replacement bridge would be constructed. The bridge piers, abutments, and landings would be in slightly different locations and thus result in permanent land use impacts. Exact bridge locations and specifications will be defined in Phase II. Under Alternative D, the footprints would be slightly larger because of the two auxiliary lanes on each bridge. The affected land uses by the new bridges under both alternatives are commercial, transportation, forested, and residential. The new Sagamore Bridge alignment would affect forested areas on the western side of the bridge and would move in closer proximity to the residential area on the southern side of the Canal, south of Sandwich Road. It would also cross over the utility right-of-way and substation west of the bridge on the northern side of the Canal. At the Bourne Bridge, the new alignment would be relocated to where there is currently a Dunkin Donuts at the Bourne Rotary, and would also affect the forested area between there and the Canal. On the northern shore of the Canal, the new alignment would cross over the forested area on the eastern side of the bridge. The construction staging areas would be returned to pre-project conditions where possible. Road networks connected to the bridges would likely change under future conditions in locations where the existing bridges are replaced. Therefore, effects on land uses from Alternative D are expected to be minor. The Massachusetts Department of Transportation has completed a *Cape Cod Canal Transportation Study* (MassDOT, 2019) with recommendations for infrastructure improvement projects based on replacement of both the Bourne and Sagamore Bridges, but this is only a conceptual planning study at this time. Potential impacts of these conceptual projects combined with bridge replacement projects are discussed in the *Cumulative Impacts* section of this EA.

6.1.2 Terrain and Topography

Barnstable County has rolling hills, with elevations ranging from sea level to 200 feet above mean sea level (msl) (MassGIS, 2019). There are numerous bogs, marshes, sand dunes, and ponds on the landscape. The terrain around the bridges has varied changes in elevation, generally rising with distance away from the Canal in the project area. Elevation in the study areas ranges from sea level to approximately 100 ft. above msl around the Sagamore Bridge, with an increase in elevation around the Bourne Bridge of 50 to 100 feet above sea level (MassGIS, 2019).

Environmental Consequences

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges
There would be no impacts to terrain and topography with routine bridge maintenance or major rehabilitation because no changes to existing grades are anticipated.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes
Re-grading of some surrounding areas to accommodate the new bridge approaches and abutments will be required for new bridges. The project area has previously experienced filling and re-grading during the original construction of the existing bridges and highways, which was confirmed by soil analysis and consultation of historic topographic maps. However, until specific bridge designs are available, the exact extent of these modifications is unclear and will be fully defined in Phase II of the project. It is anticipated only minor impacts to Terrain and Topography would be expected under Alternative D.

6.1.3 Geology/Soils

The Cape is composed of glacial end moraines, which mark the approximate locations of the ice front and outwash plains formed by sediments deposited by streams of melt water from the glaciers. The result is a series of connected, broad, sandy plains and hilly terrain.
Sediments at the east end of the Canal were deposited in a lake that formed in the Cape Cod Bay between the retreating ice front and the Sandwich moraine. These glacial lake deposits are mostly well-sorted medium to fine sand, and in some places include a silt and clay layer that caps the sand. The principal outlet for the lake was formerly known as Monument Valley, the current site of the Cape Cod Canal. The Canal's main glacial features of moraine, out-wash plain and glacial lake deposits are comprised of six major soils and twenty-nine minor soils. A significant amount of Canal soils are Udipsamments, i.e. the original soil was excavated or filled during construction. The bedrock surface altitudes in the vicinity of the Canal range from roughly -125 to -175 feet msl (Fairchild et al 2013). There are 27 different soil types identified in the NRCS web soil survey (https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, Appendix G) for the project area. The three most dominant soil types by area within the study zone are Udisamments, smoothed; Plymouth loamy coarse sand, 3-8% slopes; and Urban land.

Environmental Consequences

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges
No impacts because the existing bridge structures would remain in place and only activities related to routine maintenance or rehabilitation of the existing structures would occur.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes
Bridge replacement would have no long term effect on geology and soils. Surface soils in currently managed areas (road margins and adjacent urban development) may be disturbed by construction activities during the course of work on the bridge approaches and abutments and the creation of temporary laydown areas, and also for altering the configuration of approaches under Alternative D. No measurable impacts to geology and soils are anticipated for Alternative D.

6.1.4 Climate

The National Oceanographic and Atmospheric Administration (NOAA), National Centers for Environmental Information provides historic weather and climate data in their searchable online tools, accessible through the Climate Data Online (CDO) website. According to the data obtained, Barnstable County experiences average high temperatures ranging from 80 degrees Fahrenheit (°F) in July to 38°F in January and average low temperatures ranging from 63°F in July to 20°F in January. Average annual precipitation is 47.63 inches, with the month of March generally receiving the most precipitation and the month of July receiving the least (NOAA, 2016). Extreme weather varies in Barnstable County from drought conditions to hurricane events. Recent examples include the "advisory" level drought conditions observed in 2016 and the 1991 hurricane (named "Bob") which produced winds in excess of 100 miles per hour and spawned five associated tornadoes (Mass.gov, 2016).

Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

None of these alternatives would have direct or indirect impacts to the climate of the region. Only short duration, minor discharges of carbon-based pollutants would occur during construction activities that could contribute to greenhouse gases. Routine operation and maintenance, replacing or rehabilitating existing bridges will not have any appreciable effects on climate in the region because of the limited potential of these activities to influence long term temperature and weather trends.

6.1.5 Sea Level Change

USACE policy requires an analysis of the potential effects of sea level change on a proposed project. Civil works projects must consider and evaluate future rates of sea level change (SLC), potential impacts, responses, and adaptations (ER 1100-2-8162). The New England District, Water Management Section, was tasked with assessing the potential for future sea level change within the Canal over the next 50 and 100 years to ensure adequate clearance under the Bourne and Sagamore bridges for navigational purposes.

The canal is 32 feet deep, 350-700 foot wide, and the Mean High Water is nearly 1.5 feet greater at the Sagamore Bridge than the Bourne Bridge (EA Table 1).

EA Table 1-Canal Tidal Datums in feet relative to Mean Sea Level

Water Level	Railroad Bridge	Bourne Bridge	Sagamore Bridge
Mean Higher High Water (MHHW)	2.18	2.52	3.93
Mean High Water (MHW)	1.81	2.14	3.56
North American Vertical Datum of 1988 (NAVD88)	0.57	0.57	0.56
Mean Sea Level (MSL)	0.0	0.0	0.0
Mean Tide Level (MTL)	0.10	-0.10	-0.17
Mean Low Water (MLW)	-1.60	-2.34	-3.89
Mean Lower Low Water (MLLW)	-1.85	-2.62	-4.20
Mean Range	3.41	4.48	7.45
Great Diurnal Range	4.03	5.14	8.13

Note: Water level datums obtained from NOAA's vDatum

The USACE examined three scenarios of sea level change at the project site: (1) historic rate, (2) intermediate rate, and (3) a high rate of sea level rise, to determine the potential impact to the bridge projects. Considering a project start date in 2025, the projected sea level changes after 50 and 100 years are predicted to be: 0.78 feet per year, 1.4 feet per year, and 3.34 feet per year by 2075; and 1.26 feet per year, 2.83 feet per year, and 7.82 feet per year by the year 2125. The full Sea Level Change analysis can be found in Section 7.2.2 of the MRER.

During Phase II of the project, the USACE will incorporate considerations for potential sea level change into the design analyses so both bridges can accommodate and withstand any projected sea-level change.

Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Based on the information above, none of these alternatives will be impacted by sea level change. For bridge replacement alternatives, the USACE will incorporate potential sea level change considerations into the design process during Phase II for both bridges to accommodate necessary vertical clearances for large vessel transit and maintain navigation through the Canal.

6.1.6 Air Quality

The Clean Air Act (40 CFR Part 50) requires U.S. Environmental Protection Agency (EPA) to set, and states to adopt, National Ambient Air Quality Standards (NAAQS). The standards have been established to protect the public from potentially harmful amounts of pollutants. EPA has

set National Ambient Air Quality Standards (NAAQS) for the following six criteria pollutants: Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxide (NO2), Particulate Matter with a diameter less than or equal to ten micrometers (PM10) and less than 2.5 micrometers (PM2.5), Ozone (O3), and Sulfur Dioxide (SO2).

EPA has designated specific areas as NAAQS Attainment or Non-Attainment areas. Attainment areas are those areas that meet ambient air quality standards and non-attainment areas are areas that do not meet quality standards for a specific pollutant. If an area is designated as "nonattainment", states must develop a State Implementation Plan (SIP) as a pathway to attain and maintain the National Ambient Air Quality Standards (NAAQS) (EPA, 2019a).

Both bridge replacement projects are located within Barnstable County, which is currently designated as an Attainment Area for all National Ambient Air Quality Standards. EPA promulgated a transportation conformity rule (40 CFR Parts 51 and 93) pursuant to requirements of the Clean Air Act. The rule only applies in EPA-designated non-attainment or maintenance areas (40 CFR 93.102(b). The project area is in attainment of all of the applicable NAAQS; therefore, transportation conformity rule requirements do not apply for this region.

Lead Paint:
The existing paint system on both bridges contains lead paint. Even areas that have been previously maintained contain residual amounts of lead.

During a previous bridge rehabilitation project on the Sagamore Bridge (1981), old paint was sandblasted to prepare surfaces for repairing and repainting. As the result of this work, ambient concentrations of total suspended particulates (TSP) temporarily increased in the immediate vicinity of the sandblasting. The old paint contained lead. The USACE conducted air monitoring over a 10-month period to determine impacts to ambient air quality and to ensure there were no adverse effects on public health from the rehabilitation activities. There was no exceedance of lead or annual TSP standards throughout the entire monitoring period. Both lead and TSP concentrations were low in comparison to Federal and State ambient air quality standards (USACE, 1982).

Contract specifications and work requirements for painting of the Sagamore Bridge again in 1998 ensured that all work was performed in accordance with applicable environmental regulations and health and safety standards. Protective measures included BMPs such as proper surface preparation and removal of lead containing paint, shrouds and negative pressure work environments around sand blasting activities for containment, emissions monitoring, collection, and proper disposal of all lead containing paint debris (USACE, 1998).

Environmental Consequences

None of the Alternatives will result in permanent air emissions or long-term impacts to air quality providing BMPS are incorporated at the time of scheduled construction activities. No impact to local or regional air quality should occur as the result of the proposed project.

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges

Bridge routine and emergency maintenance, as well as major rehabilitation activities, have the potential to cause a temporary increase in air emissions due to traffic backups and delays associated with this work.

MassDOT conducted a preliminary air quality evaluation as part of their *Cape Cod Canal Transportation Improvements Study* (2019) to assess the potential for increased or decreased air quality impacts associated with their conceptual improvement projects. They examined modeled traffic impacts for "worst-case conditions" during summer peak traffic. They used carbon monoxide (CO) for their analysis of pollutant levels as it is the most abundant pollutant emitted by motor vehicles and can result in high concentrations in congested areas (MassDOT, 2019). The study concluded that increased traffic volumes and delays could result in an increase in CO emissions.

Routine maintenance and major rehabilitation will require removal of lead containing paint from both bridges. During the design and construction phase, a detailed monitoring plan will be developed in conjunction with both Federal (EPA) and state agencies according to applicable regulations and BMPs to identify and mitigate potential air and soil impacts from construction activities. Impacts to air quality under Alternatives A and B would be temporary during construction and would be considered minor.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Over the short term, bridge replacement will not significantly affect regional air quality levels because existing bridges will remain open until new bridge construction is completed; therefore, the emissions from bridge traffic during construction would remain unchanged from existing conditions.

Short-term/temporary increases in emissions would occur during the construction period for new bridges. To reduce temporary impacts to air quality, construction contractors would be required to water down construction areas if necessary, keeping fugitive dust to a minimum.

Emissions from fuel-burning internal combustion engines during construction (e.g., heavy equipment and earthmoving machinery) would temporarily increase the levels of some of the criteria pollutants including CO, NO_2, O_3, PM10, and non-criteria pollutants, such as volatile organic compounds (VOCs). To reduce the emission of air pollutants, fuel-burning equipment running times would be kept to a minimum and engines would be properly maintained.

Short term impacts resulting from dust, construction vehicles, and related equipment are expected to be minor and should not have a significant impact on local air quality. To address short-term air quality impacts, specific mitigation measures will be listed in contract specifications and will be implemented during all construction activities.

Replacement of the existing bridges will also include demolishing the old bridges which may produce lead contaminated blast debris. All work will be performed in accordance with applicable environmental regulations, BMPs as well as worker health and safety standards,

including containment, emissions monitoring, collection, and disposal of all contaminated blast debris and as such, there will be no significant impacts to air quality.

With respect to long term impacts, the MassDOT hired a contractor to prepare a qualitative evaluation of twelve intersections for both existing and future intersections and with and without the Bourne and Sagamore bridges being replaced. The potential effects of replacing the bridges on air pollutant emissions depends on the degree to which their replacement would affect the efficiency of the flow of traffic and whether the increase in efficiency would result in an increase in overall traffic volume. An apparent effect of replacing the bridges would be to reduce travel durations over the bridges, which would reduce idling during peak transit time periods when congestion normally occurs and reduce overall air pollutant emissions. The MassDOT traffic study concluded that replacing the bridges and associated intersection upgrades would not significantly reduce travel times onto and off of Cape Cod because of bottlenecks to traffic flow that are located on the downstream of the bridges. Therefore, replacement of the bridges with more efficient vehicle lanes would not substantially affect the overall broad scale distribution or quantity of traffic-related air pollutant emissions. The MassDOT air quality evaluation assessed the potential for increased or decreased air quality impacts within the study area utilizing EPA and FHWA guideline criteria. Based on their analysis, minor increases in emissions of CO and Mobile Source Air Toxics, VOCs, and NOx could result from the bridge replacement, but given the relatively small expected average daily traffic increase of 1.5 to 2.0 percent relative to the total vehicle miles traveled in the region, it is unlikely the project would result in a substantial change in emissions. The report indicated that regardless of whether the bridges are replaced, future vehicle emissions would likely be lower than present levels because of the EPA's national air quality control programs mandated under the federal Clean Air Act (MassDOT, 2019). The MassDOT preliminary air quality evaluation can be viewed in Appendix E.

MassDOT plans on conducting additional air quality analyses in the next phase of the project to evaluate existing and future air quality impacts associated with the bridges and associated roadways. Impacts would be assessed with respect to the methodologies and assumptions for each pollutant consistent with FHWA and EPA guidance as well as that of the MassDOT and Massachusetts Department of Environmental Protection (MassDEP) (MassDOT, 2019).

6.2 Water Resources

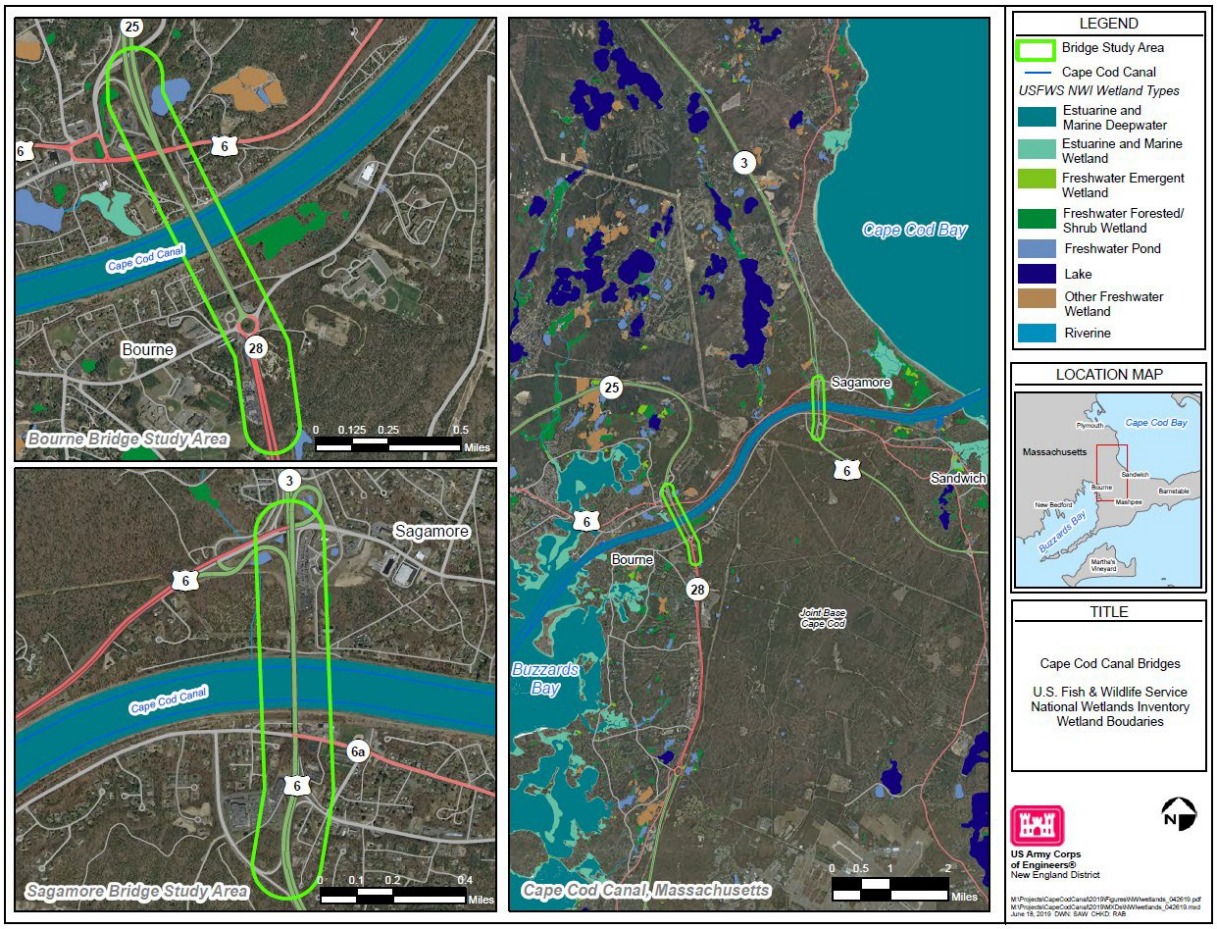
6.2.1 Surface Water and Wetlands

The Cape Cod Canal FNP connects Buzzards Bay and Cape Cod Bay, and has significant tidal exchange with those water bodies. On land, surface water resources on the Cape include freshwater wetlands, salt marshes, bogs, and ponds. Large streams do not exist on Cape Cod because of the high permeability of the Cape's sandy soils. Precipitation that does not evaporate or get transpired by plants infiltrates into the ground with little direct surface runoff. Much of the groundwater on the Cape discharges directly to coastal waters and embayments (USGS, 1999). There are many freshwater ponds on the Cape, most of which are located in kettle holes on the glacial outwash plain. Many naturally-occurring ponds on Cape Cod are flow-through ponds where water flows directly from the upgradient pond to recharge the aquifer on the downgradient side (Walter et al, 2004). The project area has several man-made ponds and freshwater wetlands.

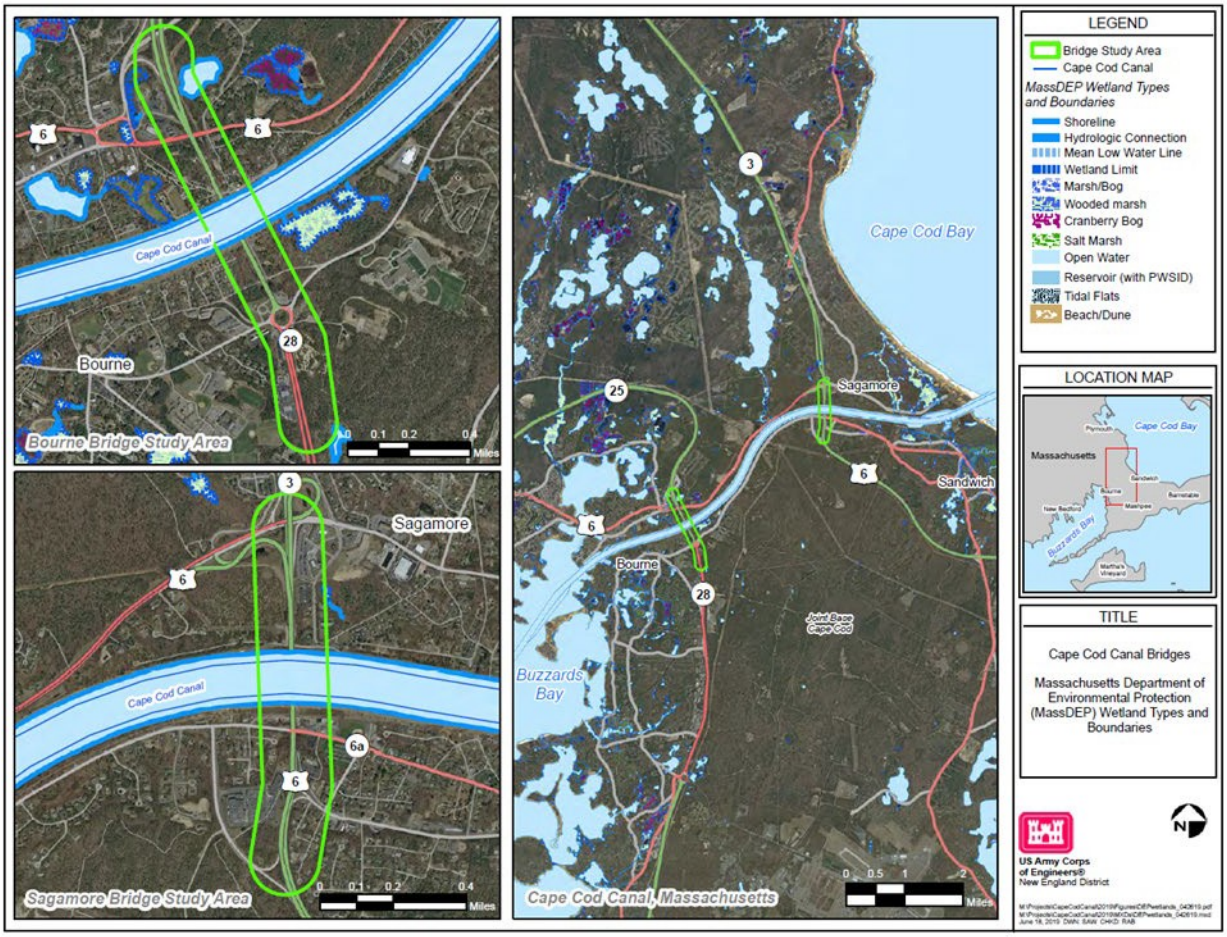
The largest water body located within the project area is the seven acre Nightingale Pond, located on the northwestern corner of the Bourne Bridge Study Area. There are four small ponds located within the existing approach to Sagamore Bridge, and two small ponds to the north of the study area that would also be affected by bridge construction and maintenance activities. Based on their location nestled within the roadways (See EA Figure 4 - Wetlands), the ponds were likely excavated for fill used to construct the bridge approaches and roads. None of these ponds are displayed on the historic USGS topographic map of the area, which was surveyed in years (1932, 1933, and 1937) prior to the 1938 construction of the current bridges There is also a small forested wetland approximately 200 feet east of Canal Rd. on the eastern side of the northern Sagamore Bridge approach.

The ponds in EA Figure 4 - Wetlands, all of which are less than a half-acre in size, are surrounded by the roadways of the Sagamore Bridge approach. The slope and topography of this area indicate these ponds drain the land within the approach, which are at a higher elevation than the surrounding natural landscape.

EA Figure 4 - Wetlands



EA Figure 5 - MassDEP Wetlands



The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) shows forested wetlands in the Bourne Bridge area (See EA Figure 4 - Wetlands).There are two forested freshwater wetlands between Rt. 6 and the Bourne Bridge approach, and another on the southern shore of the Canal roughly 700 feet east of the bridge. Finally, there is an area of estuarine marsh between the bridge and Old Bridge Rd. on the northern shore of the Canal. The Massachusetts Department of Environmental Protection (MADEP) identifies one additional forested wetland on the eastern land-ward side of the Sagamore Bridge study area, <0.3 acre, however, this is located outside of the study area. EA Figure 5 shows wetlands identified by the Massachusetts Department of Environmental Protection (MADEP). A USACE field inspection conducted on April 15, 2019 confirmed the location of wetlands found in the online databases. An additional area of forested wetland approximately 50 by 100 feet in size (0.5 acres), is located roughly 500 feet east of the Bourne Bridge on the northern shore of the Canal. This wetland was composed of open water and red maple trees growing on hummocks. The wetland was bordered vy very thick greenbrier. It is bordered on the northeast by railroad tracks and on the southeast by uphill slopes with white pine. The survey took place before the height of the growing season, so understory herbaceous plants had not yet emerged and a full botanical survey was not completed.

This wetland is located alongside the railroad tracks that run along the Canal shoreline. The tracks apparently impound water as it flows down-slope toward the Canal, thus creating a forested wetland where water would otherwise infiltrate the sandy soils and flow directly towards surface water bodies.

The Herring River Watershed is located west of the Sagamore Bridge study area on the mainland side of the Canal. This watershed is designated by the state as an Area of Critical Environmental Concern (ACEC) for its importance to anadromous fish and other wildlife.

Environmental Consequences

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges
There would be no impacts to surface water and wetland resources because activities would take place only around existing structures where no wetlands are identified. Thus, only the area of the Canal where the piers are currently situated would continue to have impacts from routine maintenance or major rehabilitation, as well as by the presence of construction support barges in the event they might be required. Routine maintenance or major rehabilitation in the future would not involve any wetland impacts outside of the Canal.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes
Nearby wetlands and ponds may be temporarily affected by construction activities. No adverse impacts are expected for the ACEC and Nightingale Pond, and construction best management practices would mitigate any potential indirect effects from construction-related runoff. The most prominent surface water feature that would be affected is Nightingale Pond in the Bourne Bridge study area. The new proposed alignment would abut the western edge of that pond. Mitigation measures to protect the pond would be developed when the new bridge designs are finalized during Phase II of the project. The Canal shoreline would also receive new proposed bridge piers, as they would be relocated out of the water. The shoreline in this area is rock/riprap, and is located on USACE property. The forested wetland 500 ft. east of the Bourne Bridge on the northern side of the Canal touches the easternmost boundary of the area affected by the new alignment. This half-acre wetland would be most impacted under Alternative D, because of the extra width imposed by the auxiliary lanes. The USACE will evaluate the effects to regulated wetlands and water resources through a Clean Water Act, Section 404(b)(1) evaluation and will obtain State Water Quality Certification for any discharge of fill material into waters of the United States. Mitigation measures will be developed during the design phase for any impacts to this wetland as a result of Alternative and D. If there are any impacts to wetlands as a result of the project, wetlands will be restored either within the Federal navigation project or at an appropriate site in the vicinity of the project. Therefore, Alternative D could have moderate impacts to wetlands, but with appropriate mitigation would be minor.

6.2.2 Water Quality

Water quality is considered for both fresh and salt water resources in the project area. The saltwater environment in the Canal is subject to the diurnal tidal cycle in connection with Cape Cod Bay and Buzzards Bay, creating a swift current that can reach 5.2 mph during the ebb tide

(USACE, 2017). Water quality in the Canal is affected by the large volume of maritime traffic that passes through on a daily basis. The Massachusetts Department of Environmental Protection designates the Canal as "Class SB," meaning that the waters of the Canal are designated for fish, other aquatic life and wildlife, and for primary and secondary contact and recreation (DeCesare and Connor, 2002). Surface water on land is affected by runoff from the urban landscape and high volume of road traffic that passes over the Canal bridges.

Nitrogen pollution from residential septic systems is a major concern on the Cape, as it can travel quickly through groundwater into ponds and coastal waters, causing algal blooms that negatively affect marine life (Dunn, 2018). Nitrogen pollution can also be exacerbated through stormwater runoff. The Cape Cod Commission notes that the number of public drinking water wells tested as "very clean" for nitrate levels has dropped from 57% to 42% from 1993 to 2008.

Environmental Consequences

Alternative A – No Action

There would be no impacts to water quality because there would be no change to existing conditions around the bridges. Routine maintenance operations would require construction activity on-site, but these operations have occurred for decades with no adverse water quality impacts. Therefore, no impacts to water quality are anticipated in the future under this alternative. Future increases in nitrogen pollution from residential septic systems are unrelated to the standard operation and maintenance of the bridges under any of the alternatives considered in this document.

Alternative B – Major Rehabilitation for Both Bridges

Major rehabilitation would have no impacts on water quality. Construction activities taking place in Alternative B would be implemented with the appropriate best management practices to minimize runoff that could impact water quality.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Replacement as authorized is not anticipated to have any substantial effect on water quality because impacts to regulated water resources would be minimized through avoidance and minimization during the design and construction phase. The USACE will evaluate the effects to regulated wetlands and water resources through a Clean Water Act, Section 404(b)(1) evaluation and obtain State Water Quality Certification for any discharge of fill material into waters of the United States. Water quality is a salient issue because of the high rate of infiltration in the Cape's highly permeable soil and the fact that the project area is located in the vicinity of the Cape Cod sole source aquifer, discussed in the groundwater section of this EA. Appropriate measures to avoid and minimize impacts from construction activities to water quality will be developed during the design and construction phases. Measures to avoid or minimize impacts to water quality include the installation of silt fences and straw bales around worksites, placement of coir logs on slopes, containment of soil or sediment stockpiles if they need to be stored onsite, avoidance or setback distance from sensitive areas, and any other project-specific minimization measures as appropriate.

6.2.3 Groundwater

Regional groundwater occurs in alluvial and bedrock aquifers. The Cape Cod Aquifer is a bedrock aquifer (See EA Figure 6 - Cape Cod Sole Source Aquifer) and is designated as the principal source of drinking water for residents of Cape Cod. In 1982, the U.S. Environmental Protection Agency (EPA) designated the Cape Cod Aquifer as a Sole Source Aquifer. This designation means that the Aquifer supplies at least 50 percent of the drinking water consumed in the area above it. The regional water bearing units of the Cape Cod Aquifer are generally comprised of contiguous and permeable sandy substrates. Groundwater is the most important freshwater resource on the Cape (DeCesare and Connor, 2002). The aquifer is recharged solely from precipitation at 27 inches per year (Cape Cod Commission, 2017).

The glacial sediments that underlie Cape Cod form an unconfined aquifer with six hydrologically distinct flow lenses, the largest of which is the Sagamore Lens (Walter et al, 2004). The Sagamore Lens has 60% of the total 450 million gallons per day flowing through the entire Cape Cod aquifer (ibid). The western edge of the Sagamore lens underlies the study area in the town of Bourne, and the top of that lens is 69 feet above msl and located well outside of the project area to the southeast (Cape Cod Commission, 2017).

EA Figure 6 – Cape Cod Sole Source Aquifer

Environmental Consequences

Alternative A – No Action

There would be no impact to groundwater because no actions would occur that could affect regional or local groundwater patterns.

Alternative B – Major Rehabilitation for Both Bridges

There would be no impact to groundwater under Alternative B. These actions would not affect the Cape's high rates of surface water infiltration, and the effects of construction activities would not change the underlying hydrogeology of the area either directly or indirectly by rehabilitating the bridges.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

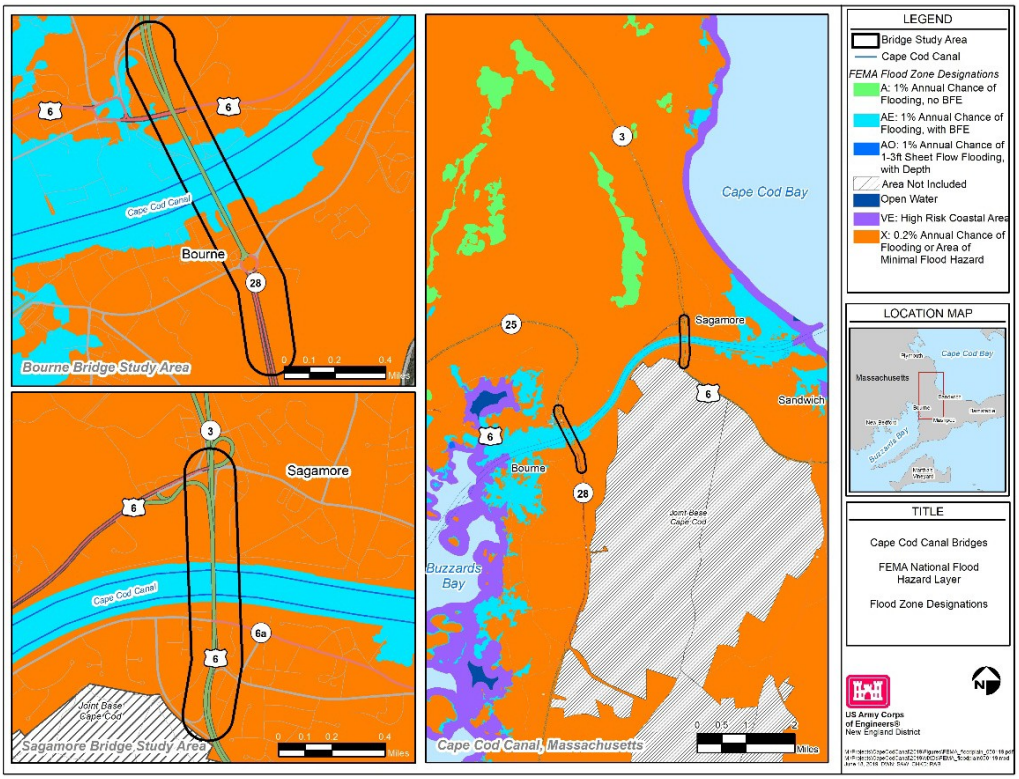
There would be no impact to groundwater under Alternative D because no actions would occur that could affect regional or local groundwater patterns. Replacing the bridges would not alter region-wide patterns of surface water infiltration to the aquifer because the work is confined to a relatively small area compared to the size of the Sagamore lens, and also located on the Western edge where the aquifer is deep and bordered by saltwater. Because of the high rate of soil infiltration of surface water, appropriate best management practices to minimize runoff would be implemented during the construction phase.

6.2.4 Floodplains

Executive Order (EO) 11988 (Floodplain Management) requires Federal agencies to avoid direct or indirect support of development within the 100-year floodplain whenever there is a practicable alternative. The Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) publishes maps identifying areas at risk from potential flooding. The flood risk information is based on historical, meteorological, hydrologic and hydraulic data. Flood hazards are identified for areas subject to inundation by 100 and 500 year storm events.

Consistent with EO 11988, flood maps were examined during the preparation of this EA (EA Figure 7). The bridges are located in two zones:
X: 0.2% Annual Chance of Flooding or Area of Minimal Flood Hazard (500 year floodplain)
AE: 1% Annual Chance of Flooding, with Base Flood Elevations (100 year floodplain)

EA Figure 7 - Floodplain



Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

There will be no significant impact to, or alteration of, floodplains or flood levels associated with any of the alternatives as the both bridges are located within an existing federal navigation channel and adjacent to developed land.

6.3 Coastal Resources

6.3.1 Coastal Zones

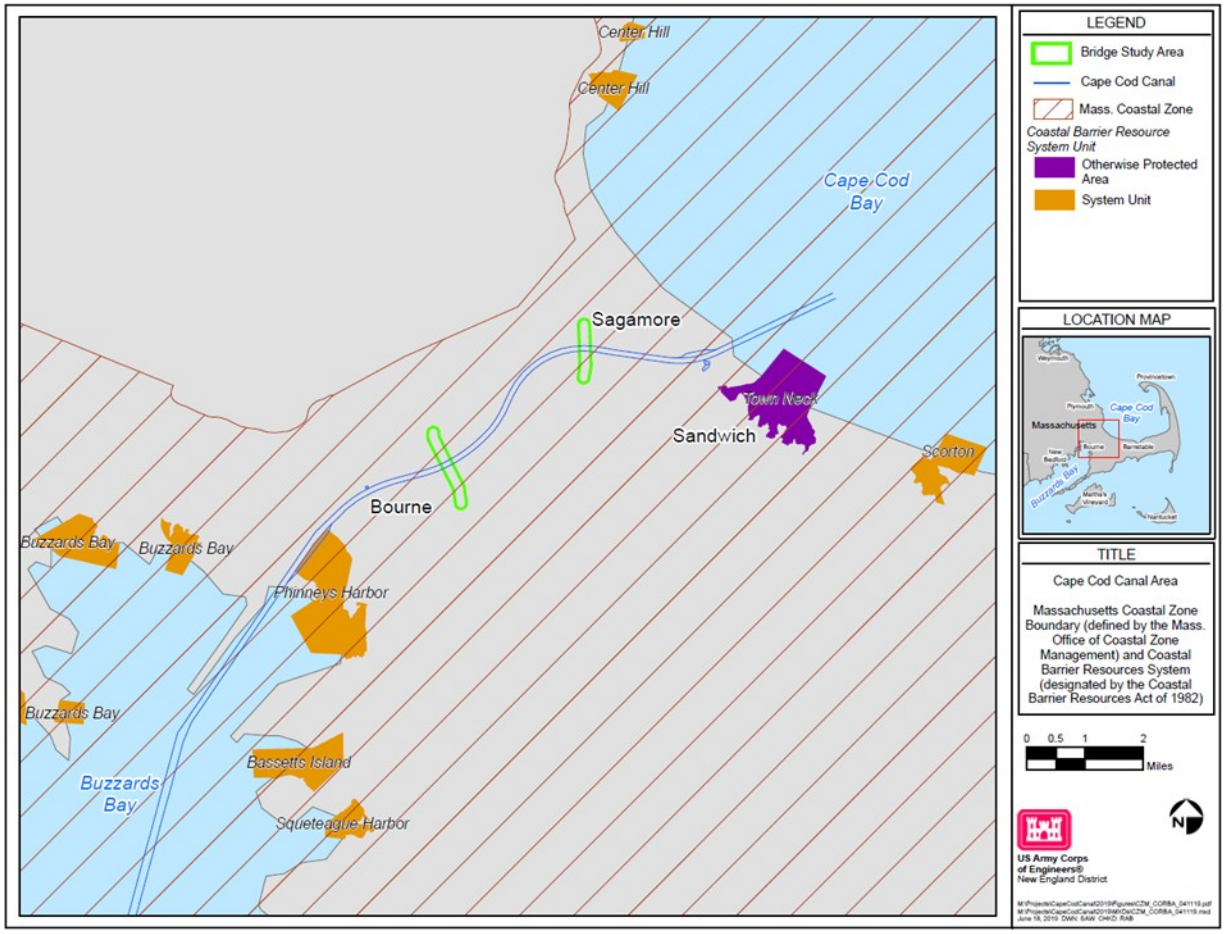
The Coastal Zone Management Act (CZMA) enables coastal States, including Massachusetts, to designate State coastal zone boundaries and develop coastal management programs to improve protection of sensitive shoreline resources and guide sustainable use of coastal areas.

Section 307 of CZMA requires federal agencies to determine if their federal actions might have reasonably foreseeable effects on any coastal use (land or water) or natural resource of the coastal zone, and are consistent with the enforceable policies of a state's federally-approved coastal management program. The Massachusetts Office of Coastal Zone Management

implements the federal consistency review process in Massachusetts. Federal consistency review is required for most projects that: 1) are in or can reasonably be expected to affect a use or resource of the Massachusetts coastal zone, and/or 2) require federal licenses or permits, receive certain federal funds, are a direct action of a federal agency, or are part of outer continental shelf plans for exploration, development, and production (MA CZM, 2019)

All of Cape Cod and the islands of Nantucket and Martha's Vineyard are included in the Massachusetts coastal zone boundary. Both the Sagamore and Bourne bridge project areas are located within these coastal boundaries (EA Figure 8).

EA Figure 8 – Coastal Zone and Coastal Barrier Resources



Environmental Consequences

<u>Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges</u>
Under the No Action and Major Rehabilitation alternatives, no new construction would occur within the coastal zone and activities associated with repair or rehabilitation of the existing bridges would not result in any short or long-term impacts to coastal resources within the project area.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

It is anticipated that bridge replacement will include the removal and re-location of existing support structures and piers within the canal to an upland setting, reducing the overall project footprint in the Canal itself. The piers from the old bridges will also be removed from the canal waters following completion of the newly constructed bridges thus reducing the overall footprint in subtidal areas. The shoreline where the piers are currently situated are shallow areas hardened with rip-rap for operation and maintenance of the Canal. Impacts during removal activities will be temporary and localized in nature and will reduce the in-water footprint of the bridges structures.

The Herring River Area of Critical Environmental Concern (ACEC) abuts the northwestern corner of the project footprint of the Sagamore replacement bridge. The USACE will utilize Best Management Practices (BMPs) during construction activities and throughout the entire removal process to minimize and avoid impacts to the surrounding coastal environment. The USACE will coordinate with the appropriate regulatory authorities during the design and construction phase of the project to ensure there will be no impact to the ACEC from replacement of the existing bridge structures.

Replacement of the two existing bridges will have no significant impact on the coastal environment. The project will preserve all coastal resources including the immediate waterfront for both recreational and vessel-related activities. The USACE has determined that the proposed action is consistent with relevant policies of the coastal zone program. A Federal Consistency Determination has been submitted to the Massachusetts Office of Coastal Zone Management for concurrence on Phase I of this project. (Appendix H). Coordination with MA CZM will continue throughout all phases of the project to ensure consistency with the relevant policies of the coastal zone program. When the project enters the design and construction phase (Phase II), an additional Consistency Determination will be submitted to ensure that activities taking place within the coastal zone are consistent with state regulations protecting coastal features. Specific details of the bridge design, construction methods, and location will be identified for the Phase II submission.

6.3.2 Coastal Barrier Resources System

Coastal barriers are unique landforms that protects coastal mainland areas from severe coastal storm damage and erosion and are important wildlife habitat and recreational areas. The Coastal Barrier Resources Act (CBRA) of 1982 established the John H. Chafee Coastal Resources System (CBRS), which includes undeveloped coastal barriers along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico.

The Coastal Barrier Resources System contains two types of units, System Units and Otherwise Protected Areas (OPAs). OPAs are typically conservation and recreation areas such as national wildlife refuges, state parks, national parks, or local conservation areas. Section 5 of CBRA prohibits new federal expenditures or financial assistance for projects located within System Units such as road construction, channel dredging, coastal engineering projects which might encourage development or modifications of the coastal barriers. The only federal spending

prohibition within OPAs is on federal flood insurance.

The Bourne and Sagamore Bridges project areas are located outside of CBRA System Units and Otherwise Protected Areas. (EA Figure 8).

Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

There is no impact to coastal barrier resources as all alternatives are located outside of the Coastal Barrier Resources System.

6.4 Biological Resources

6.4.1 Vegetation

Cape Cod is situated in the Atlantic Coastal Pine Barrens ecoregion, a globally rare habitat type that only exists on the Cape and Islands, Long Island, and New Jersey (USGS, 2003). The 2017 Environmental Assessment and Finding of No Significant Impact for the Cape Cod Canal Photovoltaic Installation (USACE, 2017) documented land cover and vegetation for areas adjacent to the Sagamore Bridge and the nearby Midway Recreation Area, providing an overview of vegetation and land cover within the canal bridges study area and the surrounding landscape. The study area was historically a pine barren, dominated by pitch pine (*Pinus rigida*) with bear oak (*Quercua ilicifolia*), black oak (*Q. velutina*) and white oak (*Q. alba*) on sandy soils. Other abundant tree species include red maple (*Acer rubrum*), American white cedar (*Thuja occidentalis*), and American beech (*Fagus grandifolia*). The understory is characterized by plants such as bayberry (*Myrica* sp.), beach rose (*Rosa rugosa*), *Aster* sp., goldernrod (*Solidago* sp.), sweet fern (*Comptonia peregrine)*, sheep laurel (*Kalmia angustifolia*), and staghorn sumac (*Rhus typhina*). There are also invasive species such as spotted knapweed (*Centaurea stoebe*), autumn olive (*Elaeagnus umbellate*) and oriental bittersweet (*Celastrus orbiculatus*) present.

The MA land cover dataset (See EA Figure 3 - Land Use in section 6.1 of this document) shows the mosaic of transportation infrastructure, forested land, and residential/commercial development that occurs in both project areas around the Bourne and Sagamore bridges. There are patches of forested land in the study area, composed of oak-pine and scrub-oak communities. Forested areas occur within 1000 feet of both bridges, and these are interspersed among roads and development. On the north shore of the Canal to the west of the Sagamore Bridge approach, there is a 24 acre area of scrubby pineland, with an increasing hardwood component on the northwestern end near Rt. 6. To the east, there is an 11 acre patch of mixed pine-hardwood forest between Canal Road and Hunters Brook Road. On the southern shore in the Sagamore Bridge study area, there are small woody patches mixed in with low-density residential and commercial development.

To the east of the Bourne Bridge approach on the south shore of the Canal, there is a 45 acre patch of mixed pine-hardwood forest separated from the project area by a low density residential area and access road. There is also ample tree cover both east and west of the Bourne Bridge approach on the north shore, but inspection of aerial imagery reveals this is low density residential development and park segmented by roads, and not a contiguous area of forest. There is also a recreation area on USACE property. There are small patches of forest occurring between the roads entering Bourne Rotary Circle, as well as an area of mixed forest and commercial development southwest of the circle.

The shorelines of the Cape Cod Canal are primarily rip rap, and above that hard shoreline is a grassy area with occasional tree cover on the transition zone between the water and Canal Service Roads for both bridges. This is a man-made, heavily managed shoreline used for recreation and navigation purposes.

Environmental Consequences – Vegetation

Alternative A – No Action
There would be no impacts to vegetation as no changes to existing conditions would occur with this Alternative. Routine maintenance activities may have small impacts to roadside vegetation, but best management practices within construction zones would mitigate any peripheral impacts.

Alternative B – Major Rehabilitation for Both Bridges
Some disturbance of roadside vegetation would occur with major rehabilitation of bridges, but the impacts would be minimal because the scope of work is largely confined to the existing right-of-ways. Construction activities, such as use of lay down areas and equipment storage, may temporarily impact vegetation. This area of impact would be minimal due to the use of existing roads and infrastructure and barge-supported cranes for routine maintenance. The MRER does not include a full design component, so the exact logistical needs for construction equipment would be defined in Phase II of this project if major rehabilitation were the selected plan. Past maintenance and rehabilitation events have successfully been completed without adverse impacts to local vegetation. For example, the 1981 major rehabilitation included bridge deck, side walk, steel, and concrete repairs, pavement replacement, and painting of the steel structure. Therefore, minimal temporary impacts to vegetation are anticipated for Alternative B.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

There would be localized permanent impacts on vegetation where the bridge approaches, piers and abutments are relocated. Forested areas adjacent to the bridges would undergo permanent changes as outlined in the Land Use section of this document. A new bridge would be constructed immediately to the east of the Bourne Bridge, and another bridge immediately to the west of the Sagamore Bridge. Therefore, overall impacts to vegetation are expected to be moderate.

The precise dimensions of the new bridges will be developed in Phase II of the project. The

existing bridges would be torn down and it has not yet been determined what would take place on the managed right-of-ways underneath those bridges. At both bridge sites, there are approximately 65 acres of tree cover within the entire 500 foot buffer zone of the existing bridge centerlines. This entire area would not be affected because the actual footprint of the new bridges is much smaller than the study zone for this phase of the project. Pitch pine, white pine, scrub oak, and red maple are examples of common species in the project area that would be permanently affected by Alternative D, and mitigation measures will be developed in Phase II when the full extent of impacts to vegetation become clear. Of the 65 acres of tree cover identified within the conceptual buffer area, 3 to 15 acres could potentially be impacted by construction of replacement bridges in Alternative D. We estimated the approximate magnitude of the direct impact of the new bridges on vegetation by estimating the percent increase in the size of the bridges and approaches and overlaying that conceptual footprint on the potential bridge touch down locations.

The potential impact for Alternative D is approximately 45% larger than the existing bridges, and the potential range of vegetation area impacted is 3 to 15 acres for Alternative D. These figures are based on a rough estimation of the potential area encompassing the replacement bridges. Bridge features, touchdown areas, location of work areas, construction equipment staging areas, and any associated mitigation measures will be identified during the design phase.

6.4.2 Wildlife

Mammals: There are a variety of mammals on Cape Cod inhabiting the diverse landscape, from the coastal pine barren forests to seashore environments. These include white footed mice (*Peromyscus leucopus*), deer (*Odocoileus virginianus*), and the North American river otter (*Lontra Canadensis*). Mammals on Cape Cod were affected by habitat conversion in the early 19th century from woodland to farmland, and there was some recovery when agriculture moved westward. Some species such as deer and beaver were actively restored by re-stocking, while others slowly recolonized naturally. In recent decades, otters have reappeared in the Cape Cod National Seashore and have become fairly common across the Cape. Black bear and bobcat have recently made forays back onto Cape Cod. In contrast, the woodchuck, which depends on open fields, has been in decline (NPS, 2012).

Several small terrestrial mammals potentially use the habitat areas surrounding the Bridges. These species include: striped skunk (*Mephitis mephitis*), eastern cottontail rabbit (*Sylvilagus floridanus*), eastern grey squirrel (*Sciurus carolinensis*), white-footed mouse, eastern chipmunk (*Tamias striatus*), American red squirrel (*Tamiasciurus hudsonicus*), and raccoon (*Procyon lotor*).

Birds: The Canal is an important corridor for birds traveling between Massachusetts Bay and Buzzards Bay. The bird-watching website Ebird.org lists several “birding hotspots” located around the Cape Cod Canal, where hundreds of different bird species have been observed

(eBird.org, 2019). Barnstable County, MA, where the project is located, has the highest number of reported species (429) of any county in Massachusetts (eBird.org 2019b).

Birds that may utilize the project sites include sparrows (Family: Emberizidae), American robins (*Turdus migratorius*), crows (*Corvus* spp.), warblers (Family: Parulidae & Peucedramidae), blue jays (*Cyanocitta cristata*), and mallards (*Anas platyrhynchos*). Double-crested cormorant (*Phalacrocorax auritus*) and Great blue heron (*Ardea herodias*) have been reported (ebird.org 2019), as well as numerous coastal and sea-dependent bird species passing through the area. The USACE has implemented programs to increase use of the Canal by birds such as ospreys (*Pandion haliaetus*) and screech owls (*Megascops asio*). There are at least five osprey nesting platforms installed on utility poles on government land along the Canal. These platforms provide nesting opportunities for ospreys in order to encourage reproduction. To increase breeding opportunities for screech owls, nesting boxes were installed in the woodland west of the Sagamore Bridge. One pair of nesting ospreys occupied one of the constructed platforms within a few months of installation, and screech owls have been recorded using the nesting boxes.

Piping plovers (*Charadrius melodus*), red knot (*Calidiris canatus*), and roseate terns (*Sterna dougallii*) may also use the study area in a migratory or transient capacity, and they are discussed further in the section on federally-threatened and endangered species in this document.

Environmental Consequences

Alternative A – No Action

There would be no impacts to wildlife under the no action alternative because existing conditions would continue. Routine maintenance activities have not negatively impacted bird and other mammal populations around the bridges in the past and are not expected to do so in the future.

Alternative B – Major Rehabilitation for Both Bridges

There may be minimal, temporary effects on wildlife because of the noise and duration of construction activities associated with major rehabilitation. However, these impacts are not expected to be significant because the noise from construction vehicles will likely deter animals from the construction site. Birds would continue to be able to use the site for roosting and shelter, but would likely vacate the bridges due to disturbance from the construction activities, but may return once those actions cease. The bridges are currently a major thoroughfare with a high volume of traffic, so the increase in disturbance from major rehabilitation-related construction will not significantly alter the quality of existing wildlife habitat. Coordination with resource agencies in Phase II will establish any necessary best practices to protect bird and mammal populations in the project area.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Impacts to wildlife are possible because of the changing footprint of new bridges, including the relocation of the piers from within the Canal to an upland setting, as well as extending the approaches. These changes would take place in the regularly-dredged Canal and existing network of transportation infrastructure around the bridges. The piers would be moved to an upland setting that is already mowed and maintained by the USACE. Wooded upland habitat used by wildlife would be affected, as well as marine epifauna living on the bridge piers and species that feed on them, but these impacts will be confined to the project area and further articulated in Phase II. Protective mitigation measures for aquatic life for Nightingale Pond will be developed when bridge designs are finalized and the full scope of impact to that area is determined. For example, aquatic basking turtles may occur on the shoreline or on coarse woody debris. At this time, the conceptual designs indicate there would be no impact to the pond because work would occur in the existing right-of-way. Protective measures such as silt fencing, coir log terracing, and runoff control, would be implemented during construction due to the close proximity of the roadway to the pond. Analysis of historical maps shows Nightingale Pond did not exist prior to the construction of the highway bridges. If during the design phase it is determined there would be any effects on the pond, USACE would analyze those impacts and conduct coordination and mitigation activities as necessary.

Birds and bats that commonly use the bridges would be disturbed by the process of constructing new bridges and demolishing the old ones. However, the noise from construction vehicles and equipment would likely deter animals from using the site during working hours, so significant impacts to wildlife populations are not expected. Any habitat that is converted to make way for the new bridges can be mitigated by either by returning the sites of the old bridges to natural conditions or restoring wooded habitats in nearby areas. Mitigation measures will be developed in detail in Phase II of the project when the full extent of impacts become clear. Through implementation of mitigation measures and BMPs, it is anticipated that Alternative and D would not have any adverse significant impacts, and overall impacts to wildlife are expected to be minor.

6.4.3 Fisheries and Marine Wildlife

The Canal is an important recreational fishery because of its swift currents and connectivity between Buzzards and Cape Cod bays. The Bournedale Herring Run entrance is located about one mile west of the Sagamore Bridge, and provides access for Alewife and Blueback Herring to spawn in Great Herring Pond. Other fish species that may be found in or near the Canal include: striped bass (*Morone saxatilis*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus altatrix*), mackerel (*Scomber scrombrus*), bonito (*Sarda sarda*), tautog (*Tautoga onitis*), scup (*Stenotomus chrysops*), cod (*Gadus morhua*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseduopleuronectes americanus*).

A March 1991 USACE survey of benthic habitat on the western edge of the Canal found no macrofauna, but did locate other sporadic marine ecological communities. These were dominated by polychaetes *Aricidea jefferysi*, *Amphitrite ornata*, and *Podarke obscura,* as well as the amphipod crustaceans *Ampelisca abdita* and *Corophium acutum.* Atlantic horseshoe crab

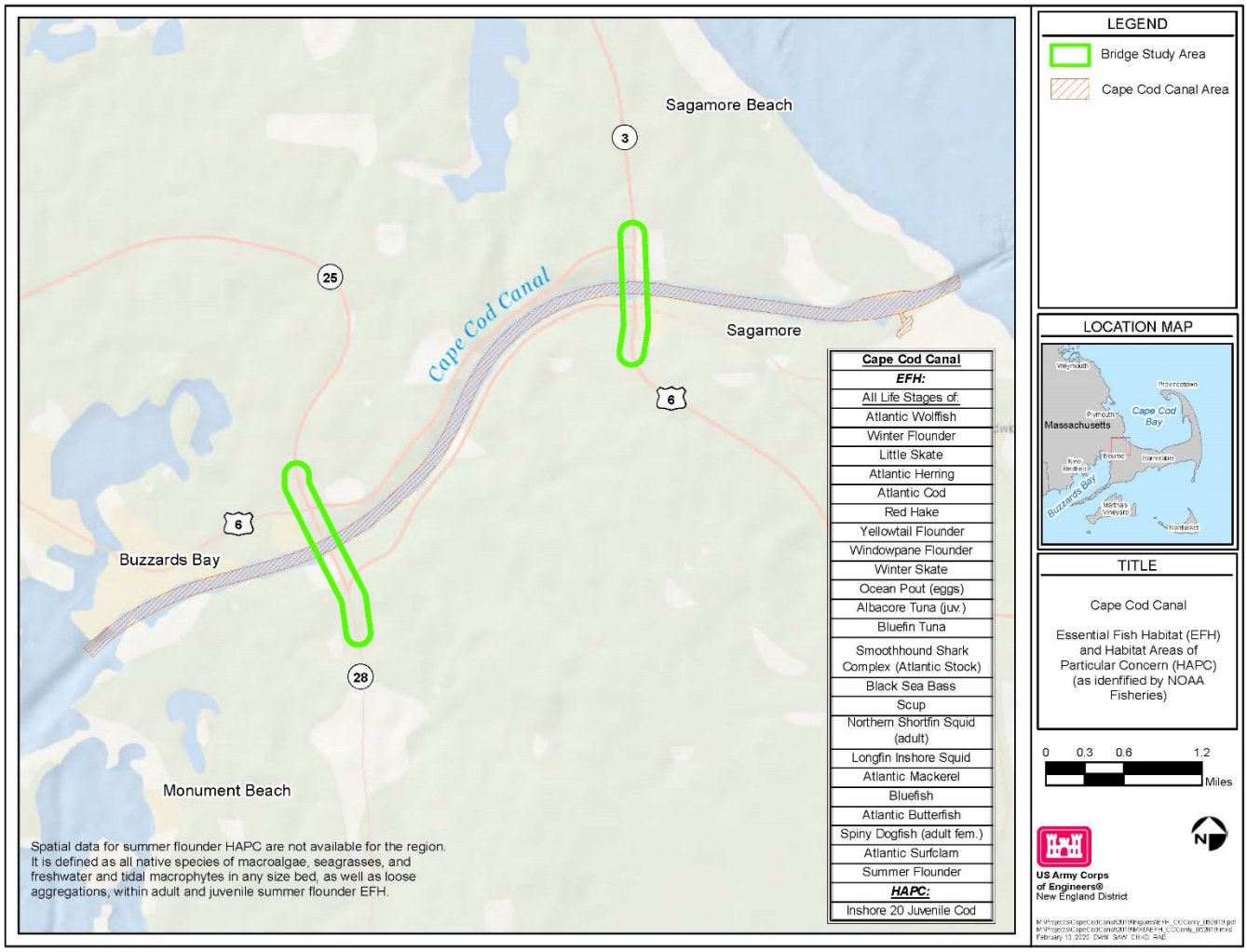
(*Limulus Polyphemus*) populates areas along the eastern seaboard, spawning on sandy beaches within bays and coves that are protected from wave action. There are recorded spawning sites within Buttermilk Bay, but none within the Canal. There is no eelgrass in the Canal's federal navigation channel, but it may be found outside of the channel near Hog's island on the western end of the Canal.

Essential Fish Habitat: The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act (MSA) strengthen the ability of the National Marine Fisheries Service (NMFS) and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "Essential Fish Habitat," (EFH) and is broadly defined to include, "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Cape Cod Canal falls into this category for multiple fish species, which are listed in EA Table 2. EA Figure 9 displays a map listing species with designated EFH in the Canal.

EA Table 2 - List of species that have designated EFH in the Cape Cod Canal

Species	Eggs	Larvae	Juveniles	Adults
Atlantic herring (*Clupea harengus)*			X	X
Atlantic cod (*Gadus morhua*)	X	X	X	X
American wolfish (*Anarhichus lupus*)	X	X	X	X
Little skate (*Leucoraja erinacea*)		X		X
Ocean pout (*Macrozoarces americanus*)	X			
Windowpane flounder (*Scophtalmus aquosus*)	X	X	X	X
Winter flounder (*Pseudopleuronectes americanus*)	X	X	X	X
Winter skate (*Leucoraja ocellata*)			X	X
Red Hake (*Urophycis chuss*)	X	X	X	X
Yellowtail flounder (*Limanda ferruginea*)			X	X
Albacore tuna (*Thunnus alalunga*)			X	
Bluefin tuna (*Thunnus thynnus*)				X
Smoothhound shark (*Mustelus spp.*)	X	X	X	X
Black sea bass (*Centropristis striata*)	X	X	X	X
Scup (*Stenotomus chrysops*)	X	X	X	X
Northern shortfin squid (*Illex illecebrosus*)				X
Longfin inshore squid (*Doryteuthis pealeii*)	X		X	X
Atlantic mackerel (*Scomber scombrus*)	X		X	X
Bluefish (*Pomatomus saltatrix*)			X	X
Atlantic butterfish (*Peprilus triacanthus*)	X	X	X	X
Spiny dogfish (*Squalus acanthias*)				X
Atlantic surfclam (*Spisula solidissima*)			X	X
Summer flounder (*Paralichthys dentatus*)		X	X	X

EA Figure 9 – EFH in the Cape Cod Canal



Environmental Consequences

Alternative A – No Action

The no action alternative would have no effects on EFH species because routine and emergency maintenance would not require in-water work.

Alternative B – Major Rehabilitation for Both Bridges

In-water work or elevated noise levels in the water due to major rehabilitation construction may have minimal temporary impacts on EFH species. A preliminary conference call was held with NMFS on May 20, 2019. NMFS also submitted a written response to the Draft EA December 20, 2019 stating the "Draft MRER EA accurately identifies the project elements that will be of highest concern for potential impacts to essential fish habitat (EFH)" (Appendix E). They requested the USACE wait until the design phase for further coordination and consultation pursuant to the MSA. The use of construction barges in the Canal to support major rehabilitation may be necessary. Such barges are

equipped with spuds that are driven into the sediment to stabilize the vessel. Specific details on the barges, the length of time they would be utilized, and the size and depth of the spuds will be defined in Phase II when the specific construction needs for major rehabilitation are established. A construction supporting barge would not cause adverse shading on benthic communities due to the small size of this structure compared to the larger width and depth of the Canal. The exact size of the construction barge is unknown at this time and is dependent on specific project needs. The impact area associated with its spuds on prey resources and benthic habitat is also minimal, given the size and frequently dredged habitat of the Canal.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Underwater work related to the removal of existing bridge piers may affect EFH or fish species. The USACE will ensure these resources are considered through consultation with NMFS at the design and construction phase of this project pursuant to the MSA. The USACE proposes to move the bridge piers from the water to the Canal shoreline, thus removing those structures as habitat.

Replacement would also require in-water barges to hold support cranes. The needed dimensions of these barges are unclear at this time and will be defined in Phase II during consultation with NMFS. Preliminary estimates indicate barge-supported cranes would be required for approximately 8 months (two months for construction and two months for demolition for each bridge). However, the small size of the project area will not substantially affect the highly mobile EFH species or their habitat, and the Canal is expected to remain a highly productive ecosystem because of the connectivity with Cape Cod and Buzzards Bay. A construction supporting barge would not cause adverse shading on benthic communities due to the small size of this structure compared to the larger width and depth of the Canal. The exact dimensions of construction barges are dependent on specific project requirements, which are not yet known and will be defined in Phase II. The impact area associated with its spuds on prey resources and benthic habitat is also minimal, given the size and frequently dredged habitat of the Canal. Potential noise impacts from the project on fisheries and marine wildlife will be evaluated in Phase II of the project in consultation with NMFS, using their Technical Guidance for Assessing the Impacts of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). If impacts to EFH occur, USACE will coordinate with NMFS to determine the mitigation requirements. These may include restoration of hard-bottomed or marine epifaunal habitat, either within the federal navigation project or at an agreed upon location within the Commonwealth of Massachusetts.

6.4.4 Threatened and Endangered Species

Federal Threatened and Endangered Species: The USACE conducted an initial screening of the proposed project site utilizing the US Fish and Wildlife Service (FWS) Information for Planning and Consultation (IPaC) webpage and as well as requesting an official species list from FWS (Appendix I). These records indicate that the federally-threatened northern long-eared bat (NLEB; *Myotis septentrionalis*), endangered northern (Plymouth) red-bellied cooter (*Pseudemys rubriventris*), endangered American chaffseed (*Schwalbea americana*), roseate tern (*Sterna dougalli dougallii*), piping plover (*Chadrius melodus*), and red knot (*Calidris canutus*) may occur in the project area. EA Figure 10 provides a map of federally-listed species and critical habitat

occurring in or near the study area. Note that northern long eared bat may occur there but has a widespread distribution, American chaffseed is not found in the study area, and the birds are present in a transient or migratory nature.

During summer months, the NLEB roosts in decaying hardwood snags (Menzel et al, 2002) in trees with more than four inches diameter at breast height, and they may also roost in softwood species. Preferred roosts are clustered in stands of large trees (MADFW, 2015), and other roosting habitat includes man-made structures such as bridges, buildings, utility poles, and barns (USFWS, 2015). NLEB forage under the forest canopy in structurally complex habitats, often above small ponds, vernal pools, small streams, or along gravel paths or roads, and at forest edges. No winter hibernacula are documented in Barnstable County (MADFW, 2015). The primary threat to NLEB is White Nose Syndrome, a fungal disease responsible for much of the species' decline. A 2017 EA for a proposed solar photovoltaic installation near the Canal used an acoustic monitoring survey to document bat activity around the Sagamore Bridge and nearby Midway Recreation Area. This survey showed limited *Myotis* activity (1.5% of total bat activity) in the vicinity of the Sagamore Bridge, which included 0.7% little brown bat (*Myotis lucifugus*), 0.6% NLEB, and 0.1% eastern small-footed bat (*Myotis leibii*). The overwhelming majority of bat activity came from the big brown bat (*Eptesicus fuscus*) and eastern red bat (*Lasiurus borealis*), with a minor component of the hoary bat (*Lasiurus cinereus*). The bat species are expected to be similar at the Bourne Bridge, because of the similarity and proximity of the bridges and surrounding habitat of coastal mixed pine- hardwood forest and development.

The federally endangered northern (Plymouth) red-bellied cooter is a large freshwater basking turtle inhabiting deep coastal plain ponds. It only occurs in a small area of Plymouth County, MA, and is a disjunct population of the northern red-bellied cooter. It subsists on aquatic vegetation and requires good water quality and suitable basking, nesting, and overwintering sites free from disturbance. Although most of their time is spent in freshwater ponds, northern red-bellied cooters may also be found on land. In late spring and early summer, females select nesting sites in sandy soil usually within 100 yards of the pond. The turtles are typically active from late March to October. During the winter, they rest on the bottoms of ponds under the ice ina state of relative inactivity or hibernation (MA DFW, 2016). Critical habitat of the Massachusetts population of the Plymouth red-bellied cooter is located within Plymouth County.

The federally-endangered American chaffseed was recently re-discovered on Cape Cod for the first time since 1965. American chaffseed is a perennial herb standing one to two feet tall with large purplish-yellow flowers. This species requires partially open habitat with a frequent disturbance regime, and historically occurred in fire-dependent open pinelands and savannahs (USFWS, 2019). No American chaffseed plants occur in the project area, and there is no suitable habitat according to discussions with USFWS (USFWS and USACE, 2019a).

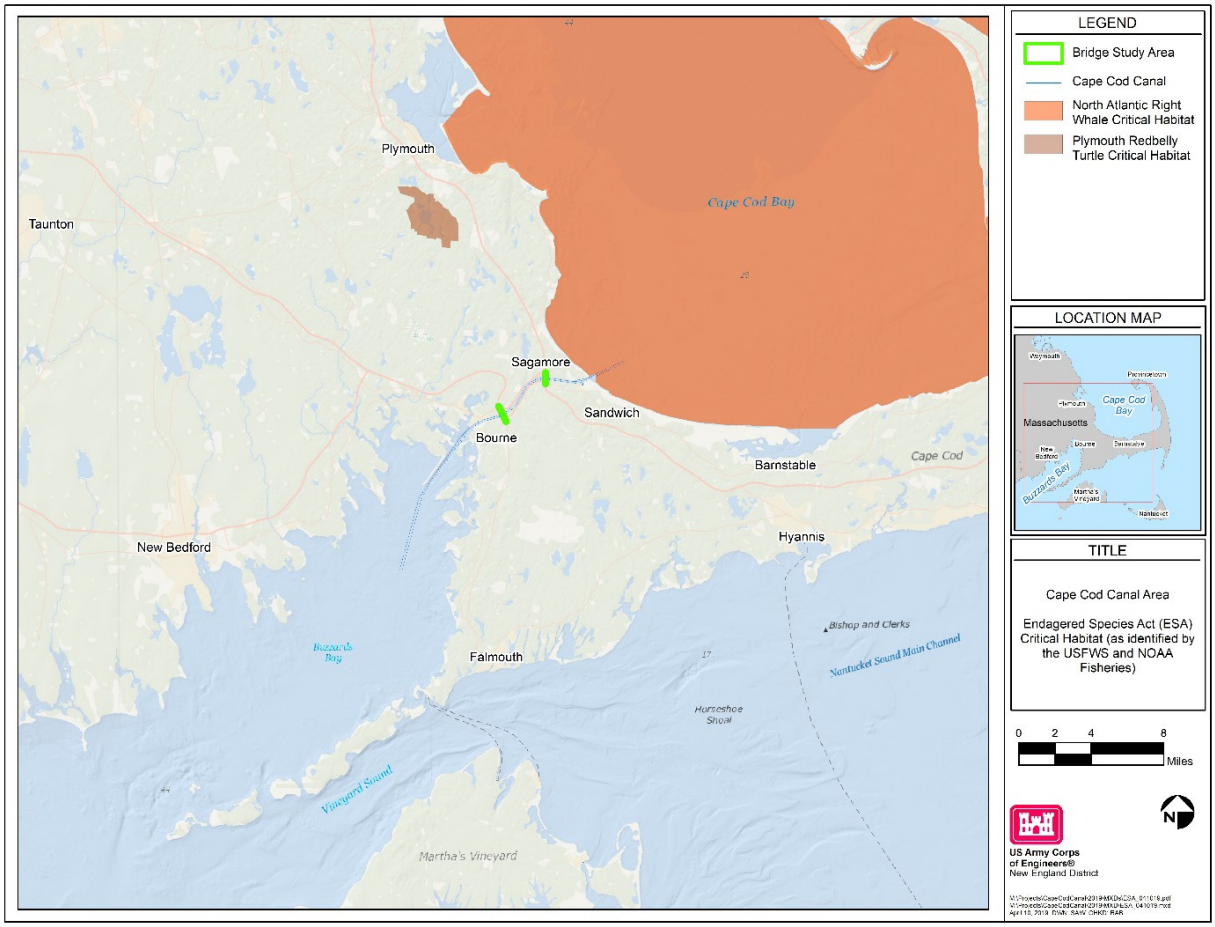
The federally-endangered roseate tern (*Sterna dougalli dougallii*) may occur in the project area. The roseate tern is an exclusively marine species of seabird. In North America, the roseate tern typically breeds on small islands in two distinct geographical areas from May to July (USFWS, 1998). The northeastern population breeds from North Carolina to Maine. After breeding, adult roseate terns and offspring feed in the northeastern Atlantic as late as August. Roseate terns usually begin to arrive in Massachusetts in late-April to mid-May to nest in a handful of coastal locations.

These locations are generally sandy, gravelly, or rocky islands and less commonly, at the ends of barrier beaches. The birds depart from breeding colonies in late-July and August and concentrate in staging areas around Cape Cod and the Islands, before departure for wintering grounds in September (MA DFW, 2016). Roseate terns may pass through the project area in a transient nature and may forage along the Canal shoreline. (USFWS and USACE, 2019b). However, there is no evidence that these birds use the Canal for roosting, nesting, or staging. A 2014 observation posted on eBird.org (2019) recorded ten roseate terns around the Bourne Bridge. Numerous other posts to this website documented sightings of roseate terns in the vicinity of the Canal but outside of the study area (eBird.org, 2019).

Other federally listed species include the piping plover (*Chadrius melodus*) and red knot (*Calidris canutus*). In a February 26, 2019, conference call, FWS stated that no habitat for these species exists within the project area, although they may migrate through. However, during migration they would be flying at higher altitudes and would not be affected by the project (USFWS and USACE, 2019b). The National Marine Fisheries Service (NMFS) has indicated seasonal movements of the endangered North Atlantic right whale (*Eubalaena glacialis*), the endangered Kemp's ridley turtle (*Lepidochelys kempi*), and the threatened loggerhead turtle (*Caretta caretta*) occur within Cape Cod Bay and as result, may be present in the project area at certain times of the year. Critical habitat for the right whale includes Cape Cod Bay, and the migratory routes of these species can include areas in Buzzards Bay as well. Other threatened and endangered whale and turtle species have also been observed in these areas, specifically humpback whales (*Megaptera novaeangliae*), finback whales (*Balaenoptera physalus*), sei whale, (*Balaenoptera borealis*), leatherback sea turtles (*Dermochelys coriacea*), and green sea turtles (*Chelonia mydas*). The threatened (Gulf of Maine Population)/endangered (New York Bight Population) Atlantic sturgeon (*Acipenser oxyrinchus*) may occur in the project areas with migrating and foraging habitat. The Cape Cod Canal Stranding Network, now part of the International Fund for Animal Welfare, has recorded a total of 44 (live and dead) marine mammal strandings in the Canal since 1998. The USACE also recorded the passage of a right whale through the Canal in April 2016.

In May 2019, the Canal was closed for several hours to all maritime traffic to allow for the passage of a pod of right whales, and in July 2019 a humpback whale was spotted transiting the Canal and safely escorted through by USACE personnel.

EA Figure 10 - Federally-listed species and critical habitat in the Cape Cod Canal



Environmental Consequences

Alternative A – No Action

The No Action alternative would have no effect on federally listed species because there would be no change in existing conditions for routine maintenance of the bridges.

Alternative B – Major Rehabilitation for Both Bridges and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

The project would have no effect on federally listed species, except for NLEB which may roost under the bridges. The USACE will consult with USFWS pursuant to Section 7 of the Endangered Species Act (ESA) to determine if NLEB are present and identify measures necessary to minimize potential impact. The USACE will also consult with NMFS in Phase II of the project to protect federally listed marine species.

During a February 26, 2019 conference call, USFWS requested that the USACE initiate

consultation when the project enters the design phase and the affected area is fully defined (USFWS and USACE, 2019a). Because the habitat use patterns of NLEB change over time, it would be more effective to conduct bat surveys closer to the time of actual activities. Mitigation measures will be identified during Phase II of the project in coordination with USFWS to avoid and minimize impacts. Potential mitigation measures may include first conducting a survey to determine bat presence/absence, then implementing best management practices or time of year restrictions on work in coordination with USFWS, or mitigation of bat habitat if impacts do occur.

The USFWS submitted a written response to the Draft EA and first phase of the project on December 23, 2019 and determined, "The proposed project, regardless of the final alternative selection and subsequent design, will largely occur within the footprint of existing developed land (i.e., the bridges and their supporting structures), and therefore is unlikely to have substantial impacts on wildlife or their habitat. However we encourage the Corps to consider listed and other high priority species during the planning and implementation of this project, and to pursue design elements that would minimize impacts and or provide beneficial impacts to these species or their habitats" (Appendix E).

It is unlikely that any northern red-bellied cooters would occur in the project area because of its proximity to the saltwater canal (USFWS and USACE, 2019b). It is confined to freshwater ponds in Plymouth County and eastern Bristol County, and none have been documented in the project area. Accordingly, there will be *no effect* on this species under any of the alternatives.

In a February 26, 2019, conference call, USFWS stated that no American chaffseed habitat exists in the project area and this species does not occur there. There will be *no effect* on this species. Roseate terns only pass through the project area on a transient basis. Because of their highly mobile nature and ability to evade disturbance, this project will have no effect on roseate terns under any of the alternatives. No piping plover or red knot habitat occur in the project area, but they may be present during migration. However, because they fly at higher altitudes during migration and do not use the bridges, there will be *no effect* on these species.

A preliminary conference call regarding ESA Section 7 consultation for marine species was held with NMFS on May 20, 2019. During this discussion, NMFS stated that no Atlantic or shortnose sturgeon have been documented in the Canal, but they may potentially occur there in the future in a rare and opportunistic manner. There are four species of sea turtles that are rare in the area of the Canal and may occur in October-December. Kemp's Ridley sea turtle and loggerhead sea turtle have been caught in Cape Cod Bay, and some beach strandings of sea turtles have been recorded. According to NMFS, their greatest concern among the ESA-listed species is the North Atlantic right whale. The timing of all bridge work will be designed to protect right whales that may transit the Canal. In order to avoid adverse effects to marine species during construction, the USACE will carefully monitor the Canal for the presence of protected species. If any marine mammals or sea turtles are identified during in-water construction activities in Alternatives B, C or D, all work will cease until the animal is safely out of the affected area. In May 2016 and May 2019, right whales were sighted transiting the Canal. The Canal was promptly closed to vessel traffic, and the whales were safely escorted through by USACE personnel. This practice would be implemented during this project if any right whales are sighted in the vicinity of the Canal.

Continuous monitoring of marine mammals and other protected species is already in place at the Canal, but would be conducted more intensively during work activities as an avoidance and minimization measure.

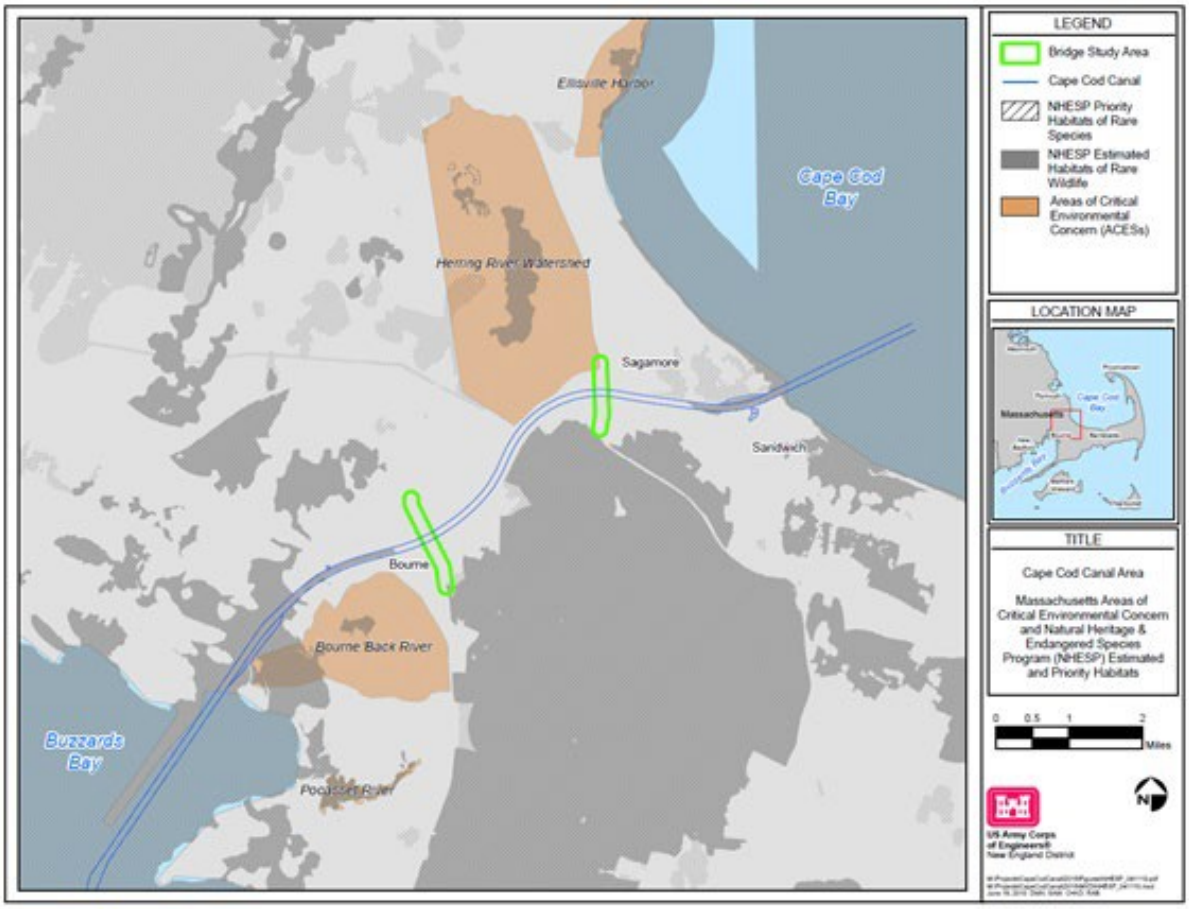
State Listed Threatened and Endangered Species: Forty-six species are listed by the Massachusetts Natural Heritage Endangered Species Program (MA NHESP) as occurring in Bourne, Massachusetts (MA NHESP 2019). According to the MassGIS, Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species are not mapped within either bridge site (2019). EA Figure 11 displays state-listed habitats and areas of critical environmental concern (ACECs) nearby the study area.

The Midway Recreation Area, a parcel adjacent to the Canal and owned by the USACE, is within NHESP Priority Habitat of Rare Species but will not be affected by the proposed project, (MA NHESP, 2019).

Coordination with the MA NHESP during the scoping process for the 2017 EA indicated that Eastern Box Turtles (*Terrapene carolina*), a Species of Concern, is known to inhabit the Midway site. Eastern Box Turtles are small, terrestrial turtles that range from southeastern Maine to northern Florida and as far west as Michigan, Illinois, and Tennessee. Although they occur in many towns in Massachusetts, they are more heavily concentrated in the southeastern section of the state. These turtles are found in many types of habitats including dry and moist woodlands, open fields, bogs, swales, stream banks, and well-drained bottomlands. The Eastern Box Turtle hibernates in the northern parts of its range from late October or November until mid-March or April depending on the weather. As soil temperatures drop, the turtles burrow a few inches under leaf litter or woody debris (MA NHESP, 2015).

Eastern Box Turtles are most active in the morning and evening, particularly after a rainfall, in the summer months. Mating is opportunistic and takes place anytime between April and October. Females nest in June or early July and may travel up to one mile to find appropriate nesting habitat which consists of early successional fields, meadows, utility rights of way, roadsides, woodland openings, residential lawns and gardens, beach dunes, and abandoned gravel pits. Habitat destruction resulting from development, road mortality, mowing of fields during the active season, and predation are some of the factors threatening Eastern Box Turtles (MA NHESP, 2015).

EA Figure 11 - MA NHESP Priority habitats of rare species and ACECs



Environmental Consequences

<u>Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges</u>
There will be no impacts to state-listed species because activities will not take place in areas designated as priority habitats of rare species or areas of critical environmental concern. Bridge maintenance or rehabilitation work will take place within the existing bridge footprints and rights of way.

<u>Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes</u>)
There are no estimated habitats of rare wildlife or priority habitats of rare species within the study area, so no impacts to state-listed wildlife are expected. The boundary of the nearby Herring River ACEC crosses into the project area northwest of the Sagamore Bridge. However, this portion of the ACEC overlaps with existing roadways and approaches to the Sagamore Bridge in the northwestern section of the study area where the Rt. 6 on/off ramps are located. A replacement bridge would affect only a portion of the ACEC that is already currently occupied by the Sagamore Bridge approach and associated roadways, therefore no additional negative impacts will occur.

6.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) (1966) defines a historic property as any prehistoric or historic districts, sites, buildings structures, or objects that are eligible for, or listed on the National Register of Historic Places. Section 106 of the NHPA requires that a federal agency take into account the effects of an undertaking on historic properties.

The earliest pre-contact sites from the PaleoIndian Period (12,000 – 10,000 B.P.) have not been positively identified on Cape Cod. This can be partially explained by the loss of the early Holocene (post glacial) shoreline and associated sites due to rising sea levels. Many coastal sites dating to the early pre-contact period may be submerged or eroded by marine inundation and wave activity. Evidence of *in situ* Early Archaic Period (10,000 – 7,500 B.P.) sites are also relatively rare as the environmental landscapes continued to change and the sea levels continued to rise. Sites from the Middle Archaic Period (7,500 – 5,000 B.P.) to the Contact Period (1500 – 1650 A.D.) are much more apparent in the pre-contact record. This is no doubt due to the stabilization of erosion and inundation, as well as the recognition of particular landscapes as being archaeologically sensitive for certain sites.

Cape Cod was one of the first areas to be explored and settled by Europeans and as a result, contemporary accounts record Native American settlements as well as interactions with European traders, explorers and settlers. The importance of trade prompted the building of the Aptuxcet Trading Post in Bourne in 1627.

The first permanent European settlements in Sandwich, Cape Cod's oldest town, began around 1637. The early economy of Sandwich relied on the town's abundant natural resources such as alewives and herring, which were augmented by livestock and limited farming. Native Americans and colonists shared in the herring that came up the Herring River each year to spawn.

Sandwich was divided into two towns in April 1884. The town of Bourne was named in honor of Jonathan Bourne, a prominent Monument Village native.

After the completion of the first Canal bridges (1913), both Bourne and Sandwich improved their highways to accommodate the growing number of motorists crossing to Cape Cod. The improved transportation facilities brought increased tourism to both Bourne and Sandwich as more people came to Cape Cod. Buzzard's Bay Village became the main commercial center, while residential development continued in the beach front areas as well as along and north of Route 6. Sandwich and Bourne have continued to develop throughout the twentieth century as much of the Cape has, with a heavy reliance on tourism and vacationers in the summer months.

The Cape Cod Canal occupies an area that was originally traversed by the Monument, Herring, and Scusset rivers. The construction of the canal transformed these waterways and communities that surrounded them. Many of the commercial and residential buildings that were located near the Monument River were moved, as were two cemeteries.

The desire for a safe and quick passage between Buzzards Bay and Cape Cod Bay dates to the early 1600s. In his role as the Pilgrims' military leader, Myles Standish made many exploratory trips from Plymouth Colony to the area of the present day canal. After observing the Native Americans portage over the small isthmus between the Monument and Scusset rivers, Standish allegedly proposed that a canal be dug to form a protected waterway between the bays (Lovell 1984). Plymouth Colony did not have the funds or labor to undertake such a massive project, however, and nothing came of Standish's proposal.

Between 1892 and 1899, at least 30 different applications for canal charters were filed. Near the end of 1899, the Boston, Cape Cod and New York Canal Company won the charter. The main partner was DeWitt Clinton Flanagan. The company was allowed to raise $12 million through stock and bond sales to cover construction costs and given the right of eminent domain on property not previously purchased. Unlike earlier efforts, the charter provided more time to begin construction (Farson 1993: 25-27).

Flanagan approached August Belmont in 1904 with his canal plans. Belmont, a wealthy New York financier had built and financed the New York City subway in 1904 (Farson 1993: 29-31). In 1907, Belmont agreed to buy the rights and property of the Boston, Cape Cod and New York Canal Company. He paid $200,000 for the deposit to the state, $250,000 in bonds, and $1.4 million in stock. Belmont received the franchise, 1,080 acres of land along the route and the stock and bond options. Belmont's chief engineer was William Barclay Parsons, a noted railroad designer (Farson 1993: 31-33; Parkman 1978: 88; Reid 1961: 13-33).

The ceremonial groundbreaking took place on June 22, 1909 when August Belmont removed a shovelful of earth, proclaiming the start of the Cape Cod Canal. Two dredges began digging the approach channel in Buzzards Bay in August of the same year. The official canal opening was scheduled for July 29, 1914.

The foundation for a new moveable-span railroad bridge at Buzzards Bay was begun in November of 1909 and completed the following April. The bridge was completed by September 20, 1910, and then the railroad tracks were relocated.

Around the same time, construction began on two highway drawbridges to cross the canal at Bourne and Sagamore. The 729 foot long Bourne Highway Bridge was completed in May 1911. The Sagamore Highway Bridge was begun in April of 1912 and completed in February of 1913.

As U.S. involvement in World War I became increasingly more likely, the government became more interested in the military value of the canal (Farson, 1993: 55-56; Reid, 1961: 64-65). On July 25, 1918, the government took over the canal and turned over control to the Railroad Administration under the Secretary of War (Farson, 1993: 55-56). In 1928, the government took over permanent ownership of the bridge.

The government began a program of continuous maintenance of the canal. It was not until the National Industrial Recovery Act of June 1933 was passed that improvements could be made to the waterway. On September 6, 1933 the Public Works Administration authorized the construction of three bridges over the canal and widening of its land cut to 205 feet and allotted

funding for the work. Construction began that December with the laying of the foundations for the two new highway bridges and the railroad bridge. The highway bridges were designed by the engineering firm of Fay Spofford and Thornkike of Boston, with architectural details by Cram and Ferguson of Boston. Both bridges were officially opened June 21, 1935 and are the two oldest continuous truss bridges in Massachusetts (Farson, 1993; Roper, 1990).

Work on the new Buzzards Bay Railroad Bridge, to replace the 1910 bridge, began on December 13, 1933. The noted engineering firm of Parsons, Klapp, Brinckerhoff and Douglas of New York City were responsible for the structural design of the bridge, which is a Waddell patent vertical lift bridge. John Alexander Low Waddell was the major designer of this type of bridge in the country (Hool and Kinne, 1943: 163). The bridge was officially completed on December 29, 1935 at a cost of $1.8 million (Parkman, 1978: 101; Reid, 1961: 108). When completed, this vertical lift span was the longest in the world.

The reconstruction of the canal was essentially complete by 1940.

The Bourne and Sagamore Bridges

The Bourne Bridge was completed in December of 1934. The builders were the American Bridge Company and the P.J. Carlin Construction Company. It is a three span, continuous "swinging" deck/through riveted steel truss bridge, with a Warren-type truss web. The bridge has highly stylized, "industrial Art Deco" light standards, which now have modern arms and heads.

The Sagamore Bridge was completed in 1935. It is of the same design as the Bourne Bridge, but is shorter. The bridge was published in 1943 (George A. Hool and W.S. Kinne, eds. in chief, *Movable and Long-Span Steel Bridges*, Second Edition, 1943 pp 255 c-d) as an example of continuous truss bridge design from the period 1923-1942.

The Bourne and Sagamore Bridges were determined individually eligible for the National Register of Historic Places (NR) under Criterion C for their graceful design and setting. They were also considered potentially eligible as part of a larger Cape Cod Canal historic district, although the boundaries and components of this possible district still need to be defined (Roper 1990). An historic inventory prepared by The Public Archaeology Laboratory Inc. for the USACE in 2000 defined features of a potential Cape Cod Canal historic district (Doherty, 2000).

In the project study area, there are three historic period resources, the Bourne and Sagamore bridges, and the canal. There are no known archaeological resources in the vicinity of the Sagamore Bridge. There are two archaeological sites within the vicinity of the Bourne Bridge, site 19 BN-224 pre-contact ceramics recovered in 1942, and post-contact archaeological site, BOU.1, the Gas House Site. The study area could have archaeological sensitivity. Many pre-contact and post-contact sites have been identified in the study area, and more are likely still unidentified. An intensive archaeological survey of the impact areas would identify the presence or absence of archaeological sites. A MassDOT report prepared by Stantec (2016) provides additional information.

Alternative A – No Action
The no action alternative will have no effect on historic properties. The bridges would continue to be maintained and repaired and there would be no effect on local historic districts, individual buildings, or known and unknown archaeological sites, since there would be no change in appearance or location.

Alternative B – Major Rehabilitation Alternative
The rehabilitation of the Bourne and Sagamore bridges will have no adverse effect to the bridges and no effect on local historic districts, individual buildings or known and unknown archaeological sites. The SHPO concurred with this determination on August 22, 2019 (Appendix E). The major rehabilitation will include replacement of the bridge superstructure, deck replacement, including stringer replacement, abutment span replacement, exterior gusset plate retrofits, interior gusset plate repairs, miscellaneous concrete repairs, suspender cable replacement, paving, and painting. The bridges would continue in their current footprints, and while changes would be made to the bridges, they will look the same after rehabilitation as materials will be replaced in-kind. This condition is contingent on the use of previously disturbed laydown and staging areas. If new areas are chosen, an intensive archaeological survey may be required.

Alternative D- Preferred Alternative – Bridge Replacement – 4 Lanes and 2 Auxiliary Lanes
This alternative would have an adverse effect on the bridges and at least two identified archaeological sites, possible unidentified archaeological resources, and several historic districts. The effects would be indirect (visual and/or viewshed) as well as direct (possible archaeological sites). The tribes attended a meeting in March 2019 and concurred with this approach taken in Phase I of the study to evaluate continued repair and maintenance, major rehabilitation, or replacement of the bridges. A formal letter was also sent to the tribes on July 17, 2019. The SHPO concurred with this approach in a letter dated August 22, 2019 (Appendix E). Additional consultation with the SHPO and THPOs on the location of the bridges and the design would be required during Phase 2 of the project. A Memorandum of Agreement will be developed in consultation with the SHPO, THPOs, Massachusetts Board of Underwater Archaeological Resources (MBUAR), and local interested parties during this phase to develop a plan to avoid, minimize, or mitigate the effects of bridge replacement on historic properties. Consultation with the SHPO and tribes is ongoing.

6.6 Socioeconomics Resources

6.6.1 Demographics

Population size and composition: The current year-round populations of the Cape and Islands (Barnstable, Dukes and Nantucket Counties), and the town of Bourne are displayed in EA Table 3. The population of the Cape and Islands grew over 130% between 1970 and 2000 (Stats

Cape Cod 2015, Martha's Vineyard Commission 2006). Since 2000, population growth tapered in Dukes and Nantucket Counties, and slightly decreased in Barnstable County (EA Table 3). These population dynamics are largely attributed to a large influx of baby boomers retiring to the region, the subsequent increase in death rates due to an ageing population, and younger populations leaving the region to pursue employment and educational opportunities (Cape Cod Commission 2017, Renski et al., 2015).

EA Table 3 – Total Population

	Total population 2000 Census	Total population 2010 Census	Total population 2015 ACS
Bourne	18,721	19,754	19,729
Barnstable County	222,230	215,888	214,766
Dukes County	14,987	16,535	17,048
Nantucket County	9,520	10,172	10,556
Massachusetts	6,349,097	6,547,629	6,705,586

Source: 2010 United States Census, 2015 American Community Survey

Seasonal population: The populations of Cape Cod and the Islands experience dramatic seasonal shifts. The summer population of Cape Cod and the Islands is at least double the year-round population; and on a given summer day the population can be as many as five times the winter population[1] (Daley, 2015, Martha's Vineyard Commission, 2006). Many individuals have second homes on the Cape or Islands, and many are used as vacation rental properties during the summer season. Fifty percent of seasonal homes in Massachusetts are located in Barnstable County (Daley, 2015). The proportion of houses that are used for seasonal, recreational, or occasional use is at least eight times the state average across the three counties (EA Table 4).

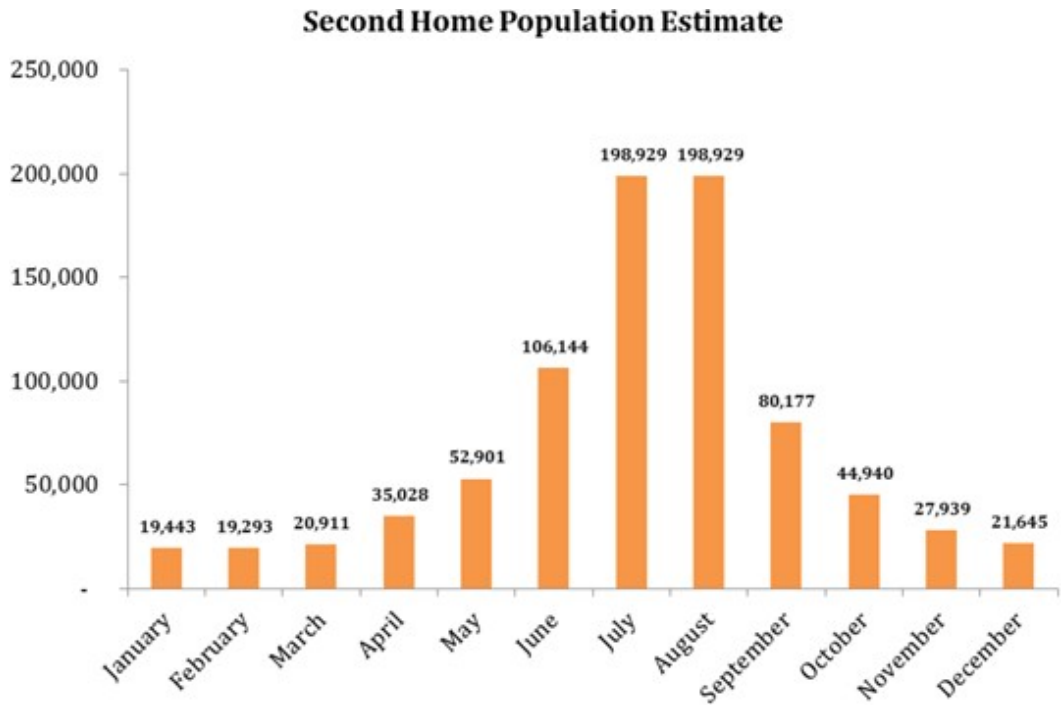
EA Table 4 – Proportion of seasonal-use houses

	Percentage of houses for seasonal, recreational, or occasional use
Bourne	20.6%
Barnstable County	35.5%
Dukes County	53.8%
Nantucket County	57.9%
Massachusetts	4.1%

Source: 2010 Census

The Cape Cod Commission estimated monthly populations in Barnstable County based on second home ownership, and show that the summer population can be ten times the winter population (EA Figure 12). Because these estimates of monthly population only consider visitors who own or rent a property, and does not take into account individuals doing day trips, they likely underestimate the actual population on a summer day.

EA Figure 12 - Second Home Population



From: Daley 2015.

Second home population estimates are based on UMass Donahue Institute's Second Home Owner Survey 2008 and the 2010 U.S. Census

Future population: Moody's analytics projects that economic growth in the area will stimulate in-migration resulting in an increase of 9,612 people to Barnstable County between 2015 and 2025; Crane Associates similarly projects a more conservative increase in population of 6,199 people (Crane Associates Team, 2017). Increases in the year-round population will consequently increase demands on local services and infrastructure, including the bridges.

[1] This estimate would include those visiting for the day – i.e. not spending the night on the Cape or Islands.

Age Distribution: The population increase between 1970 and 2000 was driven by people retiring to the Cape and Islands (Cape Cod Commission, 2017). As a result, the median age in Barnstable County is 30% higher than the state-wide median age (EA Table 5). Likewise, the percent of the population 65 and older is substantially higher, and the proportion of individuals 15 and under substantially lower, in Barnstable County compared with Massachusetts as a whole. These trends are expected to continue; the UMass Donahue Institute reports that by 2035, 35% of the Cape and Islands' population will be 65 or older (Renski et al., 2015).

EA Table 5 - Age and Ethnicity

	Median age	Percent 65 and older	Percent 15 and under	Percent foreign born population	Percent white, non-hispanic
Bourne	46.25	21.2%	14.8%	3.8%	91.3%
Barnstable County	51.3	27.1%	14.1%	6.8%	91.1%
Dukes County	45.9	19.0%	16.6%	9.7%	92.1%
Nantucket County	39.5	13.4%	19.4%	16.3%	76.6%
Massachusetts	39.3	14.7%	18.3%	15.5%	74.3%

Racial Composition: With a population that is more than 90 percent Caucasian, the racial makeup of Barnstable is homogenous compared with the rest of the state (74.3% Caucasian) (EA Table 5).

Education: The proportion of Cape and Islands residents with a High School degree is slightly higher than the rest of Massachusetts. Barnstable County has a similar proportion of the population with a bachelor's degree compared with the rest of Massachusetts. The proportion of the population with a bachelor's degree is substantially lower in the town of Bourne compared with Barnstable County and Massachusetts as a whole.

EA Table 6 - Education, Employment and Income

	Percent with high school education	Percent with bachelor's degree	Labor force participation rate (age 16+)	Unemployment rate	Percent of households with retirement income	Median household income	Percent below poverty level
Bourne	96.6%	33.2%	62.2%	3.2%	23.0%	69,157	9.1%
Barnstable County	95.1%	40.1%	60.3%	4.2%	26.4%	63,251	8.7%
Dukes County	93.2%	40.3%	65.7%	3.4%	13.9%	64,222	11.7%
Nantucket County	94.8%	43.7%	74.8%	2.3%	12.2%	84,057	11.6%
Massachusetts	89.8%	40.5%	67.5%	5.1%	16.1%	68,563	11.6%

Source: 2015 American Community Survey

Environmental Consequences

Alternative A – No Action

There will be no immediate impact on current demographics in Cape Cod with routine maintenance of the bridges. In the absence of a major rehabilitation or replacement project, the bridges would deteriorate and require more frequent closures for repair, this will likely discourage migration onto Cape Cod and restrain population growth over time.

Alternative B – Major Rehabilitation for Both Bridges

Construction during the rehabilitation project could dissuade migration to Cape Cod and the Islands in the near term, thereby resulting in subdued population growth over that time. When the rehabilitation project is completed, conditions will resort back to those comparable to the current state. Therefore no lasting economic impacts are expected. Traffic congestion will continue to restrain any substantial population growth or changes.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Construction of the replacement bridges is not expected to have a significant impact on population size or demographic makeup. Improved traffic and road conditions will likely attract more visitors and potentially new residents to Cape Cod. However, future development of land beyond the bridges will continue to limit population growth substantially (further detail in the Induced Development section below).

6.6.2 Community Economics

Employment and Industry: Barnstable County's labor participation rate is 7% lower than Massachusetts overall (EA Table 7), and the percent of households with retirement income in Barnstable county is more than 50% higher than Massachusetts overall. Barnstable County's lower labor force participation and greater proportion of households with retirement income is not surprising given many individuals relocate to Cape Cod in their retirement.

The unemployment rate in Barnstable County is below the state unemployment rate. Interestingly though, there are relatively fewer employment opportunities on the Cape and Islands compared with areas closer to the Boston metropolitan area. Therefore at least 13,000 Cape Cod residents commute over the Bourne and Sagamore Bridges daily to work on the mainland (MassDOT, 2016a). Median household income in Barnstable County is less than that of the state-wide median household income. Average weekly wage rates are also lower in Barnstable County ($833) compared with the state's average weekly wage rate ($1233) (Bureau of Labor Statistics, 2017).

In Barnstable County the five main employment sectors are: 1. Education, health and social services 2. Retail 3. Professional, scientific and management services 4. Arts, entertainment

recreation, accommodation and food services 5. Construction. There is more employment in the construction, retail, and arts, entertainment recreation, accommodation and food services industries on the Cape and Islands compared with state-level industry employment rates. This is due to the seasonal economy typical of summer vacation destinations.

EA Table 7 - Proportion of Individuals Employed by Industry

	Bourne	Barnstable County	Dukes County	Nantucket County	Massachusetts
Agriculture, forestry, fishing and hunting, and mining	0.3%	0.9%	2.4%	2.3%	0.4%
Construction	9.5%	9.4%	15.2%	17.4%	5.4%
Manufacturing	4.7%	3.7%	4.1%	3.4%	9.2%
Wholesale trade	2.6%	2.0%	1.6%	1.7%	2.4%
Retail trade	13.1%	14.0%	9.8%	14.0%	10.8%
Transportation and warehousing, and utilities	5.1%	4.1%	2.2%	4.6%	3.6%
Information	2.5%	1.9%	2.0%	2.3%	2.3%
Finance and insurance; real estate, rental and leasing	7.0%	6.5%	9.1%	7.2%	7.6%
Educational, health care and social services	25.2%	24.1%	18.6%	16.4%	27.9%
Arts, entertainment, recreation, accommodation and food services	9.9%	11.7%	12.8%	10.7%	8.8%
Other services, except public administration	3.4%	4.9%	5.2%	5.0%	4.4%
Public administration	6.3%	4.8%	4.8%	4.3%	4.0%
Professional, scientific, and management services	10.4%	11.9%	12.2%	10.6%	13.2%

The Cape and Islands' economies rely heavily on summer tourism, and are thus seasonal. The number of employed individuals increases by nearly 20% during the summer months in Barnstable County. The economy is less seasonal today than it was several decades ago, but still depends heavily on summer tourism (Cape Cod Commission, 2017).

Cape Cod and the Islands have historically been home to a large number of small businesses, many of which serve the tourist industry. Respondents of the Cape Cod Business Climate Survey reported approximately one third of the total customer base to be seasonal visitors (UMass Donahue Institute, 2012). Sixty-two percent of establishments on the Cape employed between one and four people (90% employ less than 20), and over 70% of establishments on the Islands employed one to four people (EA Table 8). Typical of tourist areas, most businesses on the Cape and Islands are in the construction, retail and accommodation and food services industries (EA Table 9). Revenue generated in these sectors is substantial, and generally comprises a greater proportion of overall receipts compared with the state of Massachusetts as a whole (EA Table 10). More than half of businesses on the Cape are family owned (UMass Donahue Institute, 2012).

EA Table 8 - Proportion of small businesses

	Proportion of businesses with 1-4 employees
Barnstable County	**61.8%**
Dukes County	71.9%
Nantucket County	73.0%
Massachusetts	53.0%

Source: 2015 County Business Patterns, U.S. Census Bureau

EA Table 9 – Proportion of business in each industry

	Barnstable County	Dukes County	Nantucket County	Massachusetts
Total # of establishments	8488	1071	996	175225
Agriculture, forestry, fishing and hunting	0.5%	0.1%	0.1%	0.2%
Mining, quarrying, and oil and gas extraction	0.1%	0.0%	0.1%	0.0%
Utilities	0.1%	0.3%	0.1%	0.2%
Construction	13.4%	19.0%	27.7%	10.2%
Manufacturing	2.1%	2.1%	1.4%	3.7%
Wholesale trade	2.3%	1.2%	0.6%	4.4%
Retail trade	17.4%	18.3%	15.6%	13.8%
Transportation and warehousing	1.6%	3.0%	1.5%	2.2%
Information	1.5%	1.3%	1.4%	2.1%
Finance and insurance	3.6%	2.7%	1.9%	5.5%
Real estate and rental and leasing	4.3%	6.3%	5.3%	4.0%
Professional, scientific, and technical services	8.9%	6.3%	5.7%	12.3%
Management of companies and enterprises	0.3%	0.1%	0.4%	0.7%
Administrative and support and waste management and remediation services	7.9%	7.6%	12.3%	6.0%
Educational services	1.3%	1.2%	1.1%	1.8%
Health care and social assistance	9.5%	5.3%	3.5%	10.7%
Arts, entertainment, and recreation	2.8%	3.6%	2.7%	1.9%
Accommodation and food services	13.2%	13.4%	12.6%	9.8%
Other services (except public administration)	8.7%	7.1%	5.6%	10.2%
Industries not classified	0.3%	1.0%	0.3%	0.3%

Source: 2015 County Business Patterns, U.S. Census Bureau

EA Table 10 - Total sales, shipments, receipts, revenue and business done by establishments

	Barnstable Receipts ($1,000)	Dukes Receipts ($1,000)	Nantucket Receipts ($1,000)	Massachusetts Receipts ($1,000)
Mining, quarrying, and oil and gas extraction				4714
Utilities	1049	400	D	29525
Construction				3882960
Manufacturing	11948	1825	2263	321880
Wholesale trade	N	N	N	706935
Retail trade	77073	8817	8610	1683816
Transportation and warehousing(104)	23138	2174	2829	814293
Information	9909	1891	D	275497
Finance and insurance	32780	3315	1650	1243355
Real estate and rental and leasing	238824	30790	39172	5529594
Professional, scientific, and technical services	174984	21719	13435	4800603
Administrative and support and waste management and remediation services	62126	14579	9107	939990
Educational services	12930	1092	918	307925
Health care and social assistance	61591	6578	3664	1603643
Arts, entertainment, and recreation	34518	10849	9423	757688
Accommodation and food services	19409	3694	1356	258659
Other services (except public administration)	78909	11153	7081	1667474
Total of all receipts where sector data is available in all counties	828230	116585	99508	19928920
Retail percentage of total receipts	9.31%	7.56%	8.65%	8.45%
Arts, entertainment and recreation percentage of total receipts	4.17%	9.31%	9.47%	3.80%
Accommodation and food services percentage of total receipts	2.34%	3.17%	1.36%	1.30%

Source: U.S. Census Bureau, Economic Census, 2012.

Housing and Cost of Living: Median housing prices in Bourne are similar to that of the state median and are slightly higher than the state median across Barnstable County (EA Table 11). Median rent is slightly less in Bourne than the state-wide median rent. Barnstable County's median rent is the same as the state's;

EA Table 11 – Median housing values and rent

	2015 Median Housing Value	2015 Median Rent
Bourne	**334,600**	**988**
Barnstable	**363,500**	**1,104**
Dukes	660,800	1,428
Nantucket	902,500	1,609
Massachusetts	333,100	1,102

Source: ACS: 2011-2015 ACS estimates

Town-level cost of living indices are available via Sperling's Best Places Website. EA Table 12 compares the cost of living in Bourne with two adjacent communities on the mainland, Plymouth and Wareham. The overall cost of living index for Bourne is higher than Plymouth and

Wareham. The relative cost of living measures for the categories of expenditures suggests that it is primarily housing costs that drive the higher cost of living in Bourne. The median housing value for Plymouth and Wareham (323,000 and 254,100 respectively) is indeed lower than that of Bourne (2015 ACS).

EA Table 12 - Cost of living indices for Bourne, Plymouth and Wareham

	Bourne	Plymouth	Wareham
Overall	142.5	137.3	125.3
Food	113	120	120
Housing	193.1	169.2	131.7
Utilities	127.7	147.6	147.6
Transportation	107.6	105.7	105.7
Health	118.8	123.1	123.1
Miscellaneous	127.9	129.4	129.4

†100=national average
Source: http://www.bestplaces.net/cost-of-living/bourne-ma/sandwich-ma/50000

Environmental Consequences

Alternative A – No Action
There is no impact in the near term under the no action alternative. However, as the bridges continue to deteriorate, repair projects that create significant traffic closures and delays will be necessary to keep the bridges in functioning condition. Given the large number of workers commuting on and off the Cape via the bridges daily, there could be an impact on employment potential and wages for those living on Cape Cod. This in turn could have a dampening effect on tourism, local business, and housing values on the Cape.

Alternative B – Major Rehabilitation for Both Bridges
Given that at least 13,000 Cape Cod residents commute over the Bourne and Sagamore Bridges daily to work on the mainland, construction during the rehabilitation project will create traffic congestion which will likely impact wages and job potential for Cape Cod residents that require commuting on and off the Cape via the bridges daily. In addition, the abundance of small businesses that heavily rely on tourism will be negatively impacted when tourists are deterred from traveling to the Cape given increased traffic congestion. This will dampen the overall economy of Cape Cod and in turn could lower demand for homes on Cape Cod and the Islands, lowering home prices in the near term. This will occur each time the bridges require major rehabilitation which is expected to occur twice in the next fifty years. Between rehabilitations, conditions will become comparable to current conditions.

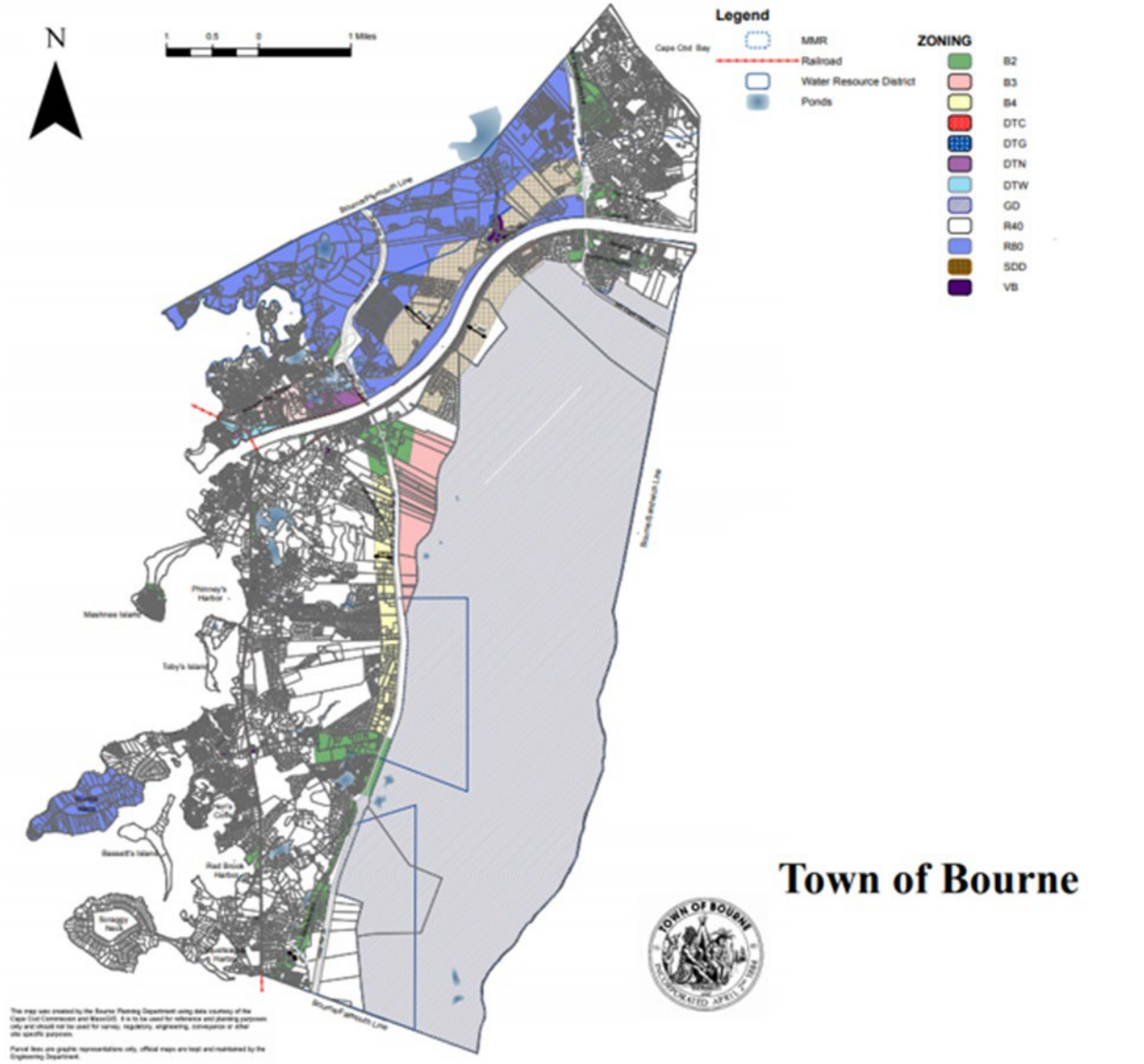
Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Safer, more efficient bridges would ease traffic congestion especially in Alternative D. The ease of traffic could improve commute times for those 13,000 residents commuting off Cape Cod daily. It could also make traveling on and off the Cape more attractive to potential labor force participants. Safer and more efficient bridges may also attract more tourism onto Cape Cod and the islands increasing seasonal demand for local goods and services. Overall this will positively benefit the economy and could drive up demand and prices in the housing market.

6.6.3 Land Use and Zoning

Bourne Land Use: *Zoning:* The focus area of this study consists of a 500 foot buffer zone around the existing Bourne and Sagamore Bridges (EA Figure 2). This is the location where all potential projects will be constructed including the replacement bridges which are expected to be built adjacent to the existing bridges. The focus area will be more clearly defined in Phase II of the project. The focus area is contained almost entirely within the town of Bourne. The downtown area is zoned for a variety of uses, including higher-density public works, landscaping, construction, and retail facilities. Moving toward the east, the "village" area is zoned to preserve the historic character of the town, which features compact buildings with traditional Cape Cod architecture. Other parts of the downtown area are zoned for natural resource protection. Much of the area abutting the Bourne Bridge is zoned for residential use or protected forest.

EA Figure 13 – Bourne Zoning Map



Source: Town of Bourne, Unofficial Zoning Map

Environmental Consequences

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges
There will be no impacts to land use or zoning under Alternatives A and B as the existing footprint of the bridges will not change.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes
There are no known conflicts with federal, state, and local land use plans in the area directly associated with the proposed replacement bridges footprints. There are no future land plans by local Native American Tribes however the area is considered sensitive for tribal resources. MassDOT proposed road construction projects surrounding the bridges are more likely to be undertaken, changing some land usage. The proposed footprints of the new bridges are located on federal public lands/waterways, residential properties, and some commercial property. Therefore the land use of those specific properties will be redesigned for bridge construction. The projects do not conflict with proposed federal, regional, state, and local land use. Indirect effects are discussed in further detail in Section 7.

6.6.4 Recreation

Leisure time and recreational opportunities influence individuals' well-being. Project activities and outcomes that influence the availability or accessibility of leisure time and recreational opportunities thus need to be considered.

Being a major tourist destination, recreational activities abound on the Cape and Islands. The area hosts some of the country's finest beaches, walking and biking trails including Cape Cod National Seashore, which had 4,722,344 visitors in 2016 (http://www.whycapecod.org/tourism-statistics.html). Shopping, water sports, fishing, boating and golf are major leisure activities, as are dining out and live entertainment. Retail; arts, entertainment and recreation; and accommodation and food services are among the most important industries in Barnstable, Dukes and Nantucket Counties (EA Table 7 and EA Table 8). These industries play a more important role in local economies than they do across the state of Massachusetts as a whole.

Recreational opportunities on the Cape and Islands are valuable to the local economy because they draw tourists to the area. Local residents also enjoy the abundant recreational opportunities available on the Cape and Islands. Many residents move to the Cape and Islands so that they can enjoy the cultural and recreation amenities that exist there. More than 60% of Cape Cod residents surveyed in 2013 reported the primary reason they live on the Cape is because it is a "great place to spend time" (The Chesapeake Group, 2013). The 2008 Second Homeowner's survey concluded that residents relocating permanently to their Cape summer homes plan to increase their use of cultural attractions and activities, particularly theatre and music venues (UMass

Donahue Institute, 2008). Concerts, theatre and beach activity are the most common forms of recreation that residents report participating in (EA Table 13).

EA Table 13 – Cape Cod resident recreational participation

Entertainment	Percent
Live Music Concerts	20.38%
Theater	14.97%
Beach	13.38%
Sporting Events	9.55%
Walking	7.01%
Dining out	6.69%
Golf	6.37%
Art Shows	5.10%
Museums	4.46%
Shopping	3.18%
Park	2.23%
Kayaking	1.91%
Fishing	1.59%
Biking	1.59%
Swimming	1.59%

(The Chesapeake Group, 2013)

The Cape Cod Canal itself is also a prime destination for biking and walking with over 14 miles of paved and off-road trails.

The USACE is responsible for operating and maintaining the Cape Cod Canal. The primary mission of the Canal is to provide safe navigation to the commercial and recreational vessels that transit the 17.5 mile waterway each year. However the 1,000 acres of land that surrounds the canal provides diverse recreational opportunities such as hiking, fishing, biking, picnicking, and ship watching. The USACE operates the Cape Cod Canal Visitor Center and multiple recreation areas equipped with restrooms, picnic areas, and parking lots. Service roads which parallel both sides of the Canal are available for bicycling, jogging, and walking. (https://www.nae.usace.army.mil/missions/recreation/cape-cod-canal/)

Environmental Consequences

Alternative A – No Action

With ongoing bridge maintenance, Cape Cod residents and tourists would continue to experience intermittent traffic congestion leading to longer travel times to their recreation destination, and

therefore, reduced time available to enjoy their recreational pursuits. This could reduce revenues to businesses that rely on the public's enjoyment of recreational activities. The frequency of intermittent repairs would increase as the bridges age, exacerbating these effects over time. Residents' and tourists' access to boating, fishing, trail, or other recreational activities may be temporarily affected by construction activity if construction renders some areas inaccessible to the public, for example some areas of the service roads may be temporarily restricted and even access through the canal in the instance of emergency canal repair projects.

Alternative B – Major Rehabilitation for Both Bridges

Each major rehabilitation project is expected to occur over three years non-concurrently. A second rehabilitation project for each bridge will also occur 40 years subsequently. These projects require extensive closures of lanes and bridges during construction. In addition, as the bridges age and conditions start to deteriorate, the bridges will require additional safety maintenance measures. Therefore there will be major disruptions to traffic for residents and tourists. The disruptions will limit demand and time able to be spent at recreational activities. This will be harmful to the local economies that rely on tourism. In addition, residents' and tourists' access to boating, fishing, trails, or other recreational activities may be affected by rehabilitation activity if construction renders some areas inaccessible to the public particularly in the areas directly surrounding the canal during the rehabilitation projects. For example, during rehabilitation, there will likely be temporary restrictions to service roads or access through the canal. Therefore, under Alternative B there would be temporary short-term impacts to recreation.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Impacts to traffic will be limited as the new bridges will be built adjacent to the current bridges and therefore do not require significant lane and bridge closures during construction. In addition, the replacement bridges will require less frequent maintenance work (and therefore closures). Construction of the bridges will however require the closure of the canal for 30 days each which will disrupt fishing and boating activities. In addition, there may be other temporary impacts such as portions of the access road will be closed for public use during construction which is projected to last for five years for each bridge. Therefore, there would be no significant impacts to recreation under Alternative D.

6.6.5 Public Utilities

Gas, electric, and telecommunication/fiber companies have been given permission by the USACE to place utilities across the Canal on the Sagamore and Bourne bridges. Companies directly locating utilities on the bridges or in the area of the bridge footprint include Comcast, Verizon, Open Cape, National Grid, Eversource/NSTAR, and Algonquin Gas. These connections provide critical utility connection to the entirety of Cape Cod.

EA Table 14 – Utility Licenses

Company	Utility	Description
Comcast	Telecommunications	Cables on both bridges
Verizon	Telecommunications	Cables on both bridges
National Grid	Gas	Sagamore Bridge
National Grid	Gas	Bourne Bridge
Formerly Colonial Gas	Electricity	Electric transmission wires under Sagamore Bridge
Open Cape	Telecommunications	Innerduct for fiber optic cable on Sagamore Bridge. Sub-license from Verizon
NSTAR	Electricity	Electric wire, poles near Bourne Bridge
Algonquin Gas	Gas	Gas line near Sagamore Bridge

Environmental Consequences

Alternative A – No Action

In the no-action alternative, the utility companies would continue to operate utilities on the bridges through licenses or easements with the USACE; therefore, there would be no impacts to utilities under this alternative.

Alternative B – Major Rehabilitation for Both Bridges

Major rehabilitation is too hazardous to accomplish with live gas and electric lines, long interruptions would also not be practical for the telecommunications and other utilities. Therefore, in the instance of major rehabilitation, relocation of the wires, gas lines, and pipelines would be accomplished with a form of conduit buried under the canal, which would need to be approved and constructed prior to removing utilities from the bridges to limit any disruption to services. The underground relocation would be accomplished using horizontal directional drilling (HDD) technology The HDD process generally involves boring a pilot hole into the ground beneath a water body, and then enlarging the hole with

one or more passes of a reamer until the hole is the necessary diameter to install the pipeline. The prefabricated pipe segments are then pulled through the hole to complete the crossing. Staging areas are established along both sides of the proposed crossing typically at the entry and exit points (Algonquin/Spectra Energy Partners, 2014).

The site-specific HDD procedures used to relocate the gas lines under the Canal will not be determined until Phase II of the project,

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

If the bridges were to be replaced, the utilities would have to be placed under the newly constructed bridges. Some utilities, including natural gas lines, would need to be relocated off the bridges due to safety considerations. It is anticipated that National Grid would install new 10-inch pipes inside conduits below the Canal at both bridge locations using HDD. The specific location and HDD methodology used to relocate these lines will be determined and analyzed during the design phase of the project (Phase II). Relocation of the utilities will incur additional costs at the burden of the grantee. Placement of new lines/pipes will occur prior to removing the existing bridges and precautions will be taken to limit disruption of services.

The HDD process uses bentonite-based drilling fluids. The drilling fluids are tested for specific engineering properties to ensure a successful HDD installation. The environmental impact associated with HDD is the potential for inadvertent release of drilling fluids to the surface along the drill alignment during drilling operations. The drilling fluids are typically a mixture of fresh water and bentonite. Bentonite is natural clay usually mined in Wyoming. Bentonite is extremely hydrophilic and can absorb up to ten times its weight in water. Typically, the drilling fluid contains no more than 5 percent bentonite (95 percent fresh water).

The potential drilling under the canal will not affect the sole source aquifer. It is anticipated that HDD will take place approximately 30 ft. below the canal, although exact depths of the drill route cannot be estimated during Phase I without more specific drilling plans. The bedrock surface altitude ranges from 50 feet below National Geodetic Vertical Datum (NGVD) 1929 near the Canal, to 500 ft. below NGVD 1929 near the Monomoy lens. While the HDD would contact the water table, based on USGS water table surface contour maps, the aquifer is much deeper and is not likely to be impacted by horizontal drilling. (Walter et al 2016). However, further analysis in Phase II would be conducted when the exact HDD entry location, drill routes, drill angles, and exit points have been identified.

Potential impact to the water table exists if drilling fluids, composed of a slurry of bentonite clay and water, were inadvertently released into the environment during the drilling process. According to Algonquin Gas, drilling fluids typically contain no more than 5 percent bentonite (95 percent fresh water). Best management practices (BMPs) and site-specific clean-up measures will be developed prior to any drilling commencing and implemented throughout the HDD process. According to Algonquin BMP procedures (2014), if a release of drilling fluids does occur, containment is typically achieved by excavating a small sump pit (5 cubic yards) at the site of the release, surrounding the release with hay bales, silt fence and/or sand bags. Once contained, the drilling fluid is either collected by vacuum trucks or pumped back to the mud recycle unit, or to a location where vacuum trucks can be accessed. The fluids are then transported either back to the HDD Drilling Rig or to a disposal site".

(Spectra Energy Partners, 2014). Therefore there would be no adverse impact to the environment.

Public Water Supply

The North Sagamore Water District is a community public water supplier located in Bourne, which supplies drinking water and fire protection to 4,600 residents and businesses in the Sagamore Beach Village on the mainland side of the Sagamore Bridge. The District's two largest producing wells and a large storage tank are located on the west side of the Sagamore Bridge approach, while the majority of District customers reside on the east side.

There are two major transmission water mains and numerous arterial mains located in the Sagamore Bridge Study Area. A twelve inch transmission water main runs alongside and under the existing Sagamore Bridge and is located on an easement granted to the Water District by USACE (Easement no. DACW33-2-79-129 Cape Cod Canal). A second transmission main runs along Scenic Highway under the Route 3 overpass/approach to the Sagamore Bridge.

Environmental Consequences

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges

In the no-action alternative, transmission water mains and the water system would continue to operate without any interruption. Therefore, there would be no impacts to the public water supply under this alternative.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

If the bridges were to be replaced, the water transmission lines would need to be relocated. The transmission water mains are integral to the operation of the water system and cannot be offline for any period of time. The Corps will coordinate with the N. Sagamore Water District during Phase II of the project to ensure there will be no interruption to water supply to area residents. Therefore there is no impact to the public water supply.

6.6.6 Public Health and Safety

Disaster Response: Cape Cod is subject to a number of natural hazards. In the Massachusetts State Hazard Mitigation Plan (Commonwealth of Massachusetts, 2018), Barnstable County received high hazard rankings for flood and coastal hazards, and medium hazard ratings for high wind, hurricane/tropical storms, thunderstorms, and Nor'easters. In Barnstable County, over the fifty year period between 1967 and 2016, there were 311 storm-event days, resulting in two deaths and 10 injuries and 118 storm-event-days with property damage (National Center for Environmental Information, 2017). Since 1990 there have been 15 Federal Disaster Declarations in Barnstable County, ten attributable to coastal storms and hurricanes, and five attributable to winter storms (Commonwealth of Massachusetts, 2013).

"Of all the natural threats that might affect Cape Cod, hurricanes have the potential to cause the

most property damage and loss of life if adequate planning and preparation is not undertaken" (Cape Cod Commission 2010, p. 16). Hurricane season occurs from June first through November 30th. On average Massachusetts has one tropical storm or hurricane every other year or 0.5 storms per year. (Commonwealth of Massachusetts 2018, p. 4-204-209). Accordingly, the following discussion will focus upon disaster response in the context of hurricanes.

The estimated population (2010 population estimates) of Barnstable County that is vulnerable to hurricanes is presented in EA Table 15. The analysis indicates that 2.6 percent of Cape Cod residents would be exposed to a Category 1 possible hurricane damage, and 5.3% would be exposed to a Category 4 hurricane. Barnstable County's critical facilities, including six police stations, fourteen fire stations, and one hospital, are also exposed to hurricane hazards.

EA Table 15 - Estimated Population Exposure to Hurricane Hazard

Total Barnstable County Population	Category 1 Hurricane		Category 2 Hurricane		Category 3 Hurricane		Category 4 Hurricane	
	Population	% of Total	Population	% of Total	Population	% of Total	Population	% of Total
215, 888	5,537	2.6	8,393	3.9	10,543	4.9	11,528	5.3

From: Massachusetts State Hazard Mitigation Plan (Commonwealth of Massachusetts 2018).

Disaster response to hurricanes (and other hazards) requires "rapid and efficient egress from areas of the Cape… At the same time, Cape roadways and bridges are restricted in route options, profile, and capacity" (Commonwealth of Massachusetts, 2016, p. 3). Emergency evacuation of Cape Cod is an important issue due to the high probability of a hazardous event occurring, and because of the high traffic volume and low capacity road conditions that are exacerbated by a bottleneck created by the bridges. As of the 2010 census, there were 85,698 individuals (40% of the Barnstable County's total population) living in census tracts falling within Barnstable County's Hurricane Evacuation Zone[2]. The Cape Cod Emergency Traffic Plan outlines the various travel restrictions that may be imposed in case a large number of people need to evacuate the Cape. Such restrictions may include exit closures, detours and one-way travel on roads and bridges. The bridges may be closed if weather and traffic conditions make it unsafe to travel across them[3] (Commonwealth of Massachusetts, 2016).

Because hurricanes are the most likely hazard that would prompt disaster response, the Cape Cod Emergency Traffic Plan focuses on such a scenario, however the same approach would be

[2] I obtained this in ArcGIS by selecting census tract polygons that contain one or more MA Hurricane Evacuation Zone polygons

[3] Motorists in such a case will be shuttled to the Joint Base Cape Cod for shelter.

applicable to other hazards. While hurricanes and tropical storms are generally tracked for some time before they reach the Cape, storm paths and intensity are uncertain, thus emergency traffic response decisions are not made until storms are 24-32 hours from landfall (Commonwealth of Massachusetts, 2016).

The Cape Cod Emergency Traffic Plan provides estimates for the amount of time it will take for residents and visitors to evacuate the Cape following a public advisory. Evacuation during a Category 3-4 Hurricane in peak tourist season will require up to 32 hours from the initiating emergency traffic response until roadways are completely clear.

EA Table 16 - Estimated Cape Clearance Times

	Hurricane Category 1-2	Hurricane Category 3-4
Peak Season	22 hours	32 hours
Off-peak Season	12 hours	18 hours

Source: page 19. Cape Cod Emergency Traffic Plan (Commonwealth of Massachusetts, 2016). Calculations are based on the FEMA/USACE Massachusetts Hurricane Evacuation Study (HES – March, 2015)

Because the only vehicular access off of the Cape is via the two bridges, they create a bottleneck, limiting traffic flows. In addition, the capacity of the bridges is limited; they are thus considered a "frail lifeline" to the mainland in emergency situations (Commonwealth of Massachusetts, 2016).

Emergency Response: The town of Bourne is divided by the Cape Cod Canal; the two sides of town are accessed via the bridges. The local police department has one station located north of the bridges, fire stations are located on either side of the bridges (EA Figure 13).

EA Figure 14 - Fire and Police Stations in the Town of Bourne

Both the fire and police departments take numerous trips across the bridges each day to obtain supplies and fuel, conduct inspections and trainings, and for response to emergencies. Although the fire department has staffed stations on both sides of the bridge, they travel over the bridges approximately 10-12 times per day, on average (Bourne Deputy Fire Chief Pelonzi, personal communication. July 31, 2017). Because the local police department has only one manned station on the northern side of the bridge, they take frequent patrol trips over the bridges. The police department responds to more than 10,000 calls on the south side of the bridges every year (Bourne Police Department Lieutenant Brandon Esip, personal communication. March 13, 2018), however this number grossly underrepresents the number of police vehicles traversing the bridges. It does not account for police backup, trips back over the bridge for booking at the house of corrections or for medical services at the hospital, police on the south side that need to respond to calls on the north, or any responses to emergencies by other agencies (i.e. Fire Department, etc.).

Even without construction, increased congestion on the bridges during the summer months results in delayed emergency response (Bourne Deputy Fire Chief Pelonzi, personal communication. July 31, 2017). Inspection and training schedules need to be adapted to accommodate the increased traffic delays. In addition "when traffic causes delays, [the Bourne Fire Department is] often forced

to hire additional staff on overtime to account for delays." During summer months, high traffic congestion greatly influences to which hospitals emergency responders are able to ambulate trauma victims (Bourne Deputy Fire Chief Pelonzi, personal communication. July 31, 2017). From the traffic model data used in the Economic Appendix of the accompanying MRER, the increase in summer traffic volume leads to a >75% increase in travel time from the police station to the south side of the bridges.

EA Table 17 – Change in travel time from the Bourne Police Department to the south side of the bridges

Route	Links	Travel time (min) during fall weekday	Travel time (min) during summer weekend	% increase from Fall weekday to Summer weekend
Police Dept to Cape Cod side of Sagamore Bridge via Bourne Bridge	Link 3EB + Link6SB + Link 2EB	14.7	27.2	85%
Police Dept to Cape Cod side of Sagamore Bridge via Sagamore Bridge	Link 3EB + Link 1EB + Link 9SB	13.6	24.0	76%
Police Dept to Cape Cod side of Bourne Bridge via Bourne Bridge	Link 3EB + Link 6SB	10.5	18.5	76%

Military Installations: Joint Base Cape Cod (JBCC), located in Bourne, is a military installation housing five military commands including the National Guard and Air Force (http://www.thenationsfirst.org/JBCC/index.html). Camp Edwards, part of JBCC, is New England's primary training facility for National Guard and Army Reserve soldiers. Installations at JBCC also play an important role in disaster response throughout the northeast. Currently, the two CCC bridges are the main access points for all JBCC goods and services, however some supplies are transported to the Cape via the rail system (Paul Rendon, Assistant to JBCC Director, personal communication. July 21, 2017). In addition, many JBCC personnel live off-Cape and commute to JBCC via the bridges (Paul Rendon, Assistant to JBCC Director, personal communication. July 21, 2017).

Health Services: Cape Cod Healthcare conducted a needs assessment in 2016 to identify priority areas to respond to Cape Cod residents' most urgent health needs. Chronic diseases, in particular cancer and heart disease, are the leading causes of death in Barnstable County and are accordingly identified as a topic of greatest concern (Cape Cod Healthcare, 2016). In part, this is due to greater rates of chronic diseases such as cancer and heart disease typically found in older populations. In 2011, Barnstable County's cancer incidence rate was 9% higher than Massachusetts overall (Cape Cod Healthcare, 2016).

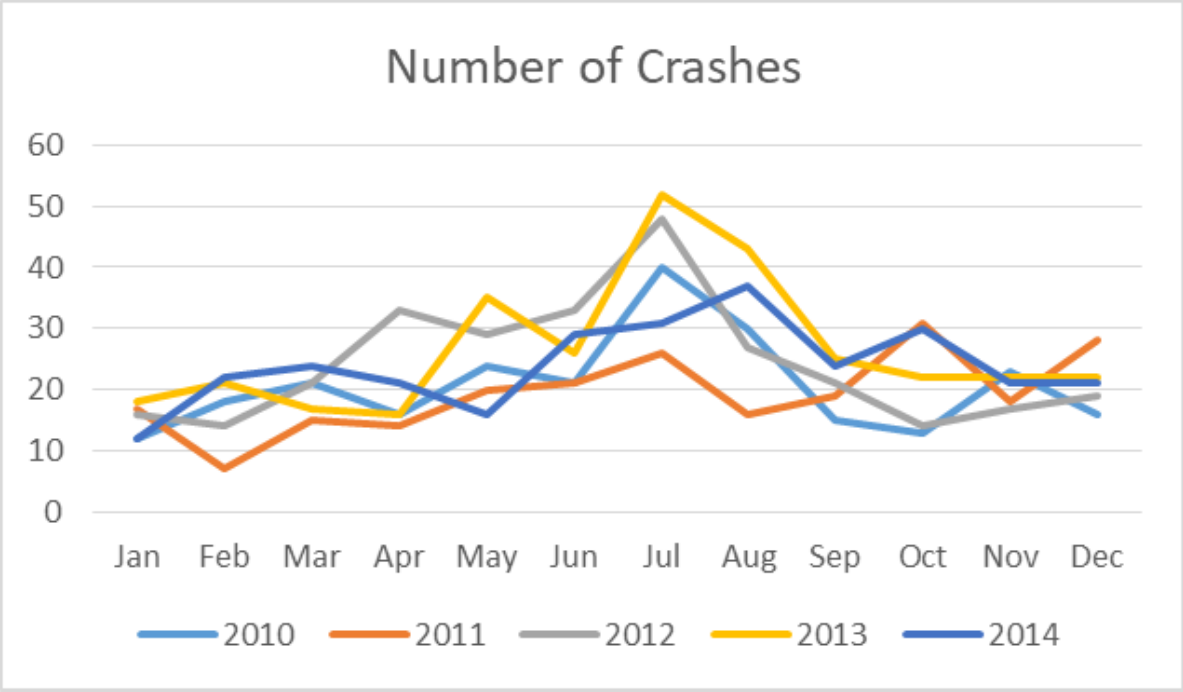
Barnstable County's population is ageing, with a greater need for health services, however the availability of health services is less than that of Massachusetts overall. For instance, the number of primary care physicians per 10,000 people is nearly 30% lower in Barnstable County compared with Massachusetts. Retirees who have moved to the Cape often prefer to stay with doctors they have an established relationship with, so they will travel off-Cape for appointments (Wendy

Northcross, CEO of the Cape Cod Chamber of Commerce, personal communication, August 8, 2017; Cape Cod Commission 2017b). In addition, there are no VA hospitals in the area, so veterans must travel to Providence or to Jamaica Plain if they wish to use VA services (Wendy Northcross, CEO of the Cape Cod Chamber of Commerce, personal communication, August 8, 2017; Cape Cod Commission 2017b). Boston's reputation for excellent, world-class health care also draws residents off of the Cape and Islands to the mainland (Wendy Northcross, CEO of the Cape Cod Chamber of Commerce, personal communication, August 8, 2017; Cape Cod Commission 2017b). Because of their distance from urban centers, Cape Cod and Islands residents face restricted access to specialty care, and often must travel to Boston, MA or Providence, RI for health care (Stasiowski, Piatt and Simpson, 2016).

In addition, there are currently no Level I or II trauma centers on Cape Cod, most trauma patients are transported to Boston hospitals for care. Currently 1,500-1,600 trauma cases each year are transported off of Cape Cod for treatment; 600-700 trauma cases are treated in local Cape Cod hospitals (Theresa Ahern, Patrick Kane and Michael Lauf; Cape Cod Healthcare, personal communication, August 2, 2017). Because transport via aircraft requires very specific conditions, much of this transport occurs via ground transportation (Cape Cod Commission, 2017b). Cape Cod Healthcare is actively seeking trauma certification and expects to receive certification after this section has been fully staffed by the end of 2020. Once certified, Cape Cod Healthcare expects to treat all Level III traumas locally but will continue to require transport to Boston hospitals for Level I traumas. (Theresa Ahern, Cape Cod Healthcare, personal communication, July 18, 2019).

Traffic Incidents: Because the bridges create bottlenecks, traffic incidents are common at the bridges' entrances. The south entrance of the Bourne Bridge and the north entrance of the Sagamore Bridge are among the Cape Cod Commission's Cape-Wide top 10 crash locations list (Cape Cod Commission, 2014). Between 2010 and 2014, there were 1380 total crashes within one mile of the two bridges; 333 resulted in non-fatal injuries and seven resulted in fatalities (MassDOT Crash Portal: accessed 7/28/2017, http://services.massdot.state.ma.us/crashportal/DataRequest.aspx). Unsurprisingly, with a greater number of vehicles on the road, there are more crashes during the summer months (EA Figure 15).

EA Figure 15 – Number of monthly crashes within one mile of the bridges (2010 – 2014)



In addition to motor vehicle incidents, the sidewalks on the bridges are not up to current federal standards and are narrower and closer in proximity to moving traffic.

Environmental Consequences

Alternative A – No Action

Though there will be no immediate impact to health and public safety, over the 50-year study period (2020-2069) as the bridge conditions deteriorate, emergency repairs will be more frequently required. This will have an impact on traffic and the ease of transport for emergency responders, access from JBCC, and for emergency evacuations. "Any closure of either of the bridges, for any amount of time, drastically impacts our ability to respond to emergencies. Long term closures would have a very negative impact on our ability to operate and respond to calls safely and efficiently" (Bourne Police Department Lieutenant Brandon Esip, personal communication. March 13, 2018). These public safety concerns associated with Alternative A could cause moderate negative impacts on the community.

Alternative B – Major Rehabilitation for Both Bridges

The Bourne and Sagamore Bridges will undergo lane closures and complete bridge closures during the rehabilitation process, influencing emergency officials' ability to evacuate residents from the Cape during hazardous events. With partial closures, the traffic model estimates an

increase in travel time over the Bourne Bridge (0.58 miles) from 1.2 minutes in the existing condition to up to 10.9 minutes during the fall weekdays and up to an hour during the summer weekends. With a full Sagamore Bridge closure the travel time over the Bourne Bridge would increase up to an hour during fall weekdays and up to four hours during summer weekends. With partial closures, the traffic model estimates an increase in travel time over the Sagamore Bridge (0.35 miles) from 0.4 minutes in the existing condition to up to 2.1 minutes during the fall weekdays and up to an hour during the summer weekends. With a full Bourne Bridge closure the travel time over the Sagamore Bridge would increase up to 21 minutes during fall weekdays and up to an hour and 45 minutes during summer weekends. These dramatic increases in travel time pertain only to the bridge segments, and do not include increased travel time on road segments leading up to the bridges. Given substantial increases in travel time associated with lane and bridge closures, a significant number of residents and visitors would likely not be able to evacuate Cape Cod prior to a major storm landfall. This could potentially lead to costly large-scale rescue efforts where residents become trapped, and may lead to additional injuries and death.

Prior incidents that have caused lane closures on the Bourne and Sagamore bridges have resulted in extensive delays in police response times (Bourne Police Department Lieutenant Brandon Esip, personal communication July 28, 2017). Lane closures due to bridge repair would have a similar effect. The National Fire Protection Association standards require first responders to be on-scene within four minutes of the first alarm, with all units arriving within eight minutes (NFPA, 2016). Although there are fire stations located on both sides of the bridges, lane closures will interfere with the Fire Department's ability to respond in a timely manner, and with adequate capacity.

Because the bridges are the primary access points for JBCC supplies and personnel, there is some concern that lane and bridge closures could limit the unit's ability to carry out their training mission (Paul Rendon, Assistant to JBCC Director, personal communication. July 21, 2017; LTC Matthew Porter, Army National Guard, Camp Edwards, personal communication. November 17, 2017). As such there would be moderate impacts to public health and safety.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

When the replacement bridges' construction is completed there will be a positive impact on health and public safety. The additional lanes will improve access on and off of Cape Cod during emergency evacuations. Additionally, reduced traffic eases travel constraints for emergency vehicles such as police, fire, and EMT. Safer, wider lanes will reduce traffic incidents and safer, wider pedestrian lanes will provide safer passage for pedestrians and bicyclists. . In addition, the bridges will not require continual maintenance repairs as experienced in Alternative A and B scenarios constricting traffic and safe passage.

6.6.7 Traffic

The Massachusetts Department of Transportation (MassDOT) conducted a Cape Cod Canal Transportation Study to examine current traffic conditions in the area surrounding the Sagamore and Bourne Bridges. The Army Corps of Engineers worked with a contractor, TrafInfo, to create traffic models using the MassDOT data. TrafInfo collected data for existing traffic conditions (2014) and future conditions (2040) matching the MassDOT framework. TrafInfo designed a regional travel demand model using TransCAD modeling software to capture traffic volumes at various times of the day in the existing and future conditions with partial lane closures and full bridge closures.

The study area of the traffic analysis is comprised of the Bourne and Sagamore Bridges and seven major connecting routes. More specifically, the routes which are depicted in EA Figure 16, include:

Between Bridges (East to West)

- Scenic Highway (Rt. 6): from Rt. 28 on/off ramps to Rt. 3 (where Rt. 6 and Rt. 3 merge to go over the Sagamore bridge), both directions
- Sandwich Rd: from Bourne Rotary (the intersection between Sandwich Rd and Rt. 28) to Rt. 6 ramps, both directions

North Bourne Rotary (Belmont Circle)

- Buzzards Bay Bypass (Rt. 6 and 28): from Glen Charlie Rd in Wareham to the Rt. 28 on-ramp, eastbound

Bourne Bridge entrances

- Rt. 25: From Exit 2 on Rt. 25 (Glen Charlie Rd in Wareham) to the entrance of the Bourne Bridge, southbound
- Rt. 28: From Rt. 151 (Nathan Ellis Hwy in Falmouth) to the entrance of the Bourne Bridge, northbound

Bourne Bridge

- The bridge itself south and northbound

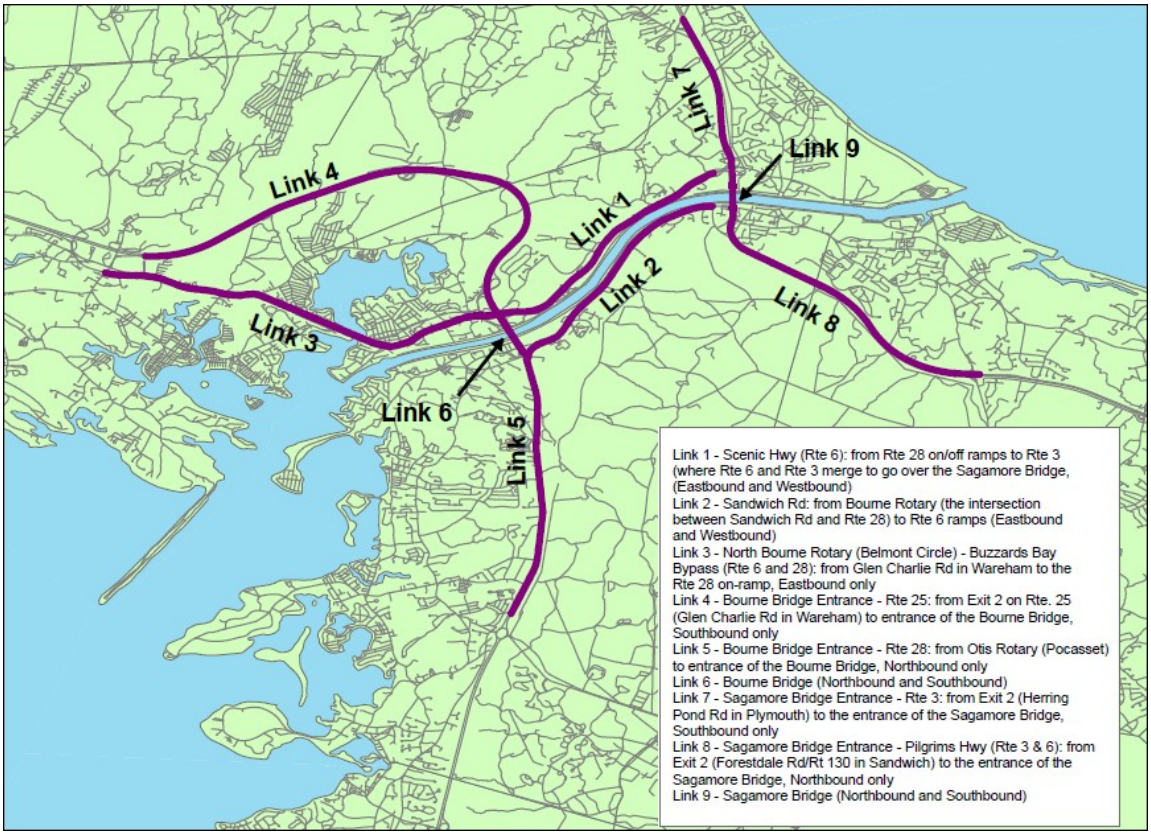
Sagamore Bridge entrances

- Rt. 3: from Exit 2 (Herring Pond Rd in Plymouth) to the entrance of the Sagamore Bridge, southbound
- Pilgrims Hwy (Rt. 3 and 6): from Exit 2 (Forestdale Rd/Rt. 130 in Sandwich) to the entrance of the Sagamore, northbound

Sagamore Bridge

- The bridge itself, south and northbound

EA Figure 16 – Traffic Routes



The modelers extracted data for weekdays (WD) and weekends (WE) for three seasons- summer, fall and winter (fall was used as a proxy for spring) during four daily time periods: morning (6AM-9AM; called AM), mid-day (9AM-3PM; called MD), afternoon (3PM-6PM; called PM), and night time (6PM-6AM; called NT). They ran model and extracted data under the conditions of full and partial lane closures for the Sagamore Bridge with no restrictions for the Bourne Bridge and vice versa. By definition, *partial lane* closure is described as passage of vehicles in one lane in each direction (2 lanes total) over the bridge identified under repair. While, *full lane* closure constitutes no vehicular traffic passage (0 lanes total) on the bridge identified under repair. The term "Open" denotes no lane closures associated with rehabilitation activities.

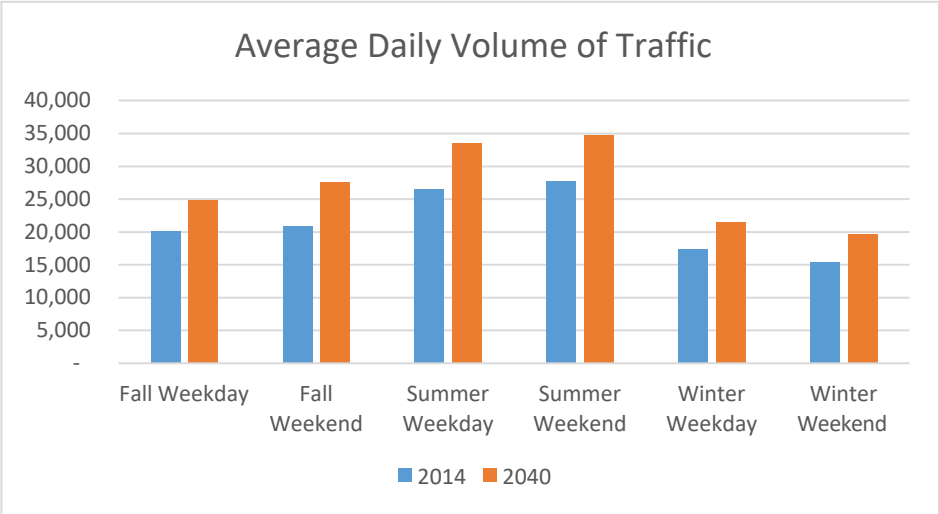
The original MassDOT Cape Cod Canal Transportation Study collected traffic data representative of summer and fall seasons, however TrafInfo modeled traffic conditions during the winter months (specifically January). Winter traffic modeling was calibrated using values input from existing data (MassDOT Canal Transportation Study and other data available through MassDOT's Traffic Collection Data Unit). Winter traffic volume and travel times were input for the four daily time periods, as well as weekends.

Conditions with no Traffic Impediments

Cape Cod is a vacation destination in the summer months, therefore, the volume of traffic

increases in the summer, particularly on weekends as visitors travel on and off the Cape. EA Figure 17 displays the average daily traffic by season and day of the week (weekday or weekend). The volume of traffic is expected to increase over the forecast horizon and traffic will be at its maximum on summer weekends. Future traffic trends for visitors were projected based on data on employments trends in the Accommodations and Food Services and through discussions with the Cape Cod Commission. Future trends in non-visitor trips were escalated using population, household, and employment data. Growth in traffic is limited by maximum capacity of the roadways.

EA Figure 17 – Average Daily Volume of Traffic



Travelers over the Sagamore and Bourne bridges use 11 major routes. The 11 routes are:

1. From the mainland Route 3 to Cape Cod Route 6 via the Sagamore Bridge (2.8 miles)
2. From the mainland Route 25 to Cape Cod Route 6 via the Bourne Bridge (9.9 miles)
3. From the mainland Route 25 to Cape Cod Route 6 via the Sagamore Bridge (9.9 miles)
4. From the mainland Route 25 to Cape Cod Route 28 via the Bourne Bridge (6.9 miles)
5. From Cape Cod Route 28 to the mainland Route 25 via the Bourne Bridge (4.7 miles)
6. From Cape Cod Route 6 to the mainland Route 25 via the Sagamore Bridge (10.3 miles)
7. From Cape Cod Route 6 to the mainland Route 25 via the Bourne Bridge (7.4 miles)
8. From Cape Cod Route 6 to the mainland Route 3 via the Sagamore Bridge (4.2 miles)
9. From the mainland Belmont Circle to Cape Cod Route 6 via the Bourne Bridge (8.0 miles)
10. From the mainland Belmont Circle to Cape Cod Route 6 via the Sagamore Bridge (8.0 miles)
11. From the mainland Belmont Circle to Cape Cod Route 28 via the Bourne Bridge(5.0 miles)

Existing Areas of Congestion on Cape Cod Roadways
The following areas were identified by MassDOT as principal intersections that are the main drivers of traffic congestion in the area surrounding the Sagamore and Bourne Bridges.

Belmont Circle
Belmont Circle is a rotary north of Cape Cod Canal. The rotary connects various roadways including Scenic Highway, Main Street, Buzzards Bay Bypass, Head of the Bay Road, and ramps to Route 25. Several retail businesses and restaurants also have driveways directly from the Belmont Circle. The entrance ramp to Route 25 also leads directly to the Bourne Bridge. Travelers also often leave Route 25 at Exit 2 to access Route 6 eastbound in Wareham towards Main Street and Belmont Circle which add to traffic volumes in the Circle.

Bourne Rotary
The Bourne Rotary is located south of the Bourne Bridge with roadway approaches that include Route 28, Trowbridge Road, and the Bourne Rotary Connector. Sandwich Road provides a connection north of the rotary between Trowbridge Road and the Bourne Rotary Connector. Sandwich Roads provides a connection to Route 6.

Route 6 Exit 1C Westbound
Exit 1C, immediately after the Sagamore Bridge, is a westbound-only exit and entrance ramps to and from Cranberry Highway. The exit/entrance ramps are of substandard length at only 200 feet and grades are steep. The roadway geometry therefore contributes to congestion and delays.

Environmental Consequences

Alternative A – No Action
There would be moderate impacts to traffic as a result of the no action alternative. Traffic will progressively worsen over the 50-year period of analysis. The average travel time for a driver going over either the Sagamore Bridge or Bourne Bridge under existing conditions using one of the 11 routes described above is exhibited in EA Table 18 below. Note that this includes only the length of the routes described (average 7.6 miles

directly correlated to bridge traffic) not the total travel time drivers experience over their entire journey.

EA Table 18 – Average Travel Time of Major Routes

Average Travel Time (min)								
	Fall Weekday				Fall Weekend			
	AM	MD	PM	NT	AM	MD	PM	NT
Base Condition - 2014	9.5	9.0	9.8	8.9	9.1	9.2	9.6	8.9
Base Condition - 2040	9.9	9.1	10.4	9.0	9.3	9.5	10.6	9.2
	Summer Weekday				Summer Weekend			
	AM	MD	PM	NT	AM	MD	PM	NT
Base Condition - 2014	9.8	9.5	10.2	9.0	10.0	15.2	14.7	9.3
Base Condition - 2040	10.5	10.1	11.4	9.4	10.7	19.2	19.5	10.3
	Winter Weekday				Winter Weekend			
	AM	MD	PM	NT	AM	MD	PM	NT
Base Condition - 2014	9.7	8.9	9.5	8.8	8.9	9.0	9.1	8.8
Base Condition - 2040	10.1	8.9	9.9	8.9	9.0	9.0	9.4	8.9

MD = midday; NT = night time
Weekend=Saturday and Sunday

These travel times reflect the anticipated regular flow of traffic. In reality, during the no-action alternative the bridges will require more frequent construction projects to maintain the bridges in working condition. These projects will require lane closures (partial closures) and full bridge closures. The impact of the lane and bridge closures are described in EA Tables 19 and 20 and a description of the type of emergency repair and associated travel restrictions is presented in EA Table 21. The further out in the study period, the more frequent emergency repair projects will be required and in turn closures increasing impact and delays.

EA Table 19 - Average Travel Time by Closure 2014

Average Travel Time in (min) 2014						
	Fall		Summer		Winter	
Alternatives	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
Existing Hwy	9.3	9.2	9.6	12.3	9.3	9.0
Partial Bourne	12.3	12.3	14.5	25.5	12.1	10.3
Full Bourne	16.6	15.7	20.8	37.0	16.3	13.0
Partial Sagamore	9.8	9.5	11.7	30.5	9.9	9.0
Full Sagamore	19.1	18.5	40.0	77.6	18.0	12.5
Difference (min)						
Alternatives	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
Existing Hwy	-	-	-	-	-	-
Partial Bourne	3.0	3.1	4.9	13.2	2.8	1.4
Full Bourne	7.3	6.5	11.2	24.8	7.1	4.0
Partial Sagamore	0.5	0.3	2.1	18.2	0.6	0.0
Full Sagamore	9.8	9.3	30.4	65.3	8.7	3.5

EA Table 20 - Average Travel Time by Closure 2040

Average Travel Time in (min) 2040						
	Fall		Summer		Winter	
Alternatives	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
Existing Hwy	9.6	9.6	10.3	14.9	9.5	9.1
Partial Bourne	15.8	23.5	61.8	85.2	21.9	11.4
Full Bourne	25.2	26.2	53.5	76.1	27.4	16.6
Partial Sagamore	31.5	32.3	85.3	106.2	31.2	10.8
Full Sagamore	47.8	58.8	125.6	177.2	59.8	29.6
Difference (min)						
Alternatives	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
Existing Hwy	-	-	-	-	-	-
Partial Bourne	6.2	13.9	51.5	70.3	12.4	2.4
Full Bourne	15.6	16.6	43.2	61.2	17.9	7.5
Partial Sagamore	21.9	22.7	75.0	91.3	21.7	1.7
Full Sagamore	38.2	49.2	115.3	162.2	50.4	20.5

EA Table 21 - Emergency repair and associated travel restrictions

Description	Lane Closures
Superstructure	
Advanced deterioration of secondary member, non-critical Gusset Plate, Stringer, Floorbeam, or Hanger Cable	9 months lane closure - no closures Memorial Day to Columbus Day
Advanced deterioration of Main Truss Member or Critical Gusset Plate	18 months lane closures
Catastrophic Damage to Main Truss Member or Critical Gusset Plate	60 Months Bridge Closure
Substructure	
Localized Concrete Defects such as Cracks or Spalls on Vertical Surfaces of Piers or Degradation of Concrete under Bearings on the Piers	6 months of lane closures, no closures Memorial Day to Columbus Day, Lane Closures limited to non-peak hours, weekdays
Widespread Concrete Defects such as Cracks or Spalls on Vertical Surfaces of Piers or Degradation on Concrete under Bearings on the Piers	12 months of lane closures, no closures Memorial Day to Columbus Day, Lane Closures limited to non-peak hours, weekdays
Bridge Deck	
Localized deterioration of Roadway Joint(s), Granite Curbs, Concrete-filled Steel Grid over Bridge Spans, or Reinforced Concrete Deck at Abutments	6 months of lane closures, no closures Memorial Day to Columbus Day
Widespread Deterioration of Concrete-filled Steel Grid Deck over Bridge Spans and Reinforced Concrete Deck at the Abutments	15 Months of Temporary Lane Closures on one Bridge, no Closures Memorial Day to Columbus Day

Alternative B – Major Rehabilitation for Both Bridges

During the major rehabilitation, expected lane or bridge closures are described in EA Table 22 below. The individual driver impact of each day of bridge or lane closure is described in the EA Tables 19 and 20 (above).

Therefore during the major rehabilitation project there will be substantial delays to traffic due to months of lane or bridge closures over the years of construction. After the major rehabilitation project, the safety of the bridges will improve and therefore require less frequent emergency repairs (as described in EA Table 21). However, given that the bridges are aging, these emergency repairs will occur at a rate less frequently than the no-action alternative but at a higher frequency than with replacement bridges.

EA Table 22 - Rehabilitation Lane Closure Duration Estimates

MAJOR REHAB ACTIVITY	BOURNE	SAGAMORE
	LANE CLOSURE DURATION (DAYS)	
BRIDGE SUPERSTRUCTURE DECK REPLACEMENT (INCLUDING STRINGER REPLACEMENT); ABUTMENT SPAN REPLACEMENT; (CONCRETE T-BEAMS) MISC. STEEL REPAIRS, ETC.; EXTERIOR GUSSET PLATE RETROFITS; INTERIOR GUSSET PLATE REPAIRS; MISC. CONCRETE REPAIRS, ETC.	165	135
SUSPENDER CABLE REPLACEMENT	65	70
PAVING	30	25
PAINTING	220	150
TOTAL DAYS OF LANE CLOSURES	**480**	**380**
	FULL BRIDGE CLOSURE DURATION (DAYS)	
INTERIOR GUSSET PLATE REPLACEMENT	70	95
FLOORBEAM REPLACEMENT	110	35
TOTAL DAYS OF FULL BRIDGE CLOSURE	**180**	**130**

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

The replacement bridge alternative will not have a notable impact on traffic flows during construction as the bridges will be built adjacent to the existing bridges. The new replacement bridges will require eight weeks of lane closures for scheduled maintenance every twenty years and then again after forty years. In this alternative the lanes of the replacement bridge will be wider making the bridges safer and the additional auxiliary on/off lane will ease some of the traffic congestion. Improvements to traffic congestion will be constrained by the road systems surrounding the bridges therefore in order for the full impact of the traffic alleviation to occur,

MassDOT will need to improve the infrastructure surrounding the bridge, most notably the Bourne Rotary. Specific MassDOT recommended improvement projects are discussed in the Cumulative Impacts Section of this EA.

The replacement bridges are expected to reduce traffic congestion but will not be a driver in increased volume for more visitors on Cape Cod. The traffic analysis includes an estimate for increased visitors on the Cape with or without replacement of the bridges. Visitor trips were projected using an annual growth rate of 0.7% or a factor of 1.2 between 2014 and 2040. As part of MassDOT's Cape Cod Canal Transportation Study, a detailed assessment was conducted into employment trends in Accommodations and Food Services as a proxy for visitor activity. A regression model was developed relating employment in Accommodations and Food Services with traffic volumes over the Bourne and Sagamore bridges. The analysis indicated the visitor growth to be in the range of 0.12% to 0.7%. Based on discussions with the Cape Cod Commission and their in-house estimates of visitor growth, the high end growth rate was used to allow for a more conservative analysis of the necessary highway improvements and to ensure the growth potential in the Cape was not constrained by the proposed highway infrastructure. Therefore, it is expected that visitor growth is linked to the tourism industry through accommodations and food services rather than road improvements.

6.6.8 Environmental Justice

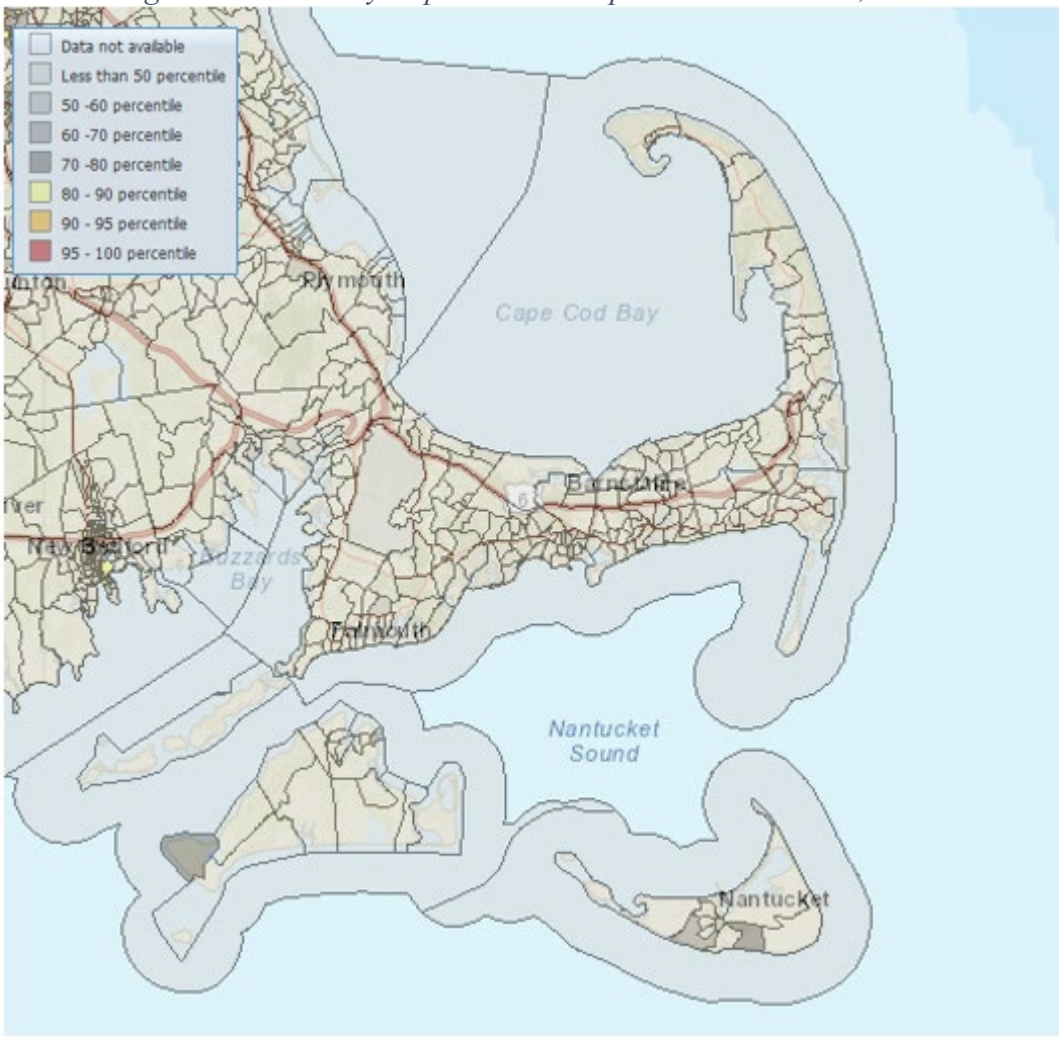
It is important that any construction project under consideration by the federal government ensures that it does not negatively impact socially vulnerable populations. The Environmental Protection Agency (EPA) defines Environmental Justice as the "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies". Impacts to vulnerable populations as pertaining to Environmental Justice were evaluated in accordance with Executive Order 12898 – *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* signed February 16, 1994. Executive Order 12898 directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law (EPA, 2019b).

The EPA has developed an Environmental Justice Screening Tool (EJScreen) which identifies areas of environmental and social vulnerability by census block using data sourced from the US Census Bureau's American Community Survey, 2012-2016.

Minority Population: The EJScreen has a map capability that views minority population as a percentile of the nation, e.g. 60 percentile of a minority population in the census block means that the minority population is higher than 60% of the nation's census blocks.

EA Figure 18, below exhibits the minority population (national percentiles) by census block for Cape Cod and the Islands. The population is majority white, with only a few pockets of the population with a percentile greater than 50 on Martha's Vineyard, Nantucket, Falmouth, and Barnstable.

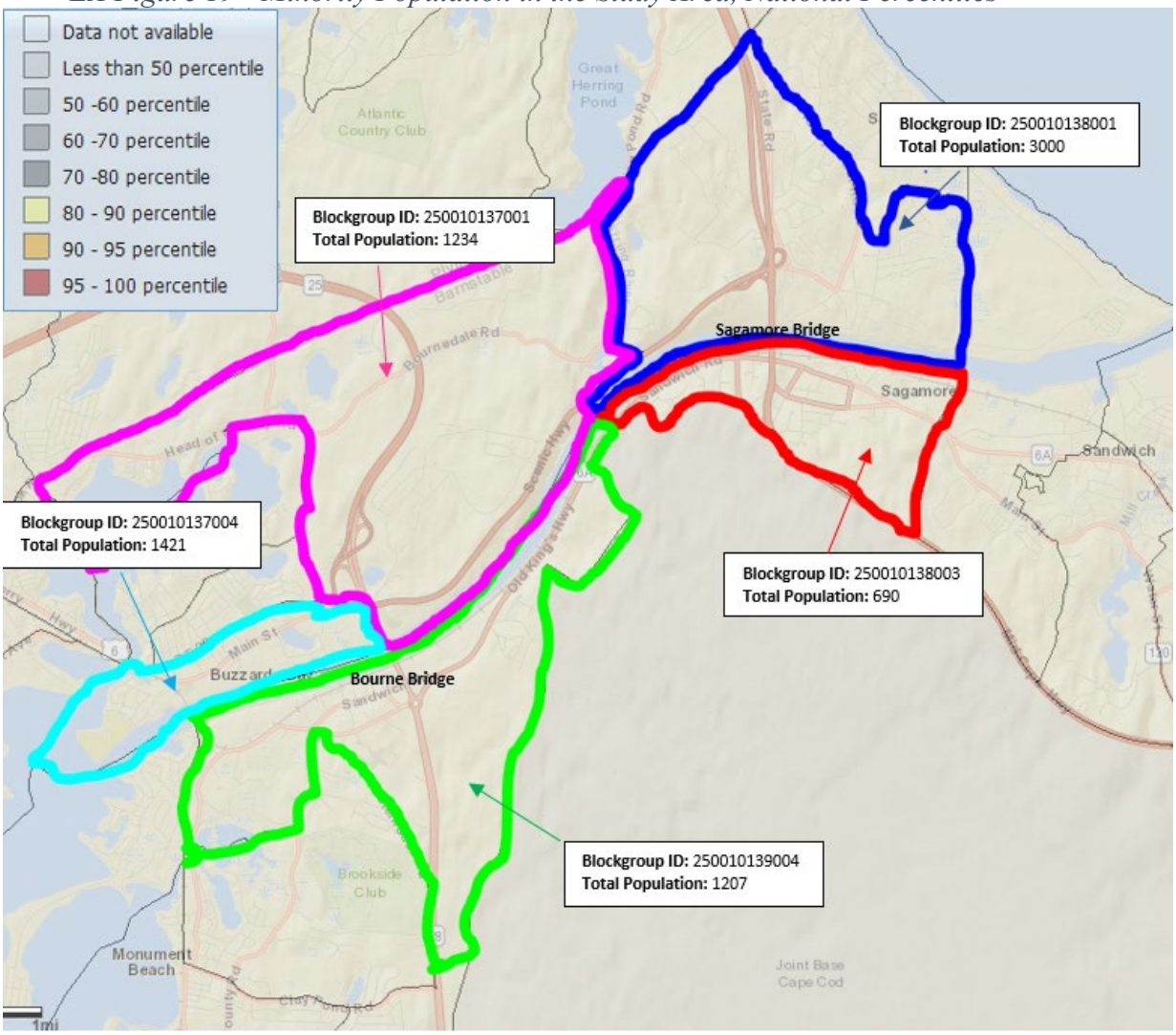
EA Figure 18 - Minority Population in Cape Cod and Islands, National Percentiles



Source: EPA, EJScreen

The study area is located across two census block groups surrounding the Sagamore Bridge and three census block groups surrounding the Bourne Bridge. EA Figure 19, below shows the focused study area, which has no census block with a minority population higher than 50 percentile in the nation.

EA Figure 19 - Minority Population in the Study Area, National Percentiles



Source: EPA, EJScreen

The EPA defines percent minority as "a fraction of population, where minority is defined as all but Non-Hispanic White Alone" and is calculated using data from the US Census, American Survey. The percent minority population of the census block groups in the project area were compared to the minority population in Massachusetts and the national average. EA Table 23, below, summarizes the results.

EA Table 23 – Percent Minority

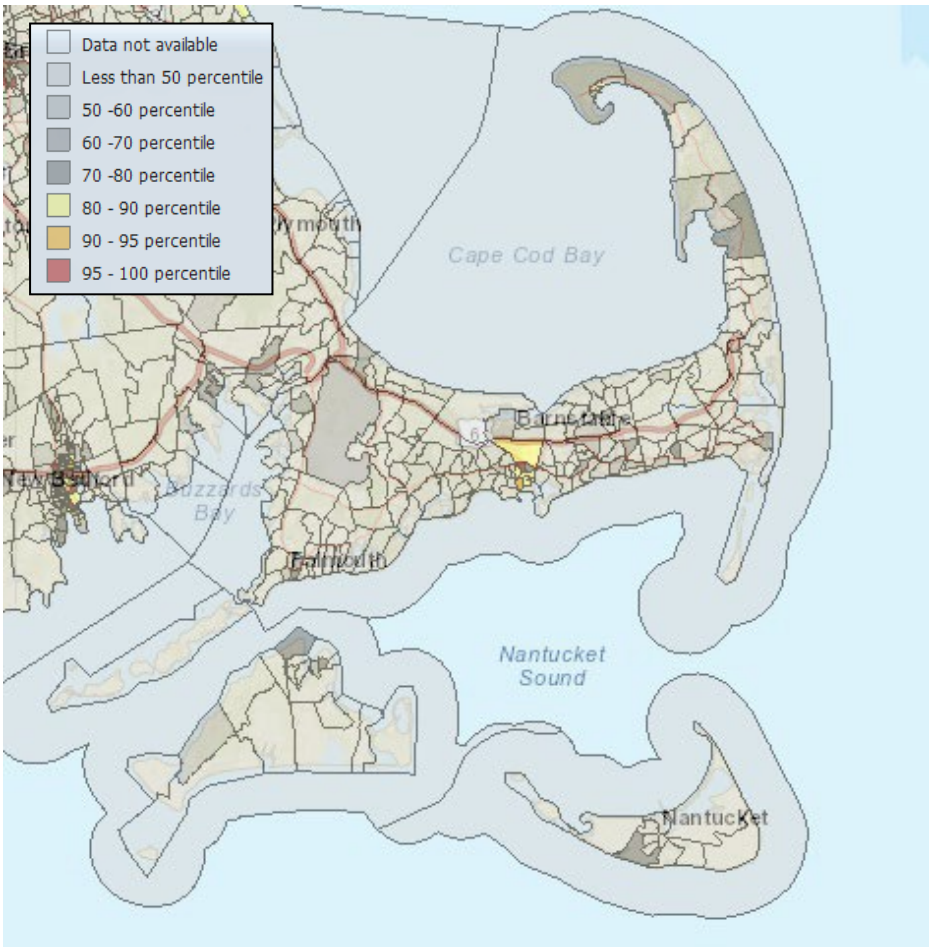
	Percent Minority
Sagamore Bridge	
250010138001	9%
250010138003	0%
Bourne Bridge	
250010137004	21%
250010137001	3%
250010139004	3%
Massachusetts	21%
United States	27%

None of the study block groups in the project area exceed the percent minority in the state or national average. Therefore, the population in the study area is not considered socially vulnerable as pertaining to minority population.

Low-Income Population: The EPA EJScreen also has a map capability to view the low-income population as a percentile of the nation, e.g. 60 percentile of low-income population in the census block means that the low-income population is higher than 60% of the nation's census blocks. Low-income population is defined by the EPA as the "percent of individuals whose ratio of household income to poverty level in the past 12 months was less than 2" and is calculated using data from the Census Bureau's American Community Survey.

EA Figure 20 below exhibits the low-income (as a national percentile) by census block for Cape Cod and the Islands. Low-income populations are more prevalent in the region as compared to minority populations. The highest concentration on low-income population is in the town of Barnstable.

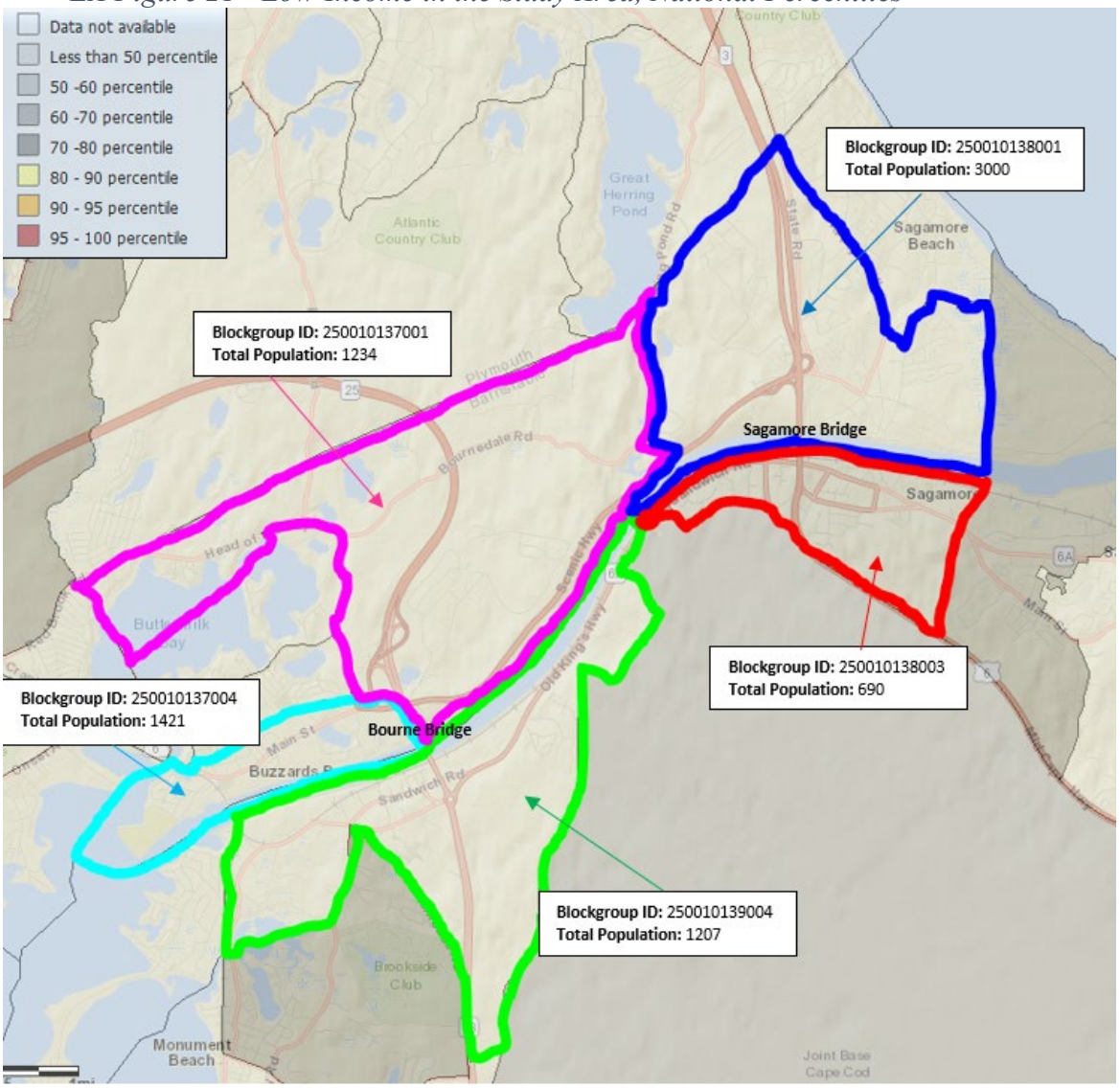
EA Figure 20 - Low-Income Population in Cape Cod and Islands, National Percentiles



Source: EPA, EJScreen

The same census block groups were used to evaluated the low-income population impacted by the proposed bridge projects. EA Figure 21 below shows the focused study area, which has no census block with a low-income population higher than 50 percentile in the nation.

EA Figure 21 - Low-Income in the Study Area, National Percentiles



Source: EPA, EJScreen

EA Table 24 below compares the block group median household income from the Census Bureau's American Community Survey.

EA Table 24 – Median Household Income

	Number Persons per Household	Median Household Income
Sagamore Bridge		
250010138001	2.5	$78,830
250010138003	2	$82,802
Bourne Bridge		
250010137004	3	$77,500
250010137001	2.5	$76,250
250010139004	2.5	$79,773
Massachusetts	2.5	$74,167
United States	2.5	$57,652

The median income of the households in the study are above the Massachusetts average and the average of the United States. According to the Health and Human Services (HHS) Poverty Guideline, the poverty threshold is $16,910 for a two person household and $21,330 for a three person household. All block groups in the study area are well above this poverty threshold. Therefore, the project will not negatively impact populations that are socially vulnerable due to low-income.

Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Given that the population surrounding the bridges is not considered socially or environmentally vulnerable, each project is not expected to have a negative impact on low-income or minority populations.

6.6.9 Hazardous Materials and Waste

This section discusses human health hazards due to exposure to existing and potential future sources of hazardous materials and wastes due to project construction and operation.

Hazardous substances are defined as any solid, liquid contained gaseous or semisolid waste, or combination of wastes that pose a substantial present or potential hazard to human health and the environment. Improper management tor disposal of hazardous substances can lead to contamination of soils, surface water, or groundwater.

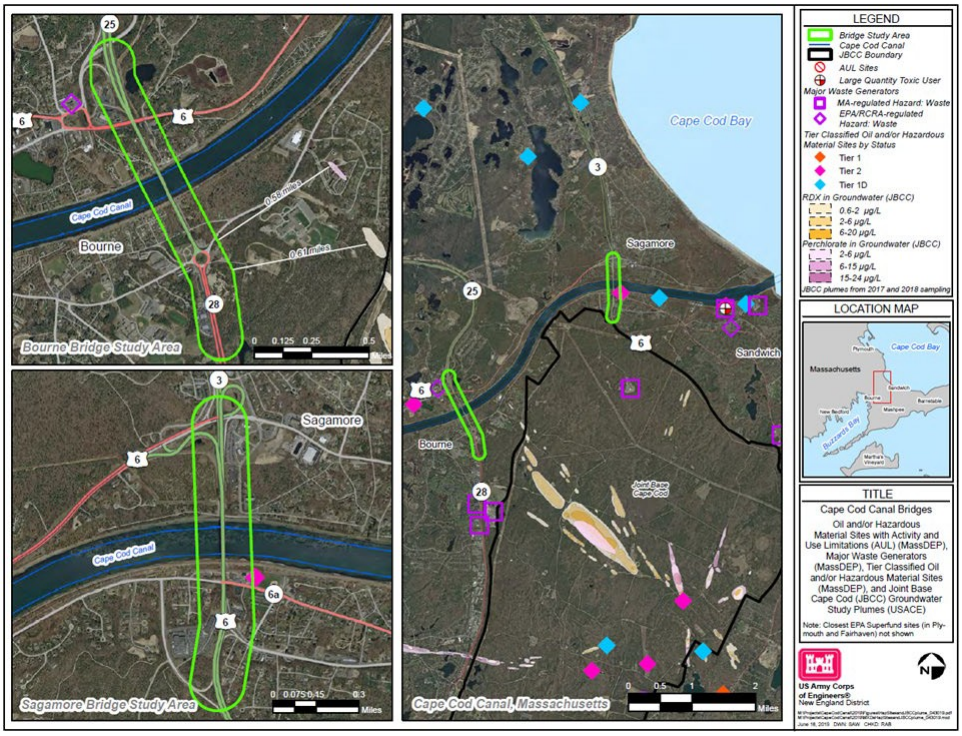
The primary federal regulations for the management and disposal of hazardous substances are the Comprehensive Environmental Response and Liability Act (CERCLA), more commonly known as Superfund, and the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq., 1976). The purpose of CERCLA is to clean up contaminated sites and reduce

impacts to public health and the environment. RCRA regulates the proper transport, treatment, storage and disposal of hazardous waste from "Cradle to Grave". EPA is the agency responsible for developing regulations, guidance, and policies for the management and cleanup of solid and hazardous waste and ensuring proper handling of hazardous waste.

The MA Department of Environmental Protection (MA DEP) maintains a statewide database of all oil and/or hazardous material releases and disposal sites classified under MA General Law Chapter 21E and the Massachusetts Contingency Plan (MCP). A review of this database was conducted to identify any listed sites that might have the potential to impact, or be affected by, the project. The database search area extended 4.5 miles north of the canal, 6-6.5 miles south of the canal, 2.5 miles east of the Sagamore Bridge, and 0.81 miles west of the Bourne Bridge. (EA Figure 22). Sites beyond these distances are unlikely to have potential to impact the project.

Results of the database search revealed only one listed site *Pairpoint Glassworks* abutting the Sagamore Bridge study area and a *CVS*, listed as an EPA/RCRA regulated hazardous waste generator, as the closest site to the Bourne Bridge (0.11 miles).

EA Figure 22 - Hazardous sites and groundwater study plumes in the study area



CERCLA: Proximity to USEPA Superfund Sites and Groundwater Contamination: The nearest Superfund Site, as regulated by the US EPA under CERCLA, listed in the National Priorities List (NPL) is Joint Base Cape Cod (JBCC) formerly known as the Massachusetts Military Reservation located approximately 1 mile southeast of the Bourne and 2 miles south of the Sagamore proposed bridge projects.

JBCC is located over a sole source aquifer that provides drinking water to 200,000 year-round and 500,000 seasonal residents of Cape Cod. Portions of the aquifer have been contaminated due to fuel spills, training exercises, improper disposal, and other past activities at JBCC's Camp Edwards and Otis Air National Guard Base. (EPA, 2019).

Perchlorate and RDX are the primary contaminants of concern at the JBCC Superfund site. The closest plume to the proposed bridges project area is 2.2 miles from edge of the Perchlorate plume and 1.7 miles from edge of closest RDX plume to the closest edge of Sagamore bridge study area; and 0.58 miles from edge of Perchlorate plume and 0.6 miles from edge of closest RDX plume to the closest edge of Bourne bridge study area (EA Figure 20). Ongoing remediation at the site is being addressed through both Federal and state actions.

Environmental Consequences

Alternative A – No Action, Alternative B – Major Rehabilitation for Both Bridges, , and Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

No project alternative will affect any listed hazardous waste sites. No contaminated soils or groundwater will be exposed as a result of proposed project alternatives including routine maintenance, major rehabilitation, or replacement, and none of these activities will be impacted by ongoing remediation at the JBCC Superfund site. The closest contaminated groundwater plume is located outside of the project area and would not be affected by the proposed project.

RCRA: Proper handling and disposal of hazardous waste

Handling, management, and disposal of any petroleum products, hazardous materials, and/or hazardous and solid waste will be in accordance with all applicable Federal, State, and Local regulations and compliance requirements.

Alternative A – No Action and Alternative B – Major Rehabilitation for Both Bridges

No project alternative will affect any listed hazardous waste sites. No contaminated soils or groundwater will be exposed as a result of proposed project alternatives including routine maintenance, major rehabilitation, or replacement, and none of these activities will be impacted by ongoing remediation at the JBCC Superfund site. The closest contaminated groundwater plume is located outside of the project area and would not be affected by the proposed project.

RCRA: Proper handling and disposal of hazardous waste

Handling, management, and disposal of any petroleum products, hazardous materials, and/or hazardous and solid waste will be in accordance with all applicable Federal, State, and Local regulations and compliance requirements.

Routine maintenance and emergency repairs as well as major rehabilitation may include the removal/sandblasting of lead containing paint from the Sagamore and Bourne Bridges. During the design and construction phase best management practices, construction specifications, and a waste disposal plan will be developed to ensure the proper handling and disposal of all hazardous and nonhazardous waste generated during the project. Waste generated

from abrasive blasting and lead-containing paints will be disposed of as a hazardous waste. All hazardous waste shall be transported by a licensed transporter. All nonhazardous waste will be transported in accordance with local regulations regarding waste transportation.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

During the construction phase of new bridges, protective measures will be taken to address all hazardous material potential impacts and will include appropriate work and construction specifications to protect worker health and safety, and to ensure proper handling and disposal of contaminated materials and demolition waste (lead-based paint).

6.6.10 Noise

Noise is unwanted sound. In a community, noise can originate from a variety of sources including transportation (automobiles, trucks, buses, trains, and aircraft), stationary sources (manufacturing facilities, HVAC systems, and utility operations), natural sources (animals, insects, and wind) and from people (talking and just going about their business). Environmental noise is composed of sounds from moving as well as stationary sources, and varies from place to place and from time to time. Land use in the general area of the bridges varies from mixed business, commercial, recreation and residential properties.

The EPA has developed federal noise-emission standards, identifying major sources of noise and determining appropriate noise levels for activities that would infringe on public health and welfare (EPA, 2009). The “Levels Document” is the standard reference in the field of environmental noise assessment. EPA identifies a 24-hour exposure level of 70 decibels (dB) as the level of environmental noise, which will prevent any measurable hearing loss over a lifetime. Levels of 55 dBs outdoors and 45 dBs indoors are identified as “preventing activity interference and annoyance”. U.S. Department of Transportation (USDOT) has established acceptable noise levels and ranges for construction equipment (USDOT, 2018).

The Noise Control Act of 1972 establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. The act establishes a means for effective coordination of federal research and activities in noise control, authorizes the establishment of federal noise emission standards for products distributed in commerce, and provides information to the public respecting the noise emission and noise reduction characteristics of these products. The act authorizes and directs that federal agencies, to the fullest extent consistent with their authority under federal laws administered by them, carry out the programs within their control in such a manner as to further the policy declared in the Act. Each department, agency, or instrumentality of the federal government having jurisdiction over any property or facility or engaged in any activity resulting, or which may result in, the emission of noise shall comply with federal, state, interstate, and local requirements respecting control and abatement of environmental noise.

Both the Bourne and Sagamore Bridges are located almost entirely within the town of Bourne. The project area includes transportation infrastructure, residential and commercial properties, and forested land (Refer to EA Figure 3 in Section 6.1.1) and "Land Use and Zoning” in Section

6.6.3.

The study area within Bourne's downtown is positioned roughly between the Cape Cod Canal Railroad Bridge and the Bourne Bridge on the northern (mainland) side of the canal (EA Figure 3). The downtown area is zoned for a variety of uses, including higher-density public works, landscaping, construction, and retail facilities. Other parts of the downtown area are zoned for natural resource protection. Much of the area abutting the Bourne Bridge is zoned for residential use or protected forest. Adjacent to the Sagamore Bridge is the South Sandwich Village Center (SSVC), which is home to 130 acres of retail, restaurant, entertainment, and professional office space. An adjacent 114-acre parcel owned by the Commonwealth serves as a protected wildlife habitat and the study area of this project also goes through areas zoned for residential and industrial use.

Replacement bridges would be constructed adjacent to the existing Bourne and Sagamore Bridges. The project area will be more clearly defined in Phase II of the project.

Environmental Consequences

MassDOT's *Cape Cod Canal Transportation Study* (2019) describes anticipated noise impacts in the proposed project area by using the worst-case existing and future traffic conditions (i.e. highest traffic volumes found during the summer Saturday peak period) to correlate to higher (i.e. worst case) noise impacts at noise sensitive locations (mostly residential neighborhoods). MassDOT modeled increases in the hourly sound level from the 2014 Existing to 2040 Build conditions were for all three peak hours. The range of increases and the peak hour with the highest increase were reported for the areas near residential land use. For reference, a sound level increase of three decibels or less is generally not noticeable under most circumstances. An increase of five dB is generally noticeable in a community setting. An increase of 10 dB is perceived by most people as about twice as loud. Also, MassDOT' s Noise Policy considers an increase of 10 dB or more above existing noise levels to be a "substantial increase" that would require consideration of abatement in a final environmental document (MassDOT, 2019).

They determined predicted sound level increases would be small for most roadways, generally less than three decibels, which is expected to be generally not noticeable Changes in traffic patterns at some locations could result in increases up to six decibels. 'These are expected to be readily noticeable, but not approach a 'substantial increase' per MassDOT policy (MassDOT, 2019).

Alternative A – No Action

Under the No Action Alternative, there would be no change in ambient noise levels associated with routine bridge maintenance. Noise levels resulting from existing traffic or from surrounding land use activities would remain the same.

Alternative B – Major Rehabilitation for Both Bridges

Major Rehabilitation would generate noise from repairs, equipment, and any needed construction-related activities. Mitigation would be accomplished by complying with conditions in construction permits or town ordinances to address short term increases in noise. Therefore,

there would be only minor impacts to noise under the Major Rehabilitation alternative.

Additionally, this project alternative would have no effect on federally listed species, except for the Northern Long-Eared Bat (NLEB) which may roost under the bridges. The USACE will consult with USFWS pursuant to Section 7 of the Endangered Species Act (ESA) to determine if NLEB are present and identify measures necessary to minimize potential noise impacts to this species in Phase II of the project. Please reference the Threatened and Endangered Species (Section 6.4.4 of this document for a discussion of potential impacts and consultation status regarding NLEB.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Estimated noise levels associated with construction and demolition activities will be calculated during Phase II of the project when specific construction methods, type of equipment, number of construction vehicles, duration of construction activities, hours of operation etc. have been identified. Mitigation measures will include complying with any conditions in construction permits or town ordinances. The project would have no effect on federally listed species, except for NLEB which may roost under the bridges. The USACE will consult with FWS pursuant to Section 7 of the Endangered Species Act (ESA) to determine if NLEB are present and identify measures necessary to minimize potential noise impacts to this species.

Underwater Anthropogenic (human made) Noise:

Underwater anthropogenic (human made) noise will likely be generated during some construction and demolition activities. Underwater anthropogenic (human-made) sounds, existing and predicted underwater noise levels, and their effect on aquatic species are addressed under EFH Section 6.4.3.

Alternative A – No Action

Routine bridge maintenance and emergency repairs would not involve any activities that would generate underwater noise levels. There would be no substantial acoustic impacts on aquatic species because all work would occur outside of the Canal. Therefore, there would be no anticipated impacts under the No Action Alternative.

Alternative B – Major Rehabilitation for Both Bridges

The use of construction barges in the Canal to support major rehabilitation may be necessary. Such barges are equipped with spuds that are driven into the sediment to stabilize the vessel. Specific details on the barges, the length of time they would be utilized, and the size and depth of the spuds will be defined in Phase II when the specific construction needs for major rehabilitation are established. In-water work or elevated noise levels in the water due to construction may have minimal temporary impacts on EFH species, and coordination would need to be undertaken with NMFS pursuant to the MSA.

Alternative D (Preferred Alternative) – Replacement of Both Highway Bridges with New Bridges - 4 Lanes and 2 Auxiliary Lanes

Underwater work related to the removal of existing bridge piers may affect EFH or fish species.

The USACE proposes to move the existing bridge piers from the water to the Canal shoreline, thus removing those structures as habitat. Replacement would also require in-water barges to hold support cranes. The needed dimensions of these barges are unclear at this time and will be defined in Phase II during consultation with NMFS. Preliminary estimates indicate barge-supported cranes would be required for approximately 8 months (two months for construction and two months for demolition for each bridge). However, the small size of the project area will not substantially affect the highly mobile EFH species or their habitat, and the Canal is expected to remain a highly productive ecosystem because of the connectivity with Cape Cod and Buzzards Bay. A construction supporting barge would not cause adverse shading on benthic communities due to the small size of this structure compared to the larger width and depth of the Canal. The exact dimensions of construction barges are dependent on specific project requirements, which are not yet known and will be defined in Phase II. The impact area associated with its spuds on prey resources and benthic habitat is also minimal, given the size and frequently dredged habitat of the Canal. Potential noise impacts from the project on fisheries and marine wildlife will be evaluated in Phase II of the project in consultation with NMFS, using their Technical Guidance for Assessing the Impacts of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0).

In-water work or elevated noise levels in the water due to construction and demolition may have minimal temporary impacts on EFH species. The USACE will ensure these resources are considered through consultation with NMFS at the design and construction phase of this project pursuant to the MSA. Please reference the Threatened and Endangered Species (Section 6.4.4) and Essential Fish Habitat (Section 6.4.3) sections of this document for discussion on noise-related impacts and consultation.

6.7 Summary of Effects

EA Table 25 - Project Alternatives: Summary of Potential Effect, Coordination and Mitigation

Affected Environment/ Resource Area	Alternative A - No Action	Alternative B - Major Rehabilitation	Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes	Best Management Practices (BMPs)/Mitigation Measures to Be Applied
Land Use	Negligible	Negligible	Minor	Mitigation for land use changes will be developed in Phase II when bridge designs are developed

Terrain and Topography	Negligible	Negligible	Minor	Standard construction industry BMPs
Geology/Soils	Negligible	Negligible	Negligible	Standard construction industry BMPs
Climate	Negligible	Negligible	Negligible	Required emissions controls and construction BMPs
Affected Environment/ Resource Area	**Alternative A - No Action**	**Alternative B - Major Rehabilitation**	**Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes**	**Best Management Practices (BMPs)/Mitigation Measures to Be Applied**
Sea Level Change	Negligible	Negligible	Negligible	
Air Quality	Minor	Minor	Minor	Short-term, minor impacts to air quality are anticipated during the construction phase. Required emissions controls and construction BMPs
Water Quality	Negligible	Negligible	Negligible	Standard construction industry BMPs
Surface Water	Negligible	Negligible	Moderate	Standard construction industry BMPs

Wetlands	Negligible	Negligible	Moderate	Mitigation measures would be developed to address any wetland impacts Please refer to Section 6.2.1 for a discussion of wetland impacts
Groundwater	Negligible	Negligible	Negligible	Standard construction industry BMPs. Full evaluation of impacts will
Affected Environment/ Resource Area	**Alternative A - No Action**	**Alternative B - Major Rehabilitation**	**Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes**	**Best Management Practices (BMPs)/Mitigation Measures to Be Applied**
				take place in Phase II.
Floodplain	Negligible	Negligible	Negligible	
Coastal Resources	Negligible	Negligible	Negligible	
Vegetation	Negligible	Negligible	Moderate	Construction BMPs will be developed when bridge designs are available

Wildlife	Negligible	Negligible	Minor	Measures to avoid, minimize, or mitigate wildlife impacts will be developed in Phase II in consultation with resource agencies. Please refer to Section 6.4 on Biological Resources for a discussion of wildlife impacts and agency consultation.
Affected Environment/ Resource Area	**Alternative A - No Action**	**Alternative B - Major Rehabilitation**	**Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes**	**Best Management Practices (BMPs)/Mitigation Measures to Be Applied**
Fisheries	Negligible	Negligible	Minor	Measures to avoid, minimize, or mitigate fisheries impacts will be developed in Phase II in consultation with resource agencies. Please refer to section 6.4 on biological resources for a discussion of fisheries impacts.

Essential Fish Habitat	Negligible	Negligible	Minor	EFH consultation will occur in Phase II. Please refer to Section 6.4 on biological resources for a discussion of EFH impacts.
Affected Environment/ Resource Area	**Alternative A - No Action**	**Alternative B - Major Rehabilitation**	**Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes**	**Best Management Practices (BMPs)/Mitigation Measures to Be Applied**
Threatened and Endangered Species	Negligible	Negligible	Minor	Consultation with the Services will determine BMPs and/or mitigation measures. Bat survey will occur prior to construction. Please see Section 6.4.4 for a discussion of T&E consultation status.
Historic and Cultural Resources	Negligible	Negligible	Moderate	Continued coordination with MA SHPO and tribes and development of a Memorandum of Agreement
Demographics	Minor	Minor	Minor	
Community Economics	Minor	Minor	Minor	
Water Quality	Negligible	Negligible	Negligible	

Recreation	Minor	Minor	Minor	
Public Utilities	Negligible	Minor	Moderate	
Public Health and Safety	Moderate	Moderate	Minor	
Affected Environment/ Resource Area	**Alternative A - No Action**	**Alternative B - Major Rehabilitation**	**Alternative D - Preferred Alternative - Bridge Replacement with Auxiliary Lanes**	**Best Management Practices (BMPs)/Mitigation Measures to Be Applied**
Hazardous Materials	Minor	Minor	Minor	Any hazardous materials/waste generated during construction will be handled and disposed of in accordance with all applicable Federal and State regulations and local ordinances
Noise	Negligible	Minor	Minor	Complying with conditions in construction permits or town ordinances to address short term increase in noise from construction and demolition activities
Traffic	Moderate	Moderate	Minor	
Environmental Justice	Negligible	Negligible	Negligible	

7.0 INDIRECT EFFECTS AND CUMULATIVE IMPACTS

CEQ's NEPA implementing regulations require federal agencies to consider the potential for indirect effects and cumulative impacts from a proposed project (40 CFR §1508.7, 1508.8). The MRER and accompanying EA evaluates the direct, indirect, and cumulative effects of major rehabilitation or replacement of the Bourne and Sagamore bridges over the Canal and to analyze alternatives to either repair or replace the existing bridges.

Indirect effects are defined as those that are caused by an action, and are later in time or farther removed in distance, but are still reasonably foreseeable. These effects can include inducing changes in patterns of land use, population density or growth rate as well as other related effects on air, water, and other natural ecosystems.

The National Cooperative Highway Research program identifies the following types of transportation projects that might result in indirect effects to a project area: construction of a new highway, highway extensions, bridges to currently undeveloped areas, new highway bypasses around congested downtowns, new or expanded airports and harbors, new rail transit, new interstate highways, or new interchanges in undeveloped or rural locations (NCHRP, 2002).

CEQ defines "cumulative impact" as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." (40 C.F.R. § 1508.7). The assessment of cumulative effects in this EA addresses the potential impacts from the project and other projects proposed within, or in the vicinity of the Cape Cod Canal bridges study area.

The Cape Cod Canal bridges have been in place since the 1930s. Past and present activities at the Cape Cod Canal include maintenance of the Federal navigation channel and routine maintenance of the Bourne and Sagamore bridges. Reasonably foreseeable future actions include the continuation of current maintenance and navigation activities as well as connected bridge approach road work required by MassDOT to connect new replacement bridges to existing roadways. MassDOT's conceptual projects described in their *Cape Cod Canal Transportation Study* (2019) and their potential for cumulative impacts to area resources will be discussed in the following sections.

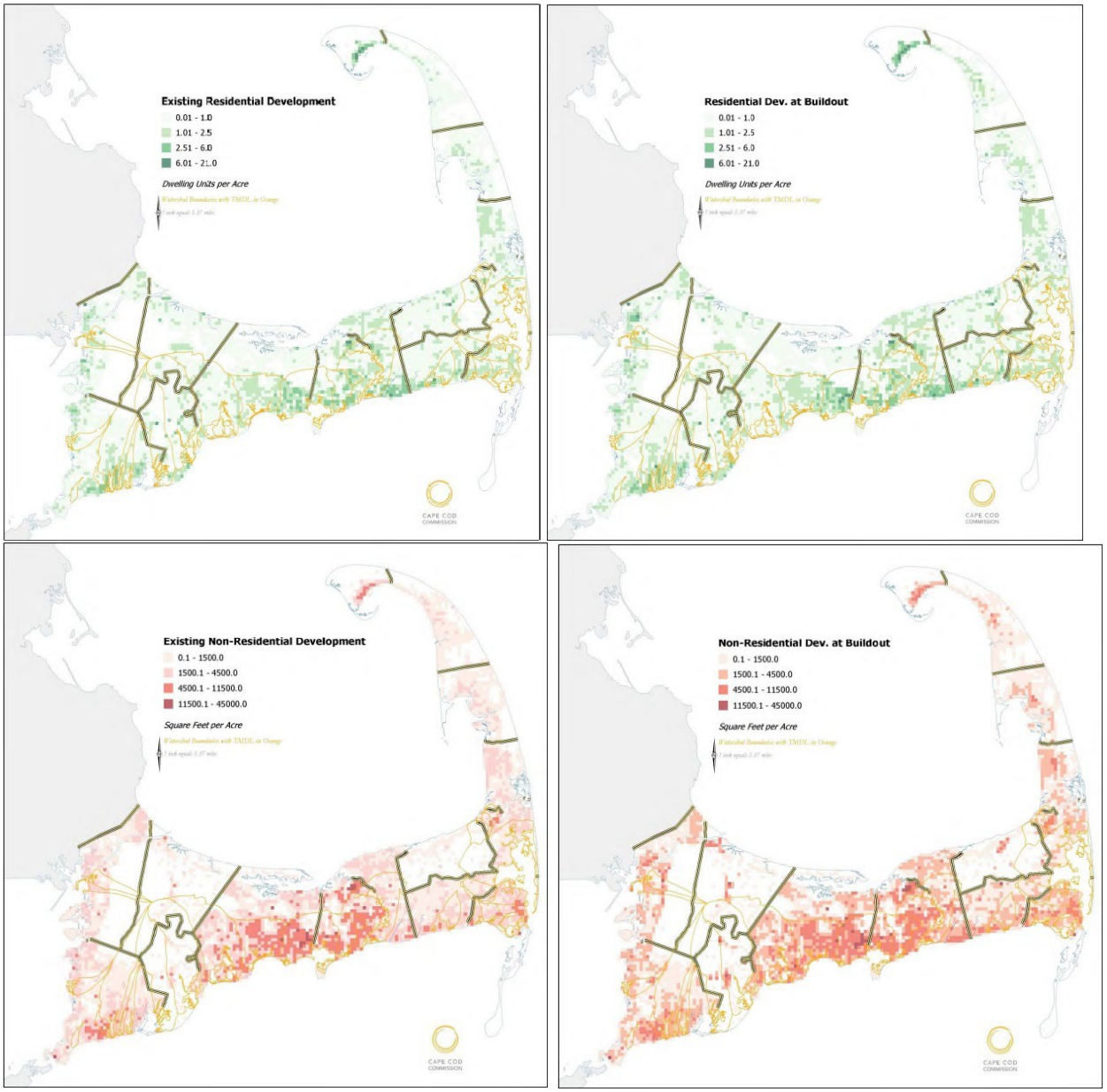
7.1 Induced Development

7.1.1 Development Potential

In 2012, the Cape Cod Commission completed a Cape-wide buildout analysis during development of a regional wastewater management plan for Cape Cod in order to quantify the growth potential in the region and determine the spatial distribution of this future growth. This study included a density analysis of existing and potential future development. The results (shown in the figures and table below) indicated that a total of 27,842 additional residential units (dwelling units/acre) and 32,042,693 square feet (s.f.) of additional non-residential area was

available for development. In 2017, the University of Massachusetts Donahue Institute conducted a 10-year forecast as part of an independent market housing analysis and estimated potential future demand for an additional 26,000 residential units in Cape Cod. Therefore near capacity residential housing is expected without any bridge improvement projects.

EA Figure 23 - Cape Cod Residential and Nonresidential Development



EA Table 26 – Cape Cod Buildouts by Town

	Existing dwellings (All Land Use Codes)	Additional Dwellings (All Land Use Codes)	% change	Existing Non-residential sf. (Land Use Codes 013, 031, 300-999)	Additional non-residential sf. (Land use Codes 013, 031, 300-999)	% change
Barnstable	25,167	4,296	17	19,442,037	4,577,937	24
Bourne	9,587	2,524	26	3,977,036	4,743,325	119
Brewster	7,440	1,661	22	1,092,877	1,184,883	108
Chatham	6,729	904	13	3,203,061	857,329	27
Dennis	14,816	1,185	8	3,021,445	3,313,741	110
Eastham	5,930	565	10	709,739	1,062,236	150
Falmouth	20,940	3,774	18	7,728,402	2,955,858	38
Harwich	10,038	2,063	21	1,993,037	1,062,282	53
Mashpee	9,687	1,559	16	2,406,349	3,922,966	163
Orleans	5,049	778	15	1,924,894	1,579,296	82
Provincetown	4,306	1,325	31	1,561,678	125,475	8
Sandwich	9,258	2,492	27	1,959,446	3,122,267	159
Truro	2,941	1,697	58	457,248	533,608	117
Wellfleet	3,958	1,463	37	583,288	794,772	136
Yarmouth	16,307	1,556	10	9,863,508	2,206,716	22
Total	**152,153**	**27,842**	**18**	**59,924,044**	**32,042,693**	**53**

Source: Cape Cod Commission

In a recent Cape Cod Commission Memorandum to the USACE the Commission explained that they are a regional land use planning and regulatory agency created by the state legislature in 1990 and that through their regulatory program, the Commission reviews projects that present

regional issues identified in the Act as Developments of Regional Impact (DRI). The Commission's regulatory review supplements local authority throughout the 15 towns of Barnstable County. Towns refer projects to the Commission for DRI review to seek Commission consideration of specific project-related impacts. Similar to other municipalities in Massachusetts, development on Cape Cod is also subject to local zoning and other regulations or town bylaws that control buildout/development on the Cape, as well as areas regulated at the state or regional level where growth may be limited (April, 2019).

As there is existing Cape Cod Commission review of proposed development projects, as well as zoning regulations or other town bylaws in place that control build out/development on the Cape, bridge rehabilitation or replacement will not affect any future development.

7.1.2 Traffic modeling

Current traffic model outputs show the current (2014) and future (2040) average speed over 13 segments of road with the existing two-lane bridges and with new two-lane bridges with an auxiliary acceleration/deceleration lane that accommodates on/off ramps (EA Table 27)[4]. The traffic model only shows a difference in average travel time over the new versus existing bridges during the weekend summer mid-day time period (change in speed spreadsheet). An increase in speed of 2 miles per hour decreases the average travel time over the average route length by less than 20 seconds[5] (note, potential road improvements made by MassDOT are not included in this analysis). This change in accessibility would translate to no or weak potential for land use change according to the matrix provided by the Oregon Department of Transportation.

It is important to note that this analysis does not include any proposed changes to road infrastructure by MassDOT. The Sagamore and Bourne bridges are not the only source of bottleneck traffic. The current network of roads around the bridges and throughout the Cape limit ease of traffic flow. Replacement bridges will not have a significant impact on alleviating traffic problems without improvements of roadways throughout the Cape.

[4] Note that these changes do not take new approaches into account. This traffic model does not incorporate land use change projections, or potential changes in travel demand, but it does incorporate future population projections.

[5] 32 miles/hr X 1/60 hr/min=0.53 miles/min

2.74 miles X 1/0.53 min/mile = 5.17 min

30 miles/hr X 1/60 hr/min=0.5 miles/min

2.74 miles X 1/0.5 min/mile = 5.48 min

5.48-5.17=.31 (so < 1/3 of a minute

EA Table 27 - Average speed over 13 segments of road with existing and new bridges during weekdays (WD) and weekends (WE) in fall, summer and winter seasons

	Average Speed (mph)					
	Fall WD	Fall WE	Summ WD	Summ WE	Wint WD	Wint WE
Existing (2014)	45	45	44	34	45	47
New Bridges (2014)	45	46	45	36	45	47
Difference	0	0	0	2	0	0
Existing (2040)	45	44	42	30	46	47
New Bridges (2040)	45	44	42	32	46	47
Difference	0	0	0	2	0	0

*Notes: The average length of routes analyzed is 2.74 miles.

Even if there are substantial reductions in travel time due to improvements to the bridges, it may not improve accessibility once on the Cape. A Cape Cod Metropolitan Planning Organization report (CCMPO, 2015) shows that there has been consistent growth in traffic throughout the Cape. Because roads throughout Cape Cod "are restricted in route options, profile, and capacity" (Commonwealth of Massachusetts 2016, p. 3) and "taxed or failing at present" (p 81, The Chesapeake Group, 2013) there are problems managing current traffic conditions throughout the Cape. The Regional Transportation Plan Survey, conducted in 2015, asked respondents to identify problem locations for transportation on the Cape (CCMPO, 2015). The below figure shows that survey respondents identified congestion issues throughout the Cape, not just along the canal. In addition, a Cape Cod Regional Transportation Plan (compiled by the Cape Cod Commission and voted on by the Cape Cod Metropolitan Planning Organization), identifies improvements to Route 28 in Hyannis as one of its highest priorities. Traffic congestion improvements resulting from bridge replacement will not resolve the traffic issues associated with the limited capacity of the current road system. Because bridge replacement will not address traffic and congestion issues on the Cape's interior roadways, visitors will still encounter high traffic volume on the Cape. Therefore, it is not likely that bridge replacement will substantially improve access to the Cape and subsequently increase the number of visitors and associated development.[6]

[6] Many residents feel that there is already too much congestion and development, and do not want to further develop road infrastructure to limit development on the Cape (Cape Cod Business Climate Survey page 15 of pdf)

EA Figure 24 - Traffic Congestion Areas on the Cape

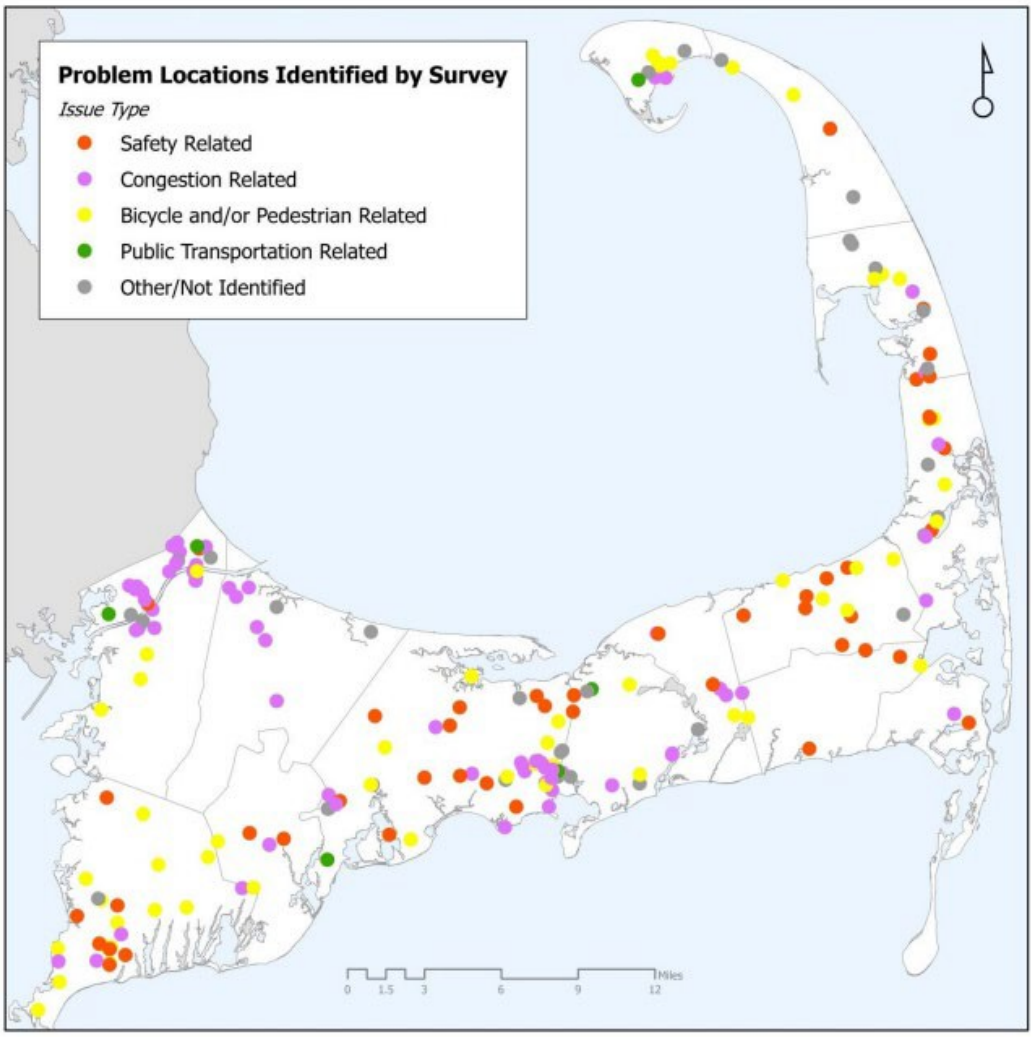


FIGURE 4. RTP SURVEY RESULTS - PROBLEM LOCATIONS IDENTIFIED

From: The Cape Cod Regional Transportation Plan (CCMPO 2015)

7.1.3 Population models and forecasted growth

Since 2000, population growth slightly decreased in Barnstable County (US Census). These population dynamics are largely attributed to a large influx of baby boomers retiring to the region, the subsequent increase in death rates due to an ageing population, and younger populations leaving the region to pursue employment and educational opportunities (Cape Cod Commission 2017, Renski et al. 2015). Retail, recreation, accommodation and food services make up more than 25% of Barnstable County's employment compared with less than 20% of employment across MA (Bureau of Labor Statistics). Employment is also highly seasonal.

Employment opportunities are relatively limited on the Cape, in addition, housing and the cost of living is higher.

The 2010 US Census reports 215,888 individuals living in Barnstable County (222,230 in 2000). While some projections estimate an overall reduction in population on Cape Cod (Renski et al. 2015), others estimate an increase in population. Moody's analytics (2016) projects that economic growth in the area (unrelated to the bridge improvements) will stimulate in-migration resulting in an increase of 9,612 people to Barnstable County between 2015 and 2025; Crane Associates similarly projects a more conservative increase in population of 6,199 people (Crane Associates Team, 2017). Even using the more conservative increase in population, the total population change is less than 5% over the ten year period. According to the ECONorthwest & Portland State University matrix (2001), an average annual growth rate of less than 1% per year is considered to have little to no potential for land use change in the study area.

EA Table 28 - Cape Cod Summer Traffic Growth by Subregion

Region*	Number of Comparisons**	10-Year Total Growth (%)	10-Year Annual Average Growth Rate (%)	One-Year Growth Rate 2016-2017 (%)
Upper Cape	167	4.98	0.48	0.64
Mid-Cape	146	2.40	0.23	4.15
Lower Cape	118	1.38	0.13	-1.66
Outer Cape	83	7.88	0.76	0.87
All Roads	514	3.80	0.37	1.28

*Upper = Bourne, Sandwich, Falmouth, Mashpee | Mid = Barnstable, Yarmouth, Dennis
Lower = Harwich, Chatham, Brewster, Orleans | Outer = Eastham, Wellfleet, Truro, Provincetown

** Corresponds to ten-year analysis only

The bridge rehabilitation or replacement projects are not expected to lead to significant induced development and will not result in localized or regional indirect effects for the following reasons:

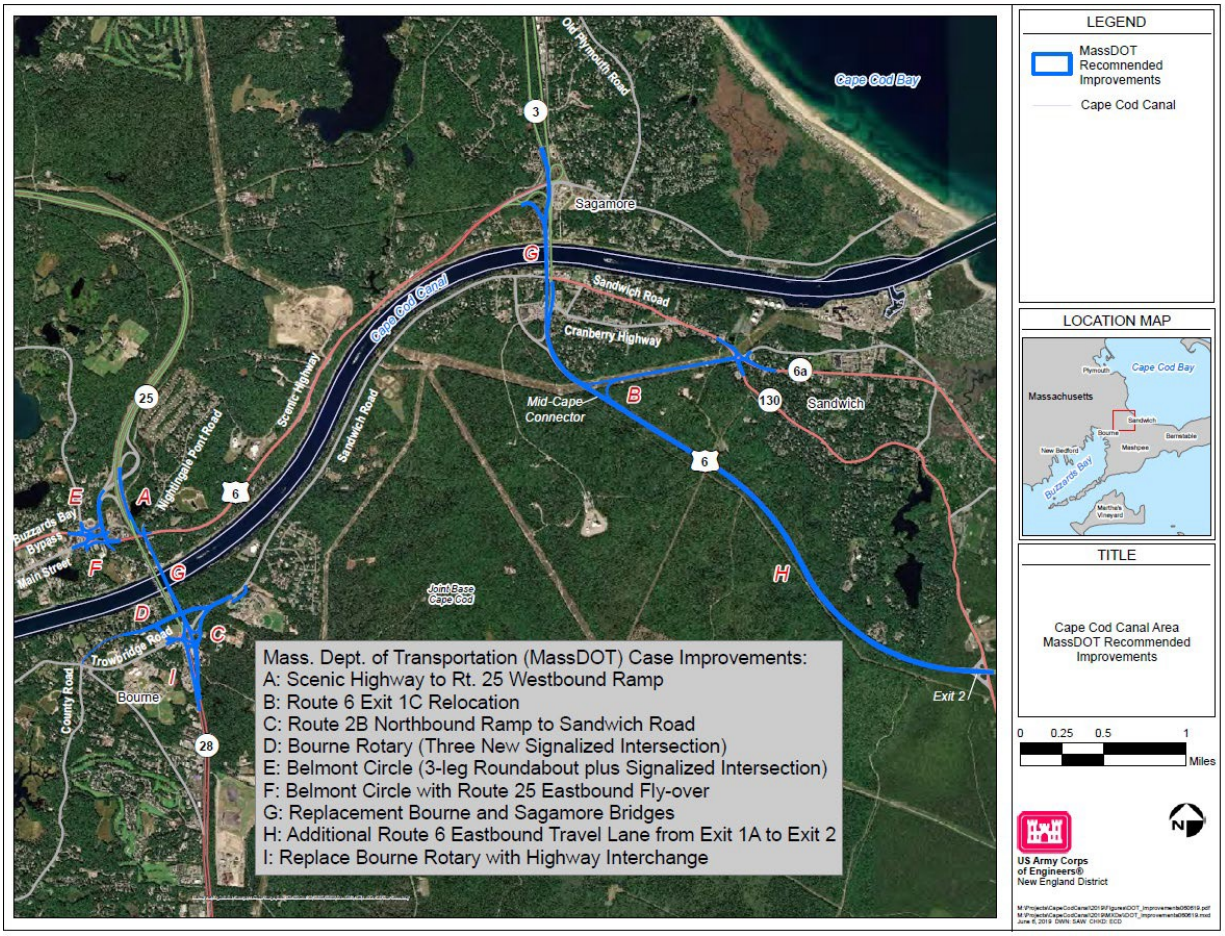
- There is not a lot of available developable land and with expected growth already anticipated without bridge projects, the available developable land will be even more limited. Near capacity residential housing is already expected without improved bridges and therefore further opportunities for development are limited.
- Employment opportunities are limited, and housing is relatively expensive compared to the state average, therefore younger populations tend to move off-Cape. Even with improved bridges the Cape's population dynamics would not change.
- The availability of seasonal and vacation housing (e.g. hotels) has a greater effect on the number of people visiting the Cape than any access limitations created by the Sagamore and Bourne bridges.
- The existing road infrastructure on the Cape has numerous transportation bottlenecks that would limit the effects of bridge replacement on future growth and development.

7.2 Cumulative Impacts

The MA Department of Transportation (MassDOT) completed a *Cape Cod Canal Transportation Study* in May 2019. The purpose of this regional "conceptual planning study" was to "evaluate existing and future transportation safety and congestion deficiencies in the Cape Cod Canal Study Area" and included the development and analysis of the following multimodal transportation alternatives (EA Figure 25):

(1) Scenic Highway to Rte. 25 Westbound On-Ramp
(2) Rte. 6 Exit 1C Relocation
(3) Rte. 28 Northbound Ramp to Sandwich Road
(4) Bourne Rotary (Three New Signalized Intersections)
(5) Belmont Circle (3 Leg Roundabout plus Signalized Intersection)
(6) Belmont Circle with Rte. 25 Eastbound Fly-over
(7) Replacement Bridges (Bourne and Sagamore) – 2 travel lanes with auxiliary lane in each direction
(8) Additional Rte. Eastbound Travel lane from Exit 1A to Exit 2 (3 total lanes)
(9) Bourne Rotary with Highway Interchange

EA Figure 25 - MassDOT Conceptual Improvement Projects



The MassDOT Alternatives are based on the assumption that the USACE will replace both the Bourne and Sagamore bridges. The section below examines only those conceptual MassDOT projects that could potentially be linked to the replacement of the Bourne and Sagamore bridges. MassDOT alternatives descriptions text below is taken from the Cape Cod Canal Transportation Study (2019) and is supplemented with USACE GIS analysis. A summary of potential impacts table is provided for each of these alternatives.

7.2.1 Bourne Rotary Alternatives

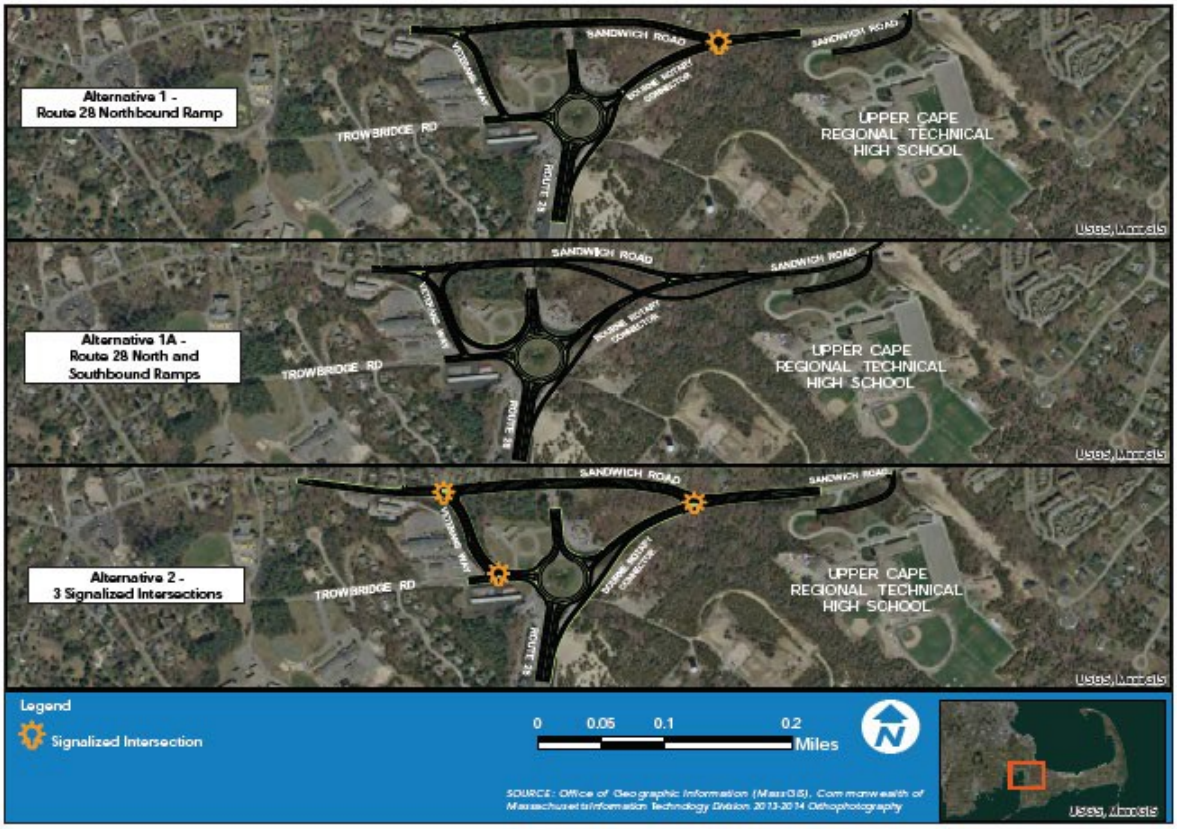
The Bourne Rotary is immediately south of the Bourne Bridge. The roadway approaches to the Bourne Rotary include Route 28 (on both the north and south sides of the Rotary), Trowbridge Road, and the Bourne Rotary Connector. Sandwich Road provides a roadway connection north of the rotary between Trowbridge Road (via Veterans Way) and the Bourne Rotary Connector. MADOT evaluated several alternatives to improve traffic operations at the Bourne Rotary. They include Route 28 Northbound Ramp (1); Route 28 Northbound and Southbound Ramp with

Sandwich Road Underpass (1A); and Three Signalized Intersections (2) (EA Figure 26, below). These alternatives were conceived to be compatible with the existing Bourne Bridge as well as with the vertical and horizontal alignment of an assumed replacement of the Bourne Bridge. Each of these alternatives assumes that the local intersection improvements at the Sandwich Road at the Bourne Rotary Connector are completed.

As shown on EA Table 29, none of the three alternatives evaluated for the reconstruction of the Bourne Rotary would impact wetland resources, 100-year floodplain, or rare species habitat. Alternative 1A would require the acquisition of approximately one acre of land from the Town of Bourne. All alternatives may require minor property acquisitions from the USACE and adjacent residential and commercial properties.

The Route 28 ramp may require a minor property acquisition from the Massachusetts State Police barracks.

EA Figure 26 - MassDOT Alternatives Evaluated – Bourne Rotary



EA Table 29 - Bourne Rotary - Environmental Impact by Alternative

	Alternative 1	Alternative 1A	Alternative 2
Resource Area (ac):			
NHESP Rare Species Habitat	0	0	0
NWI Wetlands	0	0	0
100-year Floodplain	0	0	0
IWPA (Interim Wellhead Protection Area)	0	0	0

7.2.2 Bourne Rotary with Highway Interchange

A larger-scale alternative to improve traffic operations at the Bourne Rotary was evaluated. This alternative involves the reconstruction of the Bourne Rotary as a highway interchange (EA Figure 27). This alternative assumes the prior intersection improvements at Bourne Rotary (Alternative 2 – Three Signalized Intersections – discussed above) are already in place. This alternative was conceived to be constructed concurrent with an assumed replacement of the Bourne Bridge, with an alignment immediately east of the existing bridge.

The reconstruction of the Bourne Rotary as a highway interchange intersection involves the removal of the Rotary and the construction of a grade-separated highway ramp system allowing vehicles to enter Route 28 (northbound or southbound) directly from Sandwich Road (via the Bourne Rotary Connector) or Trowbridge Road. Local traffic would pass directly over Route 28 on an overpass. The grade-separated interchange would remove the numerous conflict points that currently exist at the Rotary, substantially reducing queuing and crash rates.

As shown on EA Table 30, the Bourne Rotary Interchange alternative would not impact wetland resources, 100-year floodplains or land owned by the Town of Bourne. This alternative may impact a minor amount of rare species habitat (0.2 acres). The interchange alternative would require the acquisition of approximately 0.4 acres of land from the USACE and 0.3 acres of residential property. The interchange would also require approximately 2.2 acres of commercial land east of the Rotary.

EA Figure 27 - MassDOT Bourne Rotary Interchange

EA Table 30 - Bourne Rotary with Highway Interchange - Environmental Impact

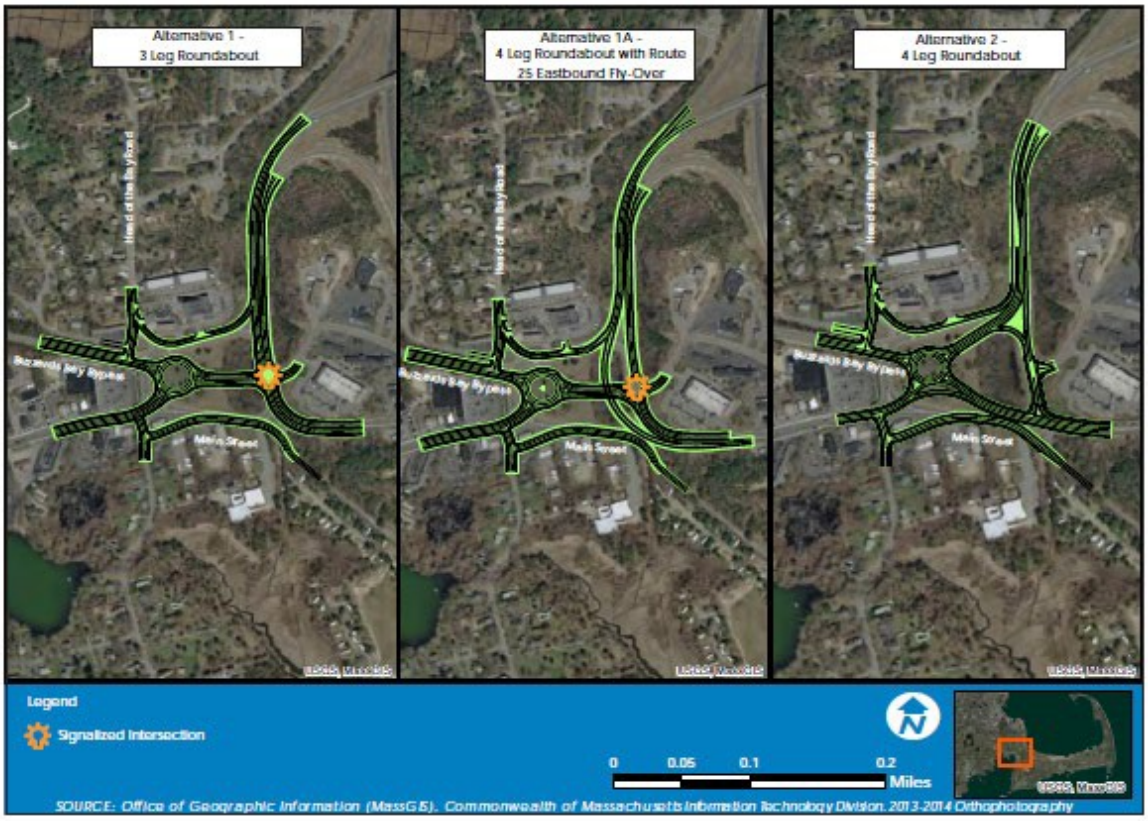
	Alternative 1
Resource Area (ac):	
NHESP Rare Species Habitat	0.2
NWI Wetlands	0
100-year Floodplain	0
IWPA (Interim Wellhead Protection Area)	0

7.2.3 Belmont Circle

Belmont Circle is the intersection of Route 25, Main Street, Scenic Highway, and the Buzzards Bay Bypass. Bourne Rotary processes vehicles from Route 28, Sandwich Road, and Trowbridge Road. Several alternatives were evaluated to improve traffic operations at Belmont Circle. All include the new Entrance Ramp, Scenic Highway Westbound to Route 25 Westbound project. Alternatives include: Three-Leg Roundabout with Signalized Intersection (1), Three-Leg Roundabout with Signalized Intersection and Flyover Ramp (1A), and Four-Leg Roundabout (2)(EA Figure 28, below).

A Route 25 westbound entrance ramp from Scenic Highway would result in approximately 0.2 acres of impact to land within an interim wellhead protection area. No wetland, floodplain, or rare species habitat areas would be impacted (EA Table 31). This ramp would be partially within an area containing natural gas lines, requiring close coordination with the utility company to determine if relocation of these gas lines would be necessary. Each of the three alternatives for the reconstruction of Belmont Circle would impact wetland resources and 100-year floodplain, as shown in EA Figure 28. Open space and residential and commercial property acquisitions may also be required.

EA Figure 28 – MassDOT Alternatives Evaluated – Belmont Circle



EA Table 31 - Belmont Circle Reconstruction - Environmental Impact by Alternative

	Scenic Hwy to Rte. 25 WB Ramp	Alternative 1	Alternative 1A	Alternative 2
Resource Area (ac):				
NHESP Rare Species Habitat	0	0	0	0
NWI Wetlands	0	0.4	0.7	0.1
100-year Floodplain	0	4.7	5.4	4.6
IWPA (Interim Wellhead Protection Area)	0.2	0.5	0.5	0.4

7.2.4 Route 6 Exit 1C Relocation

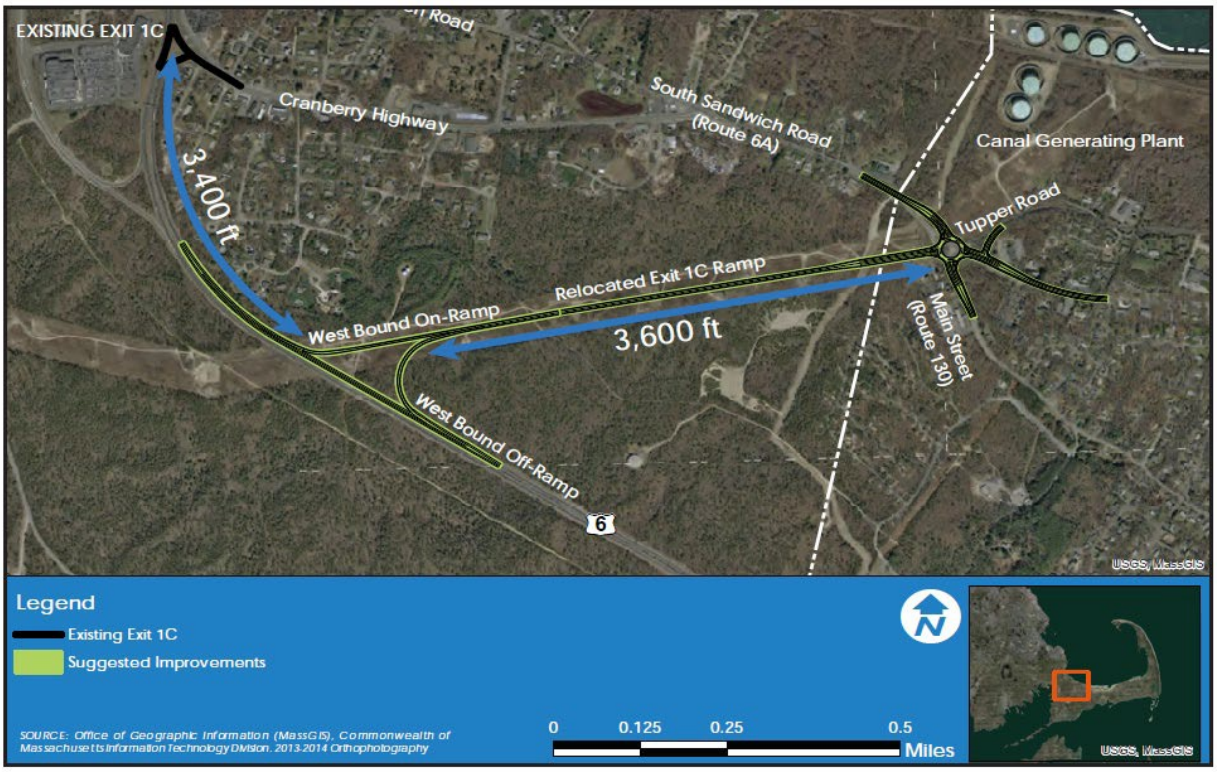
Route 6 at Exit 1C (at Cranberry Highway) provides an exit and entrance on Route 6 for westbound vehicles only (EA Figure 28). Exit 1C is the last westbound interchange on Route 6 prior to crossing the Cape Cod Canal on the Sagamore Bridge. The geometry of Exit 1C is substandard and not in compliance with current MassDOT highway design standards. The deficiencies of Exit 1C include short acceleration and deceleration lanes, and steep grades approaching the Sagamore Bridge.

The following presents the evaluation of the relocation of Route 6 Exit 1C from its existing location at the base of the south end of the Sagamore Bridge to a point further east on Route 6.

Land uses around Exit 1C include residential properties east of Route 6 and a retail shopping plaza (including a Market Basket grocery store) on the west side of Route 6. Land uses along Cranberry Highway include the Christmas Tree Shops retail store, and mix of residential, retail, restaurant, and auto-related shops. Further east, Joint Base Cape Cod abuts the west side of Route 6 from the Mid-Cape Connector interchange to Exit 2. Land use east of Route 6 includes residential neighborhoods and the Shawme-Crowell State Forest (which extends nearly to Exit 2). An electrical utility corridor divides the state forest and extends 3,600 feet from Route 6 to the Route 6A at Route 130 intersection, continuing northeast approximately 3,300 feet to the Canal Electrical Generating Plant.

No wetland, floodplain, or other regulated water resources would be impacted by the Route 6 Exit 1C Relocation. The land within JBCC, the Shawme Crowell State Forest, and the utility corridor is designated by the Massachusetts Natural Heritage and Endangered Species Program as a 'Priority Habitat for Rare Species' (EA Figure 29). These improvements would impact approximately 7.2 acres of land designated as a 'Priority Habitat for Rare Species'. The federally-listed species known to occur in the study area include the piping plover, roseate tern, and red knot (all bird species), the red bellied cooter turtle, the sandplain gerardia (flower), the northeastern red tiger beetle, and the northern long-eared bat.

EA Figure 29 - MassDOT Route 6 Exit 1C Relocation



EA Table 32 - Route 6 Exit 1C Relocation - Environmental Impact

	Alternative 1
Resource Area (ac):	
NHESP Rare Species Habitat	7.2
NWI Wetlands	0
100-year Floodplain	0
IWPA (Interim Wellhead Protection Area)	0

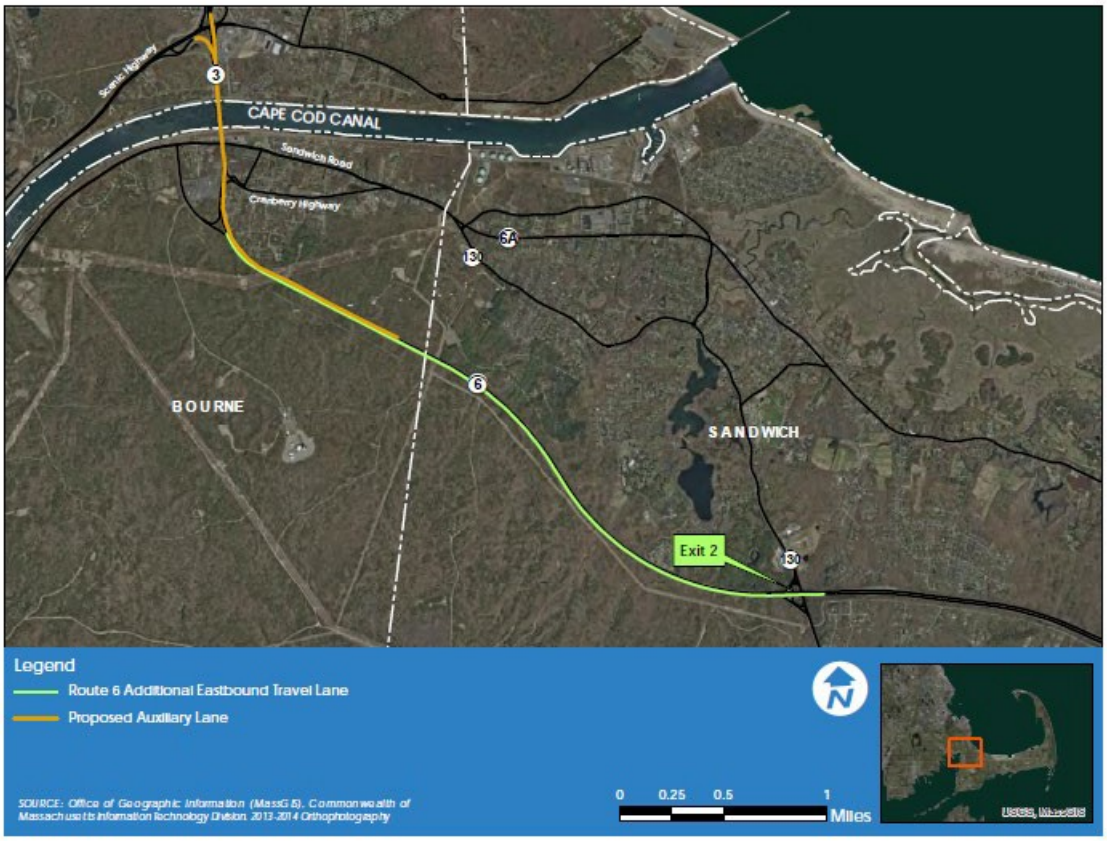
7.2.5 Route 6 Additional Eastbound Travel Lane

Land uses in the area include approximately 100 residential properties east of Route 6, with access to Cranberry Highway at Exit 1C (EA Figure 30). Other than a utility corridor and a small residential development south of Shawme Lake, land uses adjacent to Route 6 for the remainder of the corridor consist of undeveloped forest within Joint Base Cape Cod west of Route 6 and the Shawme-Crowell State Forest east of Route 6.

There are no wetlands, floodplains, or other regulated wetland resources within 100 feet of the Route 6 corridor. The forested land within Joint Base Cape Cod and the Shawme-Crowell State Forest is designated by the Massachusetts Natural Heritage and Endangered Species Program as

a ‘Priority Habitat for Rare Species’. The work may impact up to 3.9 acres of rare species habitat. No other regulated environmental resources, such as wetlands or floodplains, would be impacted. These improvements could be constructed entirely within the MassDOT right-of-way, with no property acquisitions required.

EA Figure 30 - MassDOT Route 6 – Additional Eastbound Travel Lane and Westbound Auxiliary Lane



EA Table 33 - Route 6 Additional Eastbound Travel Lane - Environmental Impact

	Alternative 1
Resource Area (ac):	
NHESP Rare Species Habitat	3.9
NWI Wetlands	0
100-year Floodplain	0
IWPA (Interim Wellhead Protection Area)	0

7.2.6 Total Cumulative Impacts

If implemented, the MassDOT options outlined above using Alternative 1 scenarios only would have 4.7 acres of impact to the 100-year floodplain, 0.4 acres of impact to NWI Wetlands, 11.3 acres of impact to NHESP Rare Species Habitat, and 0.7 acres of impact to Interim Wellhead Protection Areas (IWPA). Impacts would primarily result due to Belmont Circle reconstruction and the Route 6 Additional Eastbound Travel Lane. For similar reasons described in the section above concerning induced development, these improvements are not anticipated to substantially affect the potential for induced development on Cape Cod.

EA Table 34 - Total Cumulative Impacts for MassDOT Projects with Alternative 1 Scenarios

	Alternative 1
Resource Area (ac):	
NHESP Rare Species Habitat	11.3
NWI Wetlands	0.4
100-year Floodplain	4.7
IWPA (Interim Wellhead Protection Area)	0.7

7.3 Cumulative Significance:

While the MassDOT final report includes recommended plans for transportation improvements, these are in concept only. No plans have been identified for implementation and no funding or authorization has been obtained. Future MassDOT Cape Cod transportation improvement projects are uncertain at this phase and if identified in the future further analysis will be conducted during the anticipated Supplemental EA.

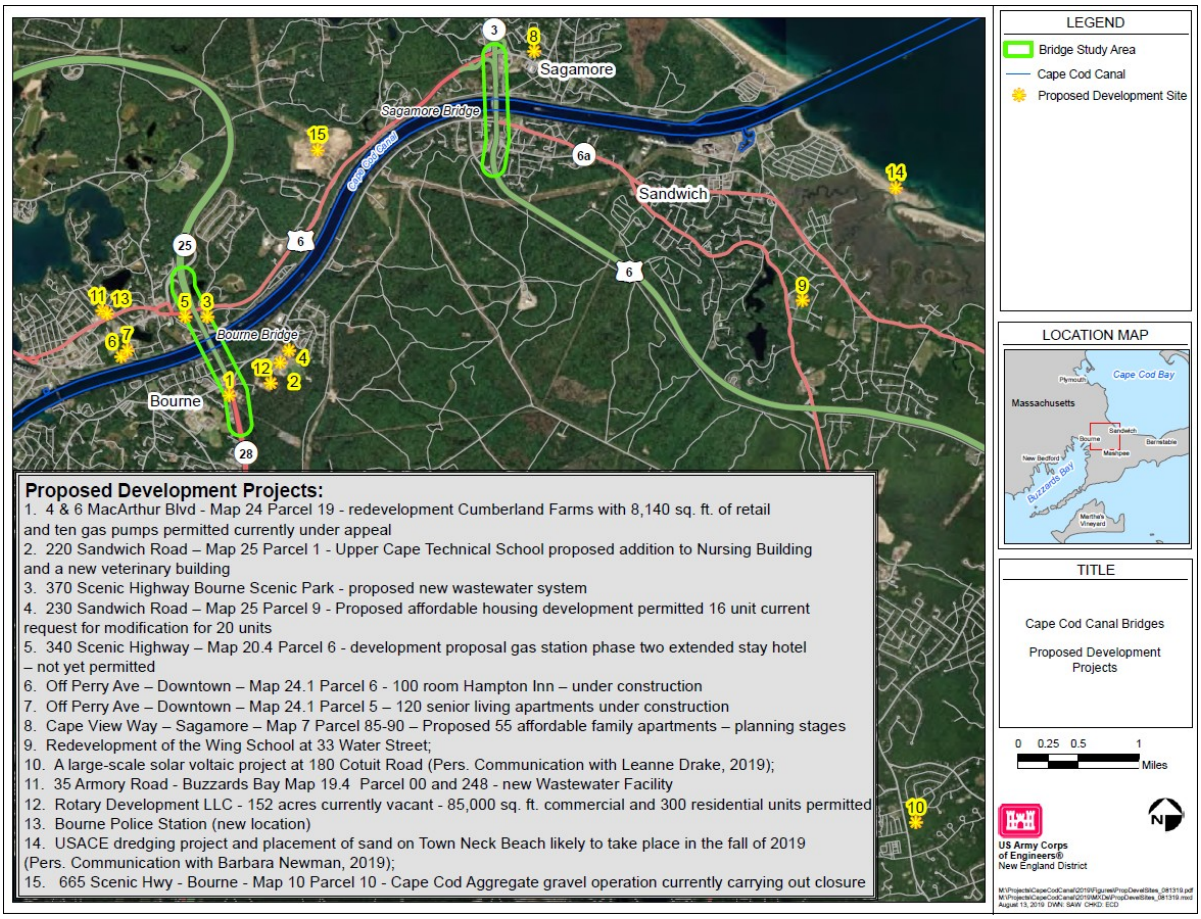
7.4 Other Development Projects:

The USACE contacted the local Conservation Commissions and Planning Boards in the towns of Bourne and Sandwich, MA to identify any current or planned future projects in each community as well as their proximity to the bridges study area. Fifteen projects were identified (EA Figure 31).

Although three projects fall within the study area: redevelopment of Cumberland Farms, a proposed new wastewater system, and a gas station and extended stay hotel, all are located in previously developed areas and present no cumulative environmental impacts.

All potential projects will be further evaluated during the design and construction phase (Phase II) of the project. There will be no significant cumulative environmental impacts from major rehabilitation or replacement of the Bourne and Sagamore bridges in association with any of the other proposed development projects listed.

EA Figure 31 - Proposed Development Projects



There are no other known past or reasonably foreseeable future actions in the project vicinity that would change the cumulative impact determination for the proposed bridge rehabilitation/ replacement alternatives. The effects of the preferred alternative of bridge replacement - 4 lanes with 2 auxiliary lanes, in combination with other past, present and reasonably anticipated future actions are not expected to have any significant cumulative effects.

8.0 PUBLIC INVOLVEMENT

USACE regulations (the Planning Guidance Notebook – ER 1105-1-100) and the National Environmental Policy Act (NEPA) require that all efforts be made to involve the public in preparing and implementing NEPA procedures and to hold public meetings whenever appropriate (USACE NEPA Implementing Procedures 33 CFR Part 230, CEQ 40 CFR 1500-1508).

The USACE encourages stakeholder engagement, collaboration, and coordination for all projects and decision-making processes (USACE, 2019). Agencies, organizations, federally recognized Tribes, and members of the public with a potential interest in a proposed project were kept informed and invited to participate in the decision-making process for this project. Appendix E

provides a record of agency and Tribal coordination and public involvement associated with the development of this EA.

The USACE involved the public early in the bridges study planning process to provide open communication and enable better federal decision-making. A series of five public informational meetings were held during the first two weeks of December 2018. These meetings introduced the MRER, environmental assessment process, and project timelines. The meetings were held in Bourne, Plymouth, Hyannis, Martha's Vineyard, and Nantucket, MA.

A project website (www.CapeCodCanalBridgesStudy.com) was developed to keep the public informed of presentations, fact sheets, documents, and provided an additional option for submitting public comments. One hundred two public comment letters or e-mails were received to date and were compiled into a matrix for consideration (Appendix F). EA Table 35 below categorizes the types of comments received.

In October 2019, another series of five public meetings was held on Cape Cod, the South Shore and in Boston to allow the opportunity for comments on this phase of the project and the draft EA. The public was notified of the public meetings and the official comment period through various forms of media including a Public Notice published on the Corps' publicly available website, through USACE sponsored social media (Facebook and Twitter), televised news reports on local and regional television stations, local news radio shows, and numerous newspaper articles on the topic of the draft report recommendation. A list of these notifications are included in Appendix F.

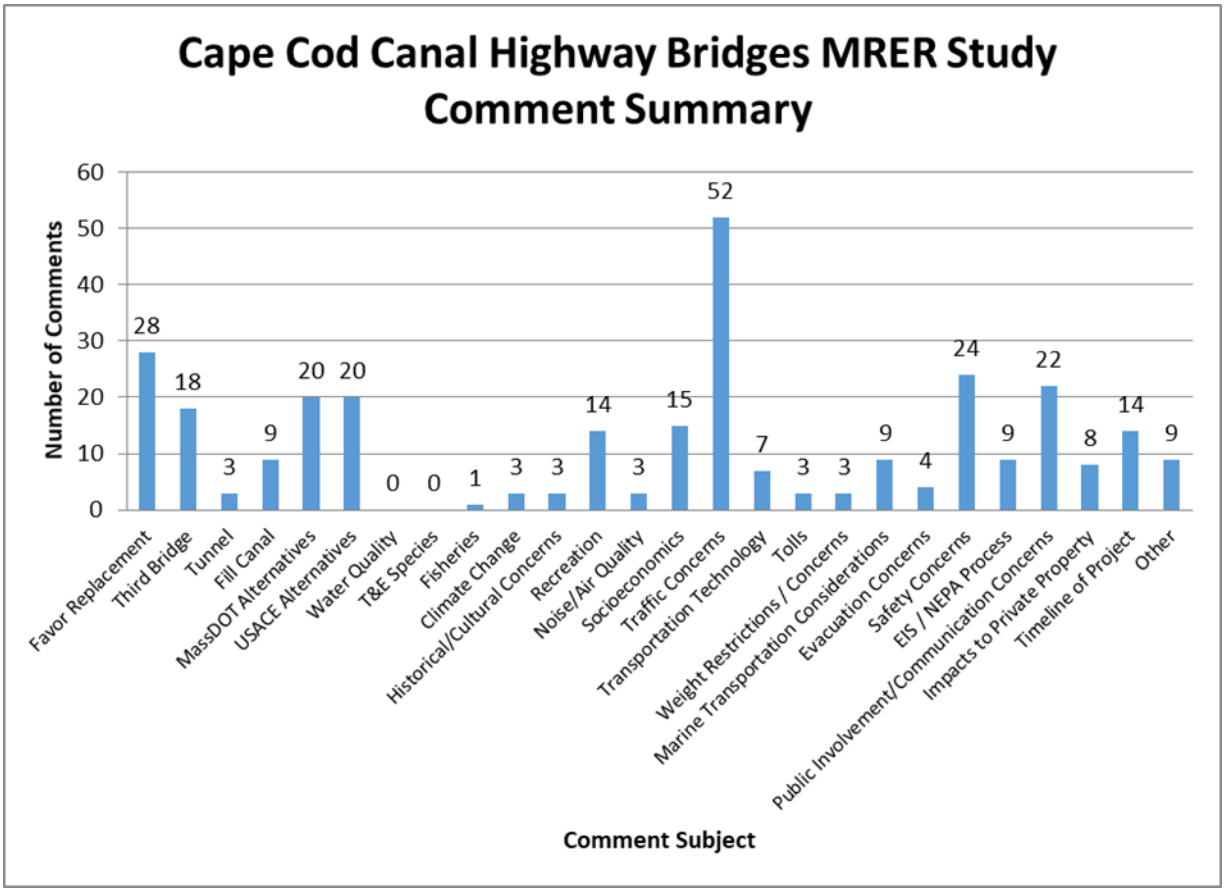
The USACE conducted a 30-day public comment period commencing on 03 October 2019. Prior to the conclusion of the 30-day public comment period, the USACE elected to extend the comment period for another 15 days, concluding the comment period on 15 November 2019. The USACE accepted comments via the agency recommendation meetings, the project website, electronic mail, and regular mail for consideration in the development of the Final MRER and EA. A total of 345 comments were received between 3 October 2019 and 15 November 2019 following publication of the Draft MRER/EA.

Additional public informational meetings will be scheduled during Phase II of the project to discuss the status of the project, design and construction details, and other key project considerations.

8.1 Initial Study Comments – Pre-draft

The United States Army Corps of Engineers (USACE) held a series of five public information meetings in December 2018 prior to issuance of the Cape Cod Canal Highway Bridges Draft MRER and EA. The USACE accepted comments during these public meetings as well as through the project website, electronic mail (e-mail), and regular mail for consideration in the development of the Draft MRER and EA. The following is a summary of the public comments (103 total comments) received between 4 December 2018 and 2 October 2019 prior to publication of the Draft MRER/EA on 3 October 2019. The comments received during this time period are shown in EA Table 35.

EA Table 35 – Pre-Draft Public Comments Summary



The majority of comments received prior to the issuance of the Draft MRER/EA were related to traffic concerns. Fifty-two (52) public comments were received noting a need to correct the traffic congestion regularly occurring on the Cape Cod Canal highway bridges (the "Bridges), nearby roadways, and roadways throughout Cape Cod, especially during the peak summer tourist season.

Twenty-eight (28) comments were received in support of replacing the Bridges, and these same comments overwhelmingly expressed concern that the current Bridges are unsafe for use. Twenty-four (24) comment submissions related to safety concerns with the condition of the current Bridges. The majority of the individuals believe the two existing Bridges are unsafe and pose a safety issue for motorists from motor vehicle accidents due to the narrow travel lanes, the high speeds traveled by commuters, and the lack of medians between the on and off-going traffic.

Twenty-four (24) comments were directed towards potential alternatives that the USACE identified and presented at public information meetings or additional alternatives that should be explored within the MRER and multiple commenters expressed their disappointment that too few alternatives were analyzed.

Twenty-three (23) public comments were directed towards alternatives to surrounding approach

roadways or other regional roadway infrastructure that the Massachusetts Department of Transportation (MassDOT) is either responsible for or should explore.

Twenty-two (22) comments addressed the need for greater public involvement and increased or better communication during the process of designing and planning for the future of the Bridges.

Other comments addressed the following topics:

- Construction of a third bridge (18)
- Socioeconomics (15)
- Timeline of the project (14)
- Recreation (14)
- Marine transportation considerations (9)
- Miscellaneous comments (9)

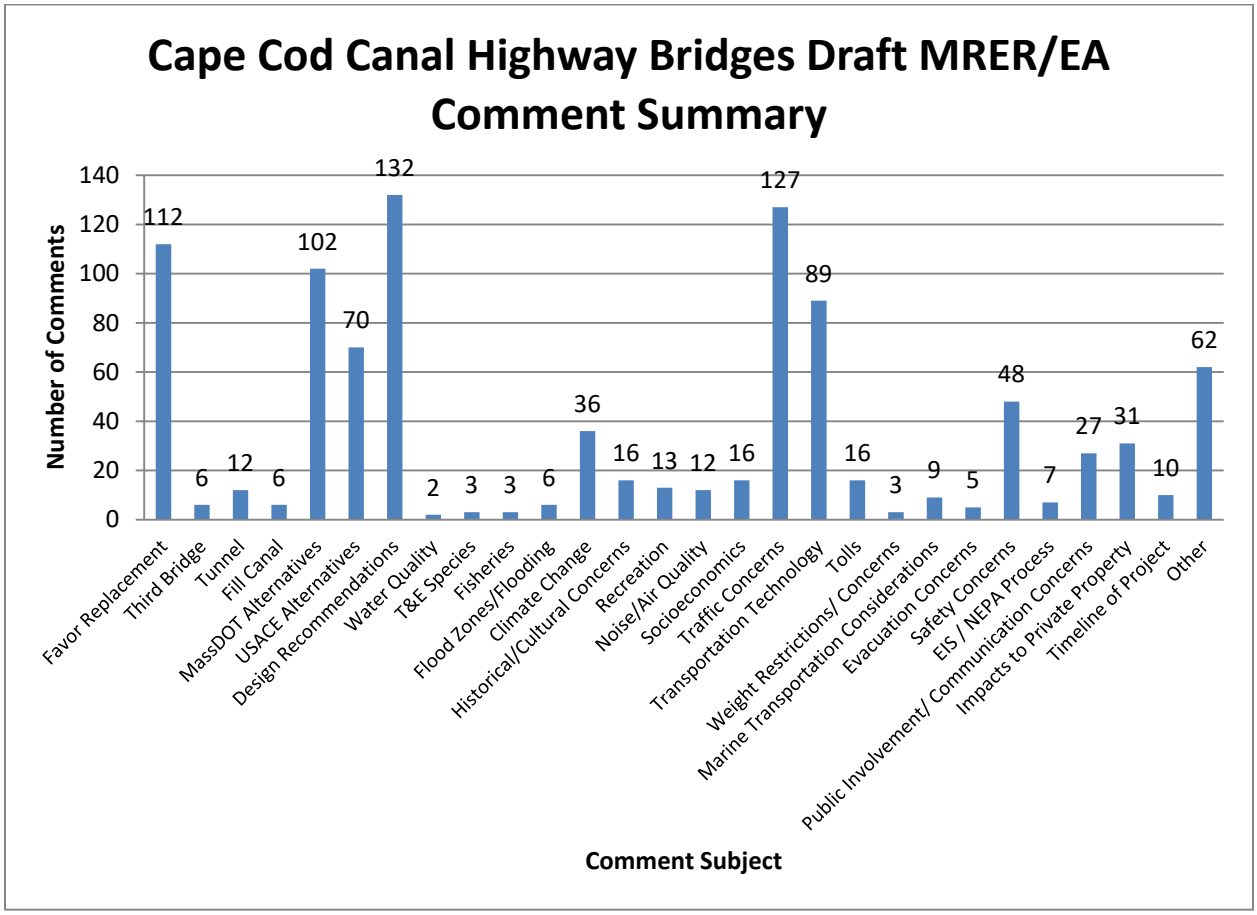
8.2 Draft EA Public Comments

The Cape Cod Canal Highway Bridges Draft MRER and EA was released on October 3, 2019 for a 30-day public comment period. Following the release of the draft report and EA, USACE held 5 public meetings in the communities of Bourne, Plymouth, Boston, Eastham, and Hyannis to solicit comments and questions from the public, and allow USACE to directly respond to questions received during the meetings.

Prior to the conclusion of the 30-day public comment period, USACE elected to extend the comment period for another 15 days, concluding the comment period on November 15, 2019. Comments were received during public meetings, through the project website, electronic email, and regular mail for consideration in the development of the Final MRER and EA.

A total of 345 comments were received between October 3, 2019 and November 15, 2019. All of the public comments received were reviewed and accounted for. Comments were grouped thematically and addressed by either amending sections of the EA, clarifying its final language, or adding analysis to the EA (EA Table 36). Specific groups of comments, and where these comments are addressed in the EA, can be found in Appendix F.

EA Table 36 – Post-Draft Public Comments Summary



The largest number of comments received addressed the design of replacement bridges, traffic concerns, and potential Mass DOT alternatives that could resolve traffic congestions concerns.

One hundred and twelve (112) public comments have been received to date which are in favor of replacement of both the Bourne and Sagamore Bridges.

Comments expressing opinions, histories, or experiences without reference to a specific issue or concern are also included in the Public Comment record (Appendix F). A summary of all public comments is located in Appendix F.

One hundred and thirty-two (132) draft EA public comments were related to design recommendations for the replacement bridges including: requests for the new bridge systems to incorporate bicycle and pedestrian lanes as well as public transportation systems; designating specific travel lanes for high occupancy vehicles and buses to reduce single-car use on Cape Cod; preserving the current appearance of the Bridges when engineering a new design; installing solar photovoltaic panels to offset energy needs and lighting requirements of the bridges; factoring future sea-level rise into the design; climate change, and the potential effects of a 100-year flood event on

the project siting, bridges, and associated infrastructure; and the ability to accommodate electric transmission cables on or under the bridges.

One hundred and twenty-seven (127) public comments were received in response to the Draft MRER/EA, identifying a need to resolve local traffic issues associated with the Bridges and approach roadways; however, multiple individuals expressed concerns with adding higher traffic capacity bridges, as they believe it will encourage additional visitors to the Cape Cod region and increase traffic flows onto local roadways and communities.

One hundred and two (102) public comments were received regarding potential MassDOT alternatives that could assist with alleviating traffic congestion around the Sagamore and Bourne Bridges. A significant number of participants recognize the bridges are in need of replacement and also serve as a primary source of the traffic congestion; however, most believe there will be no net improvement to traffic congestion unless the approaching highway systems and local roadways that support travel near the Bridges are modified to facilitate the flow of traffic.

Several comments received were related to the incorporation of a tolling system on the new bridges. There are currently no tolls in place on the Cape Cod Canal highway bridges. The Corps of Engineers has no plans to implement tolling on the bridges.

Other comments addressed the following topics:

- Incorporation of alternative transportation technology (89)
- Potential alternatives being considered by the USACE (70)
- Miscellaneous comments (62)
- Safety concerns (48)
- Climate change (36)
- Impacts to private property (31)
- Communication concerns and requests for additional agency collaboration with landowners, municipal offices and various non-government organizations (27)
- Implementation of tolls (16)
- Potential economic impacts (16)
- Impacts to recreation (13)
- Construction of a tunnel (12)
- Noise and air quality (12)
- Timeline of the project (10)
- Marine transportation considerations (9)
- EIS and the NEPA process (7)
- Construction of a third bridge (6)
- Filling the Canal (6)
- Flood zones and flooding (6)
- Evacuation concerns (5)

Topics such as impacts to fisheries, impacts to threatened and endangered species, weight

restrictions and concerns, and water quality received less than five (5) comments each.

9.0 AGENCY COORDINATION

NEPA requires lead Federal agencies to coordinate with other governmental agencies early in a project and throughout the NEPA process. CEQ regulations state that a lead agency can invite other Federal agencies, Tribes, or State or local agencies that have jurisdiction by law or special expertise to participate as a cooperating agency in the NEPA process. The benefits of cooperating agency participation include: "disclosure of relevant information early in the process; receipt of technical expertise and staff support; avoidance of duplicative reviews by Tribal, State, and local entities; and establishment of a mechanism for addressing inter- and intra- governmental issues and enhancing inter- and intra-agency and governmental trust" (CEQ, 2016). While cooperating agencies are more commonly utilized during the preparation of an EIS, they can be invited to be involved in an EA as well.

For the Bourne and Sagamore Bridges MRER Phase I project, five agencies were invited to participate as cooperating agencies: MassDOT, Federal Highway Administration (FHWA), U.S. Coast Guard, EPA and National Marine Fisheries Service. All agencies accepted (Appendix E).

Representatives from the following Federal, state, and local agencies with interest or jurisdiction in the proposed project were invited to a scoping meeting and coordinated site visit on March 19, 2019. Fifteen members attended (sign in sheets Appendix E).

Federal

U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
U.S. National Marine Fisheries Service
U.S. Coast Guard
Federal Highway Administration

State

Massachusetts Department of Transportation
Massachusetts Office of Coastal Zone Management
Massachusetts Department of Environmental Protection Massachusetts Department of Fish and Game Massachusetts Division of Fisheries and Wildlife Massachusetts Division of Marine Fisheries
Massachusetts Historic Preservation Office
Massachusetts Board of Underwater Archaeological Resources*

Tribal Governments

Wampanoag Tribe of Gay Head (Aquinnah) Wampanoag Tribe of Mashpee

Local

Bourne Conservation Commission
Sandwich Conservation Commission
Sandwich Historic Commission Bourne
Historic Commission*

(*separate coordination)

Early coordination was also conducted with several resource agencies including: U.S. Fish and Wildlife Service, National Marine Fisheries Services, MA Office of Coastal Zone Management and MA Historic Preservation Office to discuss project plan formulation and consider potential impacts to specific resources and agency comments and concerns. Consultations will continue during Phase II of the project.

10.0 COMPLIANCE WITH ENVIRONMENTAL FEDERAL STATUTES AND EXECUTIVE ORDERS

Item	Citation	Compliance
Federal Statutes		
Clean Air Act	42 U.S.C. §§ 7401 et seq.	A preliminary air quality analysis for modeled increased traffic was completed by MassDOT (appendix). Public notice of the availability of the Environmental Assessment to the USEPA is required for compliance pursuant to Sections 176c and 309 of the Clean Air Act. A Public Notice will be published and coordination with the USEPA is on-going.
Clean Water Act	33 U.S.C. 1251 et seq.	An application for a State Water Quality Certification pursuant to Section 401 of the Clean Water Act will be filed with the Commonwealth of Massachusetts if deemed necessary during the design phase.
Coastal Zone Management Act	16 U.S.C. §§ 1451-1464	Preliminary Coastal Zone Management Consistency Determination submitted to the Massachusetts Coastal Zone Management (CZM) Program for concurrence. CZM will respond after reviewing the Draft EA.
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	USACE Section 7 Coordination with USFWS and NMFS is on-going regarding threatened and endangered species.

Fish and Wildlife Coordination Act	16 U.S.C. 661 *et seq*.	Coordination with the USFWS, NMFS, and State fish and wildlife agencies fulfills compliance with the Fish and Wildlife Coordination Act. Coordination is on-going.
Magnuson-Stevens Act Fishery Conservation and Management Act	16 U.S.C. 1855(b)(2)	Coordination with the NMFS and preparation of an EFH Assessment fulfills compliance with the EFH provisions of the Magnuson-Stevens Act. Coordination with the NMFS is on-going.
National Environmental Policy Act of 1969	42 U.S.C. 432 et seq.	Preparation of an Environmental Assessment and accompanying Finding of No Significant Impact (FONSI) fulfills compliance requirements for NEPA.
National Historic Preservation Act of 1966	16 U.S.C. 470 et seq.	Compliance is established through consultation and development of a MOA. In this case, consultation with the SHPO and the Tribal Historic Preservation Officer is continuing and a Memorandum of Agreement will be developed in consultation with the SHPO, THPOs, and local interested parties during the design phase to develop a plan to avoid, minimize, or mitigate the effects of bridge replacement on historic properties.
Preservation of Historic and Archeological Data Act of 1974	54 USC 470 et seq.	Coordination with the State Historic Preservation Act signifies compliance. Coordination is ongoing.
Archaeological Resources Protection Act of 1979	16 U.S.C. 470 et seq.	Not applicable to this project.
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996	This project not likely to impede access by Native Americans to sacred sites, possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.
Estuarine Areas Act	16 U.S.C. 1221 et seq.	Not applicable to this project.
Federal Water Project Recreation Act, as amended	16 U.S.C. 4601 12 et seq.	Public notice of availability of the Environmental Assessment to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

Land and Water Conservation Fund Act of 1965, as amended	16 U.S.C. 4601 4 et seq.	Public notice of availability of the Environmental Assessment to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.
Marine Protection, Research, and Sanctuaries Act of 1971, as amended	33 U.S.C. 1401 et seq.	Not applicable to this project.
Marine Mammal Protection Act of 1972	16 U.S.C. 1361-1407	Coordination with the USFWS, NMFS, and State fish and wildlife agencies fulfills compliance with the Marine Mammal Protection Act. Coordination is ongoing.
Native American Graves Protection and Repatriation Act (NAGPRA)	25 U.S.C. 3000-3013, 18 U.S.C. 1170	Regulations implementing NAGPRA will be followed if discovery of human remains and/or funerary items occur during implementation of this project.
Rivers and Harbors Act of 1899, as amended	33 U.S.C. 401 et seq.	Not subject to Section 10 of the Rivers and Harbors Act per 33 U.S.C 403. Ongoing coordination with U.S. Coast Guard during the design phase of the project to determine if bridge construction permit is needed.
Watershed Protection and Flood Prevention Act as amended	16 U.S.C 1001 et seq.	Not applicable to this project.
Wild and Scenic Rivers Act, as amended	16 U.S.C 1271 et seq.	Not applicable to this project.
Coastal Barrier Resources Act, as amended	16 U.S.C. 3501 et seq.	Both bridges are located outside of the Coastal Barrier Resources System.

Executive Orders

Protection of Wetlands	Executive Order 11990	The replacement of the bridges would impact the man-made drainage ponds on the northern side of the Sagamore bridge, a 0.5 acre forested wetland 500 ft. east of the southern side of the Bourne Bridge and adjacent to the railroad tracks, as well as a small area of forested wetland on the northern side of the Bourne Bridge approach. Wetlands will be avoided to the extent possible, and any impacts would be mitigated for.
Protection of Children from Environmental Health and Safety Risks	Executive Order 13045	The project will not create a disproportionate environmental health or safety risk for children.
Protection and Enhancement of the Cultural Environment	Executive Order 11593	Coordination with the State Historic Preservation Officer signifies compliance.
Floodplain Management	Executive Order 11988	Replacement of the Bourne and Sagamore Bridges will not impact floodplains.
Environmental Effects Abroad of Major Federal Actions	Executive Order 12114	Not applicable to projects located within the United States.
Environmental Justice in Minority and Low Income Populations	Executive Order 12898	USACE performed an analysis and has determined that a disproportionate negative impact on minority or low-income groups in the community is not anticipated; a full evaluation of Environmental Justice issues is not required.
Federal Leadership in Environmental, Energy, and Economic Performance	Executive Order 13514	Not applicable to this project.
Improve the Resilience of Communities and Federal Assets Against the Impacts of Flooding Due to the Effects of Climate Change and Other Threats, 30 January 2015	Executive Order 13690	During Phase II of the project, USACE will incorporate considerations for potential sea level change into the design analyses so both bridges can accommodate and withstand any projected sea-level change.

Accommodation of Sacred Sites	Executive Order 13007	Access to and ceremonial use of Indian sacred sites by Indian religious practitioners will be allowed and accommodated. No adverse effects to the physical integrity of such sacred sites is anticipated.
Federal Support of Community Efforts Along American Heritage Rivers	Executive Order 13061	Not applicable to this project.
Federal Agencies may not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species	Executive Order 13122	The project will not promote the introduction or spread of invasive species.
Consultation and Coordination with Indian Tribal Governments	Executive Order 13175	Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and USACE Tribal Policy Principles signifies compliance.
Executive Memorandum		
Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA		Not applicable; the project does not involve or impact agricultural lands.
White House Memorandum, Government-to-Government Relations with Indian Tribes		Consultation with Federally Recognized Indian Tribes signifies compliance.

Accompanying Documents

References

Appendices

FINDING OF NO SIGNIFICANT IMPACT
Cape Cod Canal Highway Bridges
Bourne, Massachusetts

Major Rehabilitation Evaluation Report
Phase I Environmental Assessment

The U.S. Army Corps of Engineers New England District (Corps), conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Cape Cod Canal Major Rehabilitation Evaluation Report (MRER) and Environmental Assessment (EA), dated March 2020, for the Cape Cod Canal Bourne and Sagamore bridges is a decision document, which will provide the basis for the Corps and Congress to determine the most cost-effective, safe and practicable alternative for providing critical public transportation across the Cape Cod Canal, a Federal Navigation Project (FNP). The MRER includes engineering, economic and environmental analyses and evaluates alternatives including: continued repair and maintenance, major rehabilitation, or replacement of both bridges with new structures to address bridge component deficiencies which impact their structural and operational reliability.

The MRER decision document and accompanying EA are focused on the decision of whether to perform a major rehabilitation of the bridges, replace the bridges with new structures, or continue existing repair as needed (No Action Alternative). The Corps will address design and construction considerations and perform additional environmental analyses specific to the recommended plan in a subsequent EA.

The recommended plan includes replacement of both the Bourne and Sagamore bridges with new bridges consisting of 4 lanes with 2 auxiliary lanes each. New bridges would be built adjacent to the existing bridges and will incorporate modern safety design standards such as 12-foot wide travel lanes (compared to 10-foot widths currently on the existing bridge decks); pedestrian and bicycle lanes with a separation barrier from the vehicle lanes; a median between the two directions of vehicular travel; and shoulders to accommodate vehicle breakdowns. Bridge abutments would be located further north and south of their present locations on each side of the Canal in order to produce approach grades consistent with modern federal highway standards. The existing bridge piers are currently located within the Canal. New bridge piers would be relocated out of the water to the Canal shoreline.

The current bridges would remain open and continue to be inspected and maintained in a safe and reliable state while construction of the new bridges was underway. The current bridges would be dismantled after the new bridges have been opened to traffic. The actual bridge type, design specifications, and location of new bridges will be determined and evaluated during the design phase of the Cape Cod Canal Highway Bridges Project.

Based on my review and evaluation of environmental effects as presented in the March 2020 MRER) and EA I have determined that Phase I of the Cape Cod Canal Bridges project is not a major federal action significantly affecting the quality of the human environment. Under the Council on Environmental Quality (CEQ) NEPA regulations, "NEPA significance" is a concept dependent upon context and intensity (40 C.F.R. § 1508.27). When considering a site-specific action like the proposed project, significance is measured by the impacts felt at a local scale, as opposed to a regional or nationwide context. The CEQ regulations identify a number of factors to measure the intensity of impact. These factors are discussed below, and none are implicated here to warrant a finding of NEPA significance. A review of these NEPA "intensity" factors reveals that the proposed action would not result in a significant impact - neither beneficial nor detrimental - to the human environment.

Summary of Potential Effects:
For all alternatives, the potential effects were evaluated, as appropriate.

Impacts on Public Health or Safety: The project is expected to have no significant adverse effect on public health and safety. The project involves replacement of two existing bridges.

Unique Characteristics: The development of a programmatic agreement with the MA State Historic Preservation Officer (SHPO) will address any potential impacts to historic properties or cultural resources to ensure there will be no significant impacts to any unique characteristics within the communities.

Controversy: This project was coordinated with federal, state, local agencies, stakeholders and the public with jurisdiction or interest in the project. All comments were addressed with no significant controversy uncovered.

Uncertain Impacts: The impacts of this phase of the proposed bridge replacement project are not uncertain. They are readily understood based on past transportation projects and other similar Corps projects. Additional analyses will be conducted during the design phase to better assess other potential impacts.

Precedent for Future Actions: The proposed project involves replacement of an authorized project and will not establish a precedent for future actions other than future maintenance activities.

Cumulative Significance: The Massachusetts Department of Transportation (MassDOT) conducted a Cape Cod Canal Transportation Study. The final report included recommended plans for transportation improvement projects in the vicinity of the bridge replacement projects. These infrastructure improvement projects are in concept only. No plans have been identified for implementation and no funding or authorization has been obtained. Any future MassDOT Cape Cod transportation improvement projects are uncertain at this phase. If identified in the future, further analysis will be conducted during the design phase of the bridge project. As discussed in the EA, the effects of the proposed action in combination with

other past, present and reasonably anticipated future actions are not expected to have any significant cumulative effects. There are no significant cumulative impacts to communities, fish and wildlife, or federal and/or state threatened and endangered species.

Historic Resources: Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the Corps has determined that historic properties may be adversely affected by the recommended plan. Additional consultation with the SHPO and the Tribal Historic Preservation Officer (THPO) on the location of the bridges and the design will be required during the design phase of the project. A Memorandum of Agreement will be developed in consultation with the SHPO, THPOs, and local interested parties during the design phase to develop a plan to avoid, minimize, or mitigate the effects of bridge replacement on historic properties. All terms and conditions resulting from the agreement shall be implemented in order to minimize adverse impacts to historic properties. The project will have no known effects on any pre-contact archaeological sites recorded by the Commonwealth of Massachusetts.

Endangered Species: At this phase of the project, we have not identified any unavoidable impacts on any federal or state threatened or endangered species. The Corps has begun coordination with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) for technical assistance. Coordination with the USFWS indicated that federally-threatened northern long-eared bat (NLEB) may be present in the project area; however, because NLEB change locations over time, the USFWS indicate that it would be more effective to conduct surveys closer to the time of actual construction activities. The Corps will consult with the USFWS pursuant to Section 7 of the Endangered Species Act (ESA) during the design phase to determine if NLEB are present and identify measures necessary to minimize potential impact. These measures can be addressed through design changes and construction timing; therefore, no significant impacts to threatened and endangered species are anticipated.

The Corps held a conference call regarding ESA Section 7 consultation for marine species with the NMFS on May 20, 2019. Their greatest concern among ESA-listed species is the North Atlantic right whale. The timing of all bridge work will be scheduled to protect right whales that may transit through the Canal. In order to avoid adverse effects to marine species during construction, the Corps will carefully monitor the Canal for the presence of protected species. If any marine mammals or sea turtles are identified during bridge replacement in-water construction activities, all work will cease until the animal is safely out of the affected area. The Corps will consult with the NMFS during the design phase of the project to protect federally-listed marine species.

Mitigation measures will be identified during the design phase of the project in coordination with the USFWS and the NMFS to avoid and minimize impacts.

Potential Violation of State or Federal Law: This action will not violate federal or state laws. Measures to minimize adverse environmental effects of the proposed action are discussed in

Section 6 of the EA. All work will be performed in accordance with applicable environmental regulations, which will minimize environmental impacts. The project will include the use of protective measures such as Best Management Practices and specific mitigation measures, which will be developed during the design phase.

Based on my review and evaluation of the environmental effects as presented in the August 2019 MRER and EA, I have determined that replacement of the Bourne and Sagamore bridges is not a major federal action significantly affecting the quality of the human environment. This project, therefore, is exempt from requirements to prepare an Environmental Impact Statement.

_____
Date

_____
William M. Conde
Colonel, Corps of Engineers
District Engineer

CAPE COD CANAL HIGHWAY BRIDGES
MAJOR REHABILITATION EVALUATION REPORT
AND ENVIRONMENTAL ASSESSMENT

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