CAPE COD COMMISSION

CAPE COD METROPOLITAN PLANNING ORGANIZATION

Cape Cod 2024 Regional Transportation Plan

2024-2044

DRAFT 6-26-2023 For Public Review




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CAPE COD METROPOLITAN PLANNING ORGANIZATION

CAPE COD REGIONAL TRANSPORTATION PLAN (RTP)

FEDERAL FISCAL YEAR 2024

Anticipated Endorsement Date: July 24, 2023

Prepared by the

CAPE COD METROPOLITAN PLANNING ORGANIZATION (MPO) MEMBERS:

- Gina Fiandaca, Secretary and Chief Executive Officer, Massachusetts Department of Transportation (MassDOT)
- Jonathan Gulliver, Administrator, MassDOT Highway Division
- Robert Lawton, Chair, Cape Cod Regional Transit Authority
- Harold Mitchell, Cape Cod Commission
- Matthew Levesque., President, Barnstable Town Council
- Mark Forest, Barnstable County Commissioners
- Judith MacLeod-Froman, Bourne Selectman, for Bourne, Falmouth, Mashpee, and Sandwich
- Sheryl McMahon, Yarmouth Select Board member, for Dennis and Yarmouth
- Kevin Galligan, Orleans Select Board member, for Brewster, Chatham, Harwich, and Orleans
- Robert Weinstein, Truro Select Board member, for Eastham, Provincetown, Truro, and Wellfleet
- Brian Weeden, Chairman, Mashpee Wampanoag Tribal Council

MPO EX-OFFICIO MEMBERS:

- Jay Norton, Chair, Cape Cod Joint Transportation Committee
- Brian Carlstrom, National Park Service/Cape Cod National Seashore
- Lawrence T. Davis, US Army Corps of Engineers/Cape Cod Canal
- Robert B. Davis, Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority
- Jeffrey McEwan, Federal Highway Administration
- Joi Singh, Federal Transit Administration

AND THE CAPE COD JOINT TRANSPORTATION COMMITTEE:

- Jay Norton, Chair, Wellfleet
- Griffin Ryder, Vice-Chair, Brewster

CAPE COD COMMISSION RTP STAFF CONTACT:

Colleen Medeiros, Transportation Program Manager, Cape Cod Commission

This report was funded in part through grants from the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), United States Department of Transportation (USDOT). The views and opinions of the Cape Cod Metropolitan Planning Organization (MPO) expressed herein do not necessarily state or reflect those of the USDOT.

CAPE COD METROPOLITAN PLANNING ORGANIZATION

Cape Cod Regional Transportation Plan (RTP)

ENDORSEMENT, RTP

The signatures to follow certify that the Cape Cod Metropolitan Planning Organization (MPO) hereby endorses the Cape Cod Regional Transportation Plan (RTP) for Federal Fiscal Year 2024 in fulfillment of the requirements of 23 CFR Part 450.324.

CERTIFICATION:

The Cape Cod Metropolitan Planning Organization (MPO) Planning Process

The signatures to follow certify that the Comprehensive, Continuing, Cooperative Transportation Planning Process for the current local, regional, state, and federal fiscal years in the Cape Cod Metropolitan Planning Organization planning area is addressing major issues facing the region and is being conducted in accordance with the requirements of:

1. Section 134 Title 23, U.S.C., and Title 49 U.S.C. 5303, and this subpart;
2. Sections 174 and 176(c) & (d) of the Clean Air Act, as amended {42 U.S.C. 7504, 7506 (c) & (d)} and 40 CFR part 93;
3. Title VI of the Civil Rights Act of 1964, as amended {42 U.S.C. 2000d-1} and 49 CFR part 21:
4. 49 U.S.C. 5332, prohibiting discrimination on the basis of race, color, creed, national origin, sex, or age in employment or business opportunity;
5. Section 1101 (b) of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) (Pub. L. 109-59) and 49 CFR part 26 regarding the involvement of disadvantaged business enterprises (DBE) in USDOT funded projects;
6. Title 23 CFR part 230, regarding the implementation of an equal employment opportunity program on Federal and Federal-aid highway construction contracts;
7. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) and 49 CFR Parts 27, 37, and 38;
8. The Older Americans Act, as amended (42 U.S.C. 6101), prohibiting discrimination on the basis of age in programs or activities receiving Federal financial assistance;
9. Section 324 of title 23 U.S.C. regarding the prohibition of discrimination based on gender; and
10. Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794) and 49 CFR part 27 regarding discrimination against individuals with disabilities.
11. Anti-lobbying restrictions found in 49 USC Part 20. No appropriated funds may be expended by a recipient to influence or attempt to influence an officer or employee of any agency, a Member of Congress, in connection with the awarding of any Federal contract.

The currently endorsed Unified Planning Work Program, Regional Transportation Plan, and the Cape Cod Transportation Improvement Program (TIP) for Federal Fiscal Year 2024 were developed in accordance with FHWA/FTA regulations, EPA regulations, and fully incorporate the applicable requirements of the 1964 Civil Rights Act and the Americans with Disabilities Act of 1990.

CAPE COD METROPOLITAN PLANNING ORGANIZATION (MPO)

CAPE COD REGIONAL TRANSPORTATION PLAN (RTP)

The signatures to follow certify that the Cape Cod Metropolitan Planning Organization (MPO), at their meeting on July 24, 2023, hereby approves the following action in accordance with the Comprehensive, Cooperative and Continuing transportation planning process. In accordance with the requirements of 23 CFR Part 450 Section 308(c) of Federal Regulations, the MPO for Cape Cod has completed its review and hereby endorses the Regional Transportation Plan (RTP) for Federal Fiscal Year 2024.

Gina Fiandaca, Secretary/Chief Executive Officer – Massachusetts Department of Transportation (MassDOT)

Jonathan Gulliver, Administrator
Massachusetts Department of Transportation (MassDOT) Highway Division

Harold Mitchell
Cape Cod Commission

Robert Lawton, Chair
Cape Cod Regional Transit Authority

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Kevin Galligan
Brewster, Chatham, Harwich, Orleans

Brian Weeden
Mashpee Wampanoag Tribal Council

Robert Weinstein
Eastham, Provincetown, Truro, Wellfleet

CAPE COD COMMISSION

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Executive Summary

Cape Cod's transportation system has both shaped and been shaped by development patterns of the region. As our regional economy has evolved so too has our transportation infrastructure. From a reliance on ports and marine transport, to a steady growth by rail, and explosion of change fueled by the automobile – our region has undergone dramatic changes. All the while, our connection with our environment and our past has continued to define us. Demographic, climatic, and technological changes will present new transportation challenges over the next two decades and beyond. This plan presents a regional vision and sets of funding priorities to guide transportation investments that support the long-term vitality of the region.

The 2024 Regional Transportation Plan (RTP) is a **community-driven, performance-based** plan that considers the unique **challenges and opportunities** of the region and establishes spending **priorities** to allocate available surface transportation **funding** towards transportation **infrastructure** projects for Cape Cod through 2044.

COMMUNITY-DRIVEN

The RTP was developed through input from a wide range of federal, state, and local agencies and organizations, and the public. In addition to over two dozen meetings including six regional public meetings, eight outreach tables and two English as a Second Language (ESL) events, feedback was also solicited through an online survey. The online survey provided valuable input into the process including the identification of locations with transportation issues or challenges. The outreach will continue following release of the document for public comment including additional in-person and virtual public meetings, signs on transit vehicles, yard signs along the region's rail trail and an outreach table at a major outdoor event.

PERFORMANCE-BASED

Consistent with new federal legislation, the RTP is built on a performance-based planning approach with a vision statement, goals, objectives, performance measures and targets, strategies, and policies.

The RTP vision statement established the overarching vision of the document and is as follows:

The Cape Cod Metropolitan Planning Organization, informed by public input, envisions a multi-modal transportation system that supports the environmental and economic vitality of the region

through infrastructure investment that focuses on safety, livability, sustainability, resiliency, equity, and preservation of the character that makes our special place special.

The goals of the RTP expand on the vision statement in seven areas of emphasis. The goals are:

- **Safety**: Improve safety for all travel modes
- **Environmental and Sustainability** : Maintain, protect, and enhance the natural environment and reduce greenhouse gas emissions
- **Livability and Economic Vitality**: Support livable communities and village centers that strengthen the long-term economic vitality of the region
- **Multimodal Options/Healthy Transportation**: Provide a variety of healthy transportation options to all users
- **Congestion Reduction:** Reduce congestion and improve travel time reliability
- **System Preservation**: Preserve, maintain, modernize and ensure resiliency of the existing transportation system
- **Freight Mobility**: Improve efficiency and reliability of freight movement

The performance measures and targets established in the RTP are quantifiable targets that the region will work to achieve over the coming year through implementation of a series of strategies and policies.

CHALLENGES AND OPPORTUNITIES

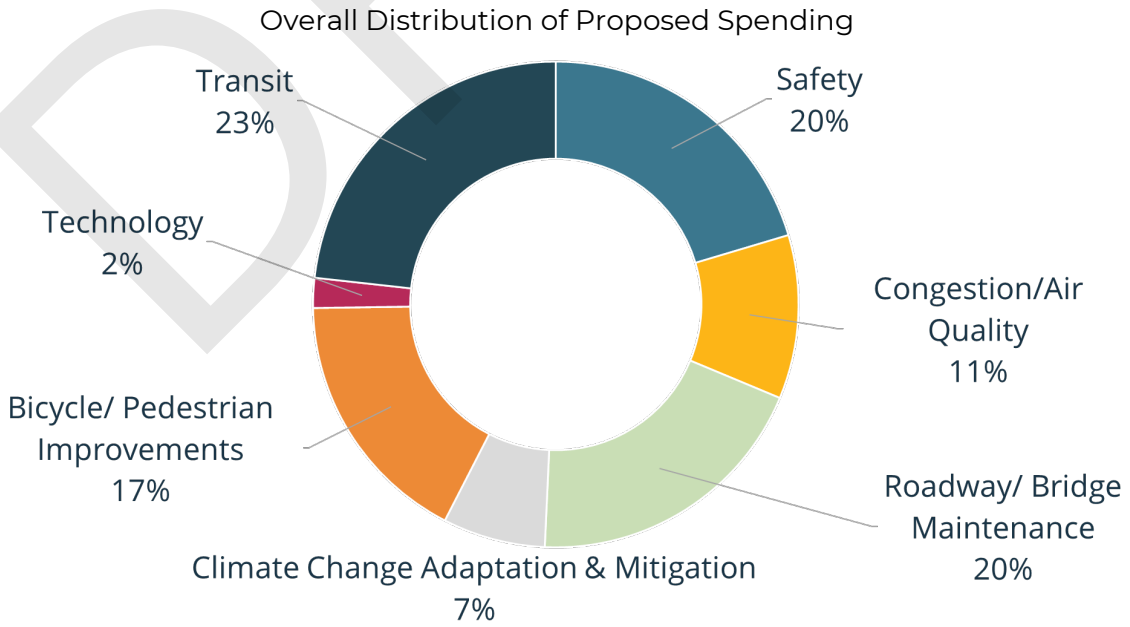
While the region faces many of the same transportation challenges as communities across the country and across the world, there are also many things that make Cape Cod unique. Developing transportation solutions for Cape Cod must account for the things that make the region a special and desirable place to live, work, and play. Some of the challenges and opportunities for the region that are detailed in the RTP include:

- **Historical Context:** maintaining a sense of place and recognition of history while evolving to meet the need of the next generation
- **Aging Infrastructure**: repairing or placing a significant amount of transportation infrastructure that is at or near the end of its design life
- **Safety**: identifying the locations of greatest need and vulnerability and implementing proven safety countermeasures to improve safety for all users
- **Security**: being prepared for extraordinary events that would threaten the people and the infrastructure of the region
- **Freight**: recognizing the importance of freight to the region while exploring a variety of ways to safely and efficiently transport it
- **Bicycling, Pedestrians, and Transit**: identifying the unique needs of all users and improving options for a variety of modes of healthy transportation
- **Congestion Management**: identifying opportunities to reduce the intensity, duration, and extent of congestion for all modes of transportation in our bottleneck locations

- **Stormwater Management**: identifying solutions to minimizing the contribution of nutrients and pollutants into the Cape's waterways from stormwater runoff including freshwater
- **Climate Change**: preparing the region for the impacts of climate change through a focus on adaptation, sustainability, mitigation and energy sources
- **Access to Essential Services**: ensuring all users of the transportation have the same and convenient options to access essential services
- **Regional Cooperation**: ensuring that there is a cooperative and coordinated planning approach that involves all stakeholder agencies and the public
- **Economic Development**: supporting sustainable, year-round economic development opportunities through transportation infrastructure
- **Environmental Protection**: ensuring that transportation projects mitigate environmental impacts and provide environment benefits including greenhouse gas (GHG) emissions reductions
- **Equity**: ensuring full and fair participation by communities in the transportation decision-making process, and equitable distribution of benefits and any potential burdens from transportation projects

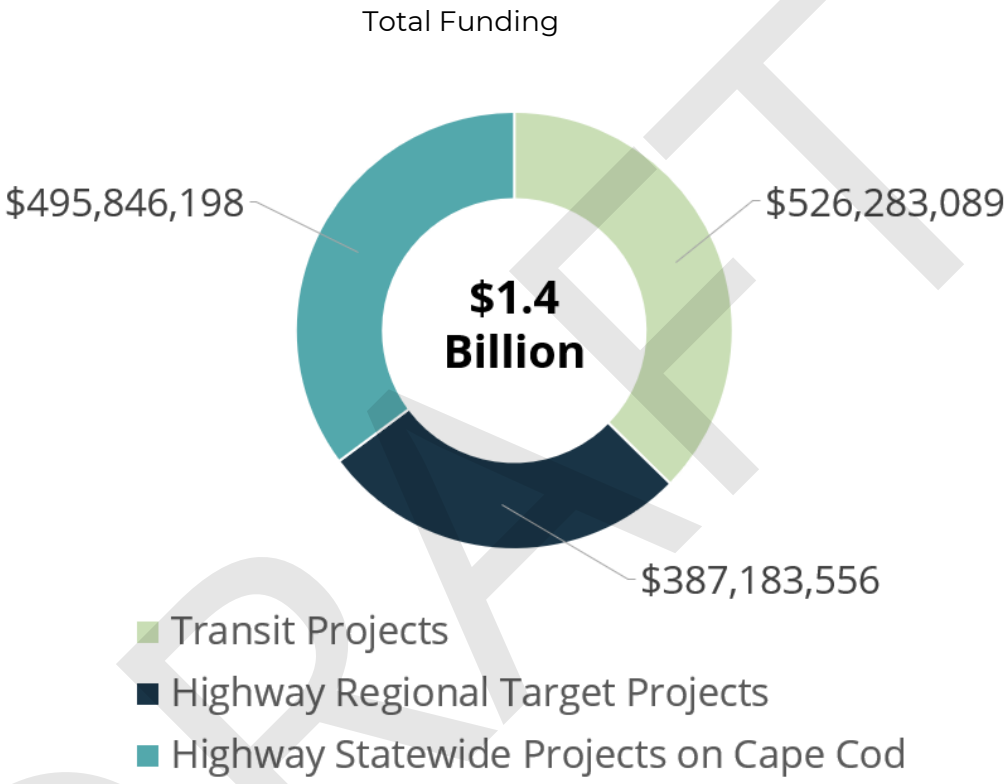
PRIORITIES

As a document that establishes the vision for the transportation system for the region, the RTP sets the framework for what will be built on Cape Cod. Based on a critical assessment of infrastructure needs, discussions at RTP development meetings, and feedback on the RTP survey, the following program of spending was developed. The overall distribution of proposed spending is shown below.



FUNDING

The anticipated funding in the region over the next 21 years totals approximately $1.4 billion. This total includes spending on transit as well as highway projects (including roads, bridges, sidewalks, multiuse paths, etc.) broken down as shown in the following figure.



INFRASTRUCTURE

Out of the nearly $387 million in funding for highway projects identified and selected by the region, the following projects were selected, balancing a number of factors including potential benefit, estimated cost, consistency with the objectives and performance measures in the RTP, equity as it relates to minority, low income, Limited English Proficiency (LEP) and other protected populations, and GHG reduction potential:

- Mashpee Route 151 Improvements
- Route 28 Multimodal Improvements (various segments)
- Provincetown Shank Painter Road and Route 6 Improvements
- Cape Cod Rail Trail Extensions: Mid- and Upper-Cape
- Cape Cod Rail Trail Extensions: Upper- and Outer Cape
- Hyannis Area Improvements

- Route 6 (Outer Cape) Safety Improvements
- Route 6 Safety Improvements (Interchanges, Shoulders)
- Various smaller-scale projects to be identified based on future evaluations

In addition to these highway regional target projects additional projects of significance are anticipated including the replacement of Route 28 bridge of the Bass River and, potentially with additional federal and state resources, the implementation of the Cape Cod Canal Bridges Program including the replacement of the Bourne and Sagamore Bridges.

In terms of transit projects, the region will transformative investments by the Cape Cod Regional Transit Authority including the move towards electric of the bus fleet and delivery of service in a manner that will meet the evolving need of the communities served.

While many uncertainties exist about the future, the strength of the transportation infrastructure will undoubtedly be a key to Cape Cod's long-term vitality. The 2024 RTP sets forth this vision for the region and sets the framework for making smart transportation investments within the region through 2044.

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Chapter 1: Introduction and Plan Development

This 2024 Cape Cod Regional Transportation Plan (RTP) is a fiscally constrained set of transportation projects, programs, and transportation studies covering 2024 to 2044. The RTP establishes the long-range view of transportation based on existing system data, and existing and projected needs. The RTP includes an assessment of the existing transportation system and its federal aid components—whether transit, highway, pedestrian, or other—and endeavors to improve the transportation system and its connections for better mobility for residents, commuters, and visitors. The RTP includes all modes of surface transportation throughout the 15 communities of Barnstable County.

Preparation of the document is undertaken by the Cape Cod Commission staff every four years on behalf of the Cape Cod Metropolitan Planning Organization (MPO).

This chapter includes background information on the transportation planning process, a synopsis of the public participation process, and regional survey results.

TRANSPORTATION PLANNING PROCESS

Cape Cod Metropolitan Planning Organization (MPO)

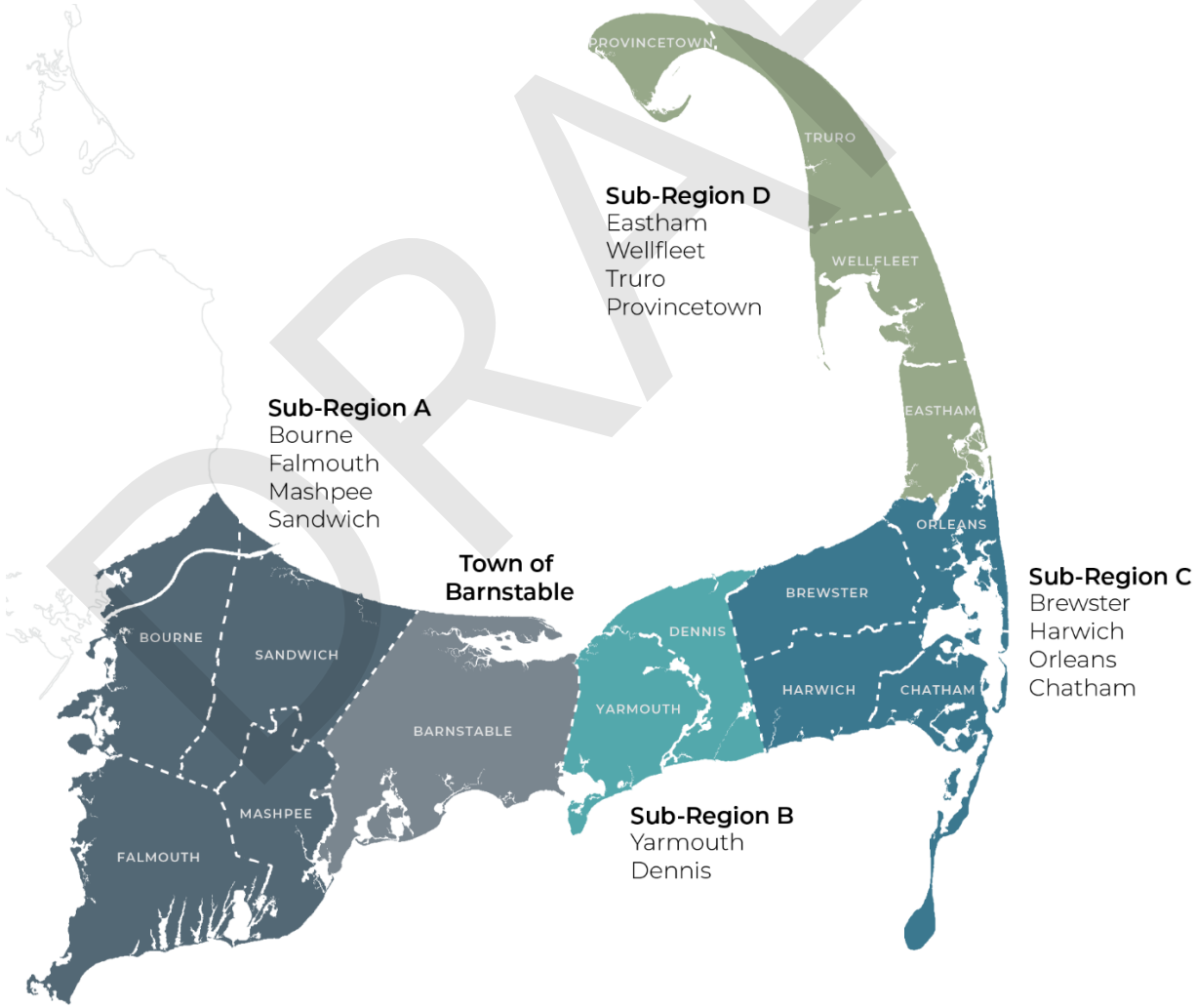
The Cape Cod Metropolitan Planning Organization (MPO) is the regional governing body established by federal law to oversee regional transportation planning and recommend the distribution of transportation funds locally. The MPO is responsible for reviewing, guiding, and endorsing the RTP.

The MPO is made up of eleven voting members that generally meet monthly. The membership is outlined in Table 1. Town representation on the body is depicted in Figure 1.

TABLE 1. Cape Cod MPO Membership

AGENCY	MPO SIGNATORY
Massachusetts Department of Transportation (MassDOT)	Secretary of Transportation
MassDOT Highway Division	Administrator
Cape Cod Regional Transit Authority (CCRTA)	Chairman
Cape Cod Commission (CCC)	Chair
Barnstable County Commissioners	Commissioner
Mashpee Wampanoag Tribe	Tribal Chairman
Town of Barnstable	Town Council President
Sub-region A (Bourne, Falmouth, Mashpee, Sandwich)	Select Board member
Sub-region B (Dennis, Yarmouth)	Select Board member
Sub-region C (Brewster, Chatham, Harwich, Orleans)	Select Board member
Sub-region D (Eastham, Provincetown, Truro, Wellfleet)	Select Board member

Figure 1. MPO Regional Representatives



The MPO also includes non-voting Ex-Officio Members: Federal Highway Administration, Federal Transit Administration, Army Corps of Engineers, National Park Service/Cape Cod National Seashore, the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority, and the Chair of the Cape Cod Joint Transportation Committee.

The MPO is served by an advisory body: the Cape Cod Joint Transportation Committee (CCJTC). The CCJTC membership includes representatives from each of Barnstable County's fifteen towns and a bicycle advocate.

Development of the RTP also includes consultation with or consideration of a wide range of federal, state, and local agencies and organizations including:

- Amplify People of Color (POC)
- Association to Preserve Cape Cod
- Bay State Cruises
- Barnstable County Government
- Barnstable Health Ministry
- Bicycle advocacy groups
- Massachusetts Coastal Railroad
- Cape Air
- Cape Cod Central Railroad
- Cape Cod Climate Change Collaborative
- Cape Cod Commission
- Cape Cod Joint Transportation Committee
- Cape Cod Metropolitan Planning Organization
- Cape Cod National Seashore/ National Park Service
- Cape Cod Regional Transit Authority
- Cape Cod Towns
- Councils on Aging
- Federal Highway Administration
- Federal Transit Administration
- Hy-Line Cruises
- Joint Base Cape Cod
- Martha's Vineyard Commission
- Massachusetts Department of Recreation and Conservation
- Massachusetts Department of Transportation
- MassBike
- Nantucket Planning and Economic Development Commission
- Old Colony Planning Council
- Freight Companies
- Peter Pan Bus Lines
- Plymouth and Brockton Street Railway Company
- Southeastern Regional Planning and Economic Development District
- U.S. Army Corps of Engineers
- Woods Hole, Martha's Vineyard and Nantucket Steamship Authority

The staff of the CCC, CCRTA, and MassDOT, along with staff of the local towns, participates in the process through preparation of the documents for MPO action.

Federal Certification Documents

In addition to the RTP, the MPO is required to endorse other federal certification documents including the Transportation Improvement Program (TIP), Unified Planning Work Program (UPWP), and the Public Participation Plan (PPP).

The RTP establishes a regional vision for the transportation system, the UPWP studies investigate deficiencies in that system and identify potential solutions, and the TIP details specific transportation projects that are implemented to improve the transportation system. The PPP provides a framework to ensure public involvement and cooperative decision making throughout the transportation planning process. A summary of the primary function, time horizon, and updated timeline is presented in Table 2. The table also includes links to the Cape Cod MPO webpages that contain more detailed information on each of the documents.

TABLE 2. Federal Certification Documents

DOCUMENT	PRIMARY FUNCTION	TIME HORIZON	UPDATE TIMELINE
Regional Transportation Plan (RTP) www.capecodcommission.org/rtp	Establishes long-range vision and goals, identifies major projects, studies, and programs	20+ years	Every 4 years
Transportation Improvement Program (TIP) www.capecodcommission.org/tip	Identifies specific transportation investments (projects)	4 years	Annually
Unified Planning Work Program (UPWP) www.capecodcommission.org/upwp	Details planning studies and tasks	1 year	Annually
Public Participation Plan (PPP) www.capecodcommission.org/ppp	Establishes plan for public participation for transportation decision-making	Ongoing	Every 5 years, or more frequently as needed

TITLE VI/NONDISCRIMINATION PROGRAM

The Cape Cod MPO follows federal and state non-discrimination laws and seeks to ensure that all interested parties in Barnstable County have access to the MPO's activities and services and that public involvement in the MPO's decision making comes from a diverse socioeconomic group that is representative of the county's population. The MPO has developed a nondiscrimination program, in accordance with federal and state requirements, to encourage broad public participation, representation, and equity in the region's transportation planning. The implementation of this program during the RTP development is summarized in the following sections and further detailed in Appendix L.

Title VI Background

Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color, or national origin. Related federal nondiscrimination authorities add the protected categories of sex (23 USC 324), age (42 USC 6101), disability (29 USC 790), low-income (Federal Executive order 12898), and limited English proficiency (federal executive order 13166). Organizations that receive Federal funds are obligated to assure nondiscrimination in their programs and activities and are required to have a comprehensive Title VI enforcement program to prevent and eliminate discrimination in their federally funded programs. Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) set forth Title VI compliance requirements for "primary" funding recipients such as MassDOT and sub-recipients such as the MPOs to follow. Effective transportation decision making depends upon understanding and properly addressing the needs of different groups. The MPO's Title VI program includes identifying the demographic distribution of minority and limited English proficiency populations within the region and implementing a comprehensive strategy to ensure that the MPO conducts effective outreach to encourage their involvement in and access to the transportation planning and decision-making process.

The Massachusetts Department of Transportation (MassDOT) is responsible for ensuring that the state's MPOs comply with federal program requirements. Following MassDOT's 2013 Title VI program update, the Cape Cod MPO developed and adopted a Title VI Program in 2014. This plan was updated in accordance with MassDOT's directives in 2022 which also included updates to its Public Participation Plan in 2022. The 2022 Title VI plan update provides certifications and assurances, Title VI notices, complaint procedures and forms, information about beneficiaries' rights,, regional demographic data and profile of the area, mobility needs of minority populations, demographic maps and charts of funding distribution a Public Participation Plan, a language access plan, data collection reporting, the dissemination of Title VI information, and analyses of MPO transportation system investments in the region, project locations and potential impacts from projects to ensure equity in the planning and implementation process for the region.

Although Title VI is the focal point of non-discrimination law in the United States, FHWA incorporates a broader spectrum of statutes, executive orders, and regulations into its requirements for states and MPOs. Other pertinent non-discrimination authority identified by MassDOT and FHWA include the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 USC Ş 4601); Federal-Aid Highway Act of 1973 (42 USC 324 et seq.); Section 504 of the Rehabilitation Act of 1973 (29 USC 794 et seq.); Age Discrimination Act of 1975, as amended (42 USC 6101); Airport and Airway Improvement act of 1982 (49 USC 471); Civil Rights Restoration Act of 1987 (PL 100-209); Titles II and III of the Americans with Disabilities Act (42 USC 12131-12189); Federal Aviation Administration's Non-Discrimination Statute (49 USC 47123); Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations; Executive Order 13166, Improving Access to Services for people with Limited English Proficiency.

In addition to mapping demographic data that identifies areas (census blocks) in the county with higher proportions of low income and minority populations, the staff conducts analyses on the geographic distribution of the region's transportation spending and project construction, to ensure equity in the distribution of transportation improvements. In examining the Title VI based project distribution analysis, the proximity, frequency, value and nature of projects are identified in relation to statistically significant population concentrations of the Title VI protected categories; i.e. race, color or national origin (including limited English proficiency) for transit related projects with the addition of age, sex and disability for highway related projects. The analysis also includes a review of potential project impacts – positive and negative – to ensure that that potentially underserved areas neither adversely impacted by, nor denied the benefits of, transportation projects. A key piece of the program is engaging such communities in the MPO's activities and decision making through expanded and targeted public outreach. The Public Participation Plan, as discussed below, establishes the MPO's public involvement goals and strategies.

Environmental Justice, Equity and Justice40

FHWA and FTA are collaborating with MassDOT, the MPO's and public transportation providers to advance racial equity and support for underserved and disadvantaged communities. Strategies within this plan will be developed that improve infrastructure for non-motorized travel, public transportation access, increased public transportation service in underserved communities, plan for the safety for all users, reduce single occupancy vehicle travel near high volume corridors, target demand-response service towards communities with higher concentrations of older adults and those with poor access to essential services, and equitable and sustainable practices while developing transit-oriented development. MassDOT has also developed a Regional Environmental Justic "Plus" layer (REJ+) to provide further analysis and demographics related to EJ communities. Equity analyses as part of the regional transportation planning process will begin to reference the MassDOT REJ+ as the mapping tool is further developed and made publicly available.

BEYOND MOBILITY

In parallel to the development of the RTP, MassDOT was developing the statewide long range transportation plan. Beyond Mobility, the Massachusetts 2050 Transportation Plan, is a planning process that will result in a blueprint for guiding transportation decision-making and investments in Massachusetts in a way that advances MassDOT's goals and maximizes the equity and resiliency of the transportation system.[1] Much of the early work on this effort, including the identification of trends related to climate change, social inequity, population shifts, and advancements in technology, helped informed RTP development. As detailed in next section, joint outreach activities helped to ensure that unique regional considerations will be reflected in this statewide plan.

[1] See www.mass.gov/beyond-mobility

PUBLIC PARTICIPATION PROCESS

To ensure an inclusive and accessible public engagement processes for development of the Regional Transportation Plan (RTP), staff looked to the framework established in the Cape Cod MPO Public Participation Plan (PPP). Goals of the PPP are to:

1. Obtain Quality Input and Participation
2. Establish Consistent Commitment
3. Increase Diversity
4. Ensure Accessibility
5. Provide Relevance
6. Foster Participant Satisfaction
7. Clearly Define Potential for Influence
8. Establish and Maintain Partnerships
9. Provide Opportunities to Build Consensus

The MPO efforts to meet each goal are detailed in Appendix L.

The PPP is available in English and Portuguese at www.capecodcommission.org/ppp

Meetings and Open Houses

Numerous meetings have been held to discuss development of the RTP. Table 3 identifies meetings held solely for the plan, as well as meetings of various organizations at which the RTP was discussed. Meeting locations were selected to provide geographic and demographic diversity as well as ensure that persons with disabilities were able to actively participate. Notices were disseminated to English and Portuguese media outlets.

BEYOND MOBILITY - MEETING IN A BOX

In coordination with the MassDOT Beyond Mobility team, a "meeting in a box" was held on January 26, 2023 in Eastham, MA with a focus group consisting of stakeholders representing the elderly population in the Outer Cape. The focus group included representatives from local Councils of Aging (COA), local community organizations (Aids Support Group, Helping Our Women) and local town representatives. This public engagement technique allowed for public feedback to be jointly collected as part of the development for both the Statewide and the Regional Long Range Transportation Plans. The focus group allowed for small group conversations to understand the unique challenges faced in this geographic and demographic group of our region.

EQUITY CONSIDERATIONS FOR TARGETED OUTREACH

As part of an inclusive public outreach strategy, efforts were focused on performing outreach at community meetings and activities already scheduled in the region. Specifically, staff organized an outreach table at the Hyannis Open Streets festival in the Fall 2022 and attended English as a Second Language (ESL) classes at the Dennis and Falmouth Public Libraries. In addition, staff ensured outreach meeting opportunities were scheduled near Environmental Justice (EJ)

communities, such as in Truro and Barnstable. Additionally, to further public outreach opportunities among limited English proficiency communities, comment cards were disseminated and collected at the IPR Church of Cape Cod in Hyannis on Sunday, May 20, 2023. Feedback received from over the 140 comment cards ranged from reducing congestion, constructing new sidewalks and increasing frequency and connections for public transit service.

Collectively, the RTP meetings provided a wide array of opportunities for the public to learn about the document and share their comments. Comments received reflected both regional interests in the Cape Cod transportation system as well as more location specific concerns based on the location of the meeting.

ENQUETE DE TRANSPORTE

Para nos ajudar na identificação de projetos de construção, favor selecionar cada objetivo abaixo relacionado de acordo com a importância:	Muito importante	Importante	Sem importância
Melhoria da segurança para veículos, ciclistas e pedestres	☒	☐	☐
Redução de congestionamento de automóveis (tempo de espera no trânsito)	☒	☐	☐
Reparos de estradas e pontes	☒	☐	☐
Melhoria nas condições para ciclistas e pedestres	☒	☐	☐
Melhoria do transporte urbano	☐	☒	☐

Favor descrever qualquer tipo de problema de transporte e ou experiências que você já teve.

Por exemplo, por favor, identifique intersecção você vê falhas, locais onde são necessários calçadas ou faixas de pedestres novos ou melhorados , ou tempos ou lugares onde você gostaria de ver serviço novo ou aumentado ônibus.

UM GRANDE PROBLEMA QUE VEJO NA REGIAO É CALÇADAS ADEQUADAS PARA PEDESTRES COM ESPAÇO ADEQUADO E SEGURO PARA PEDESTRES E CICLISTAS TBM. REPAROS NAS ESTRADAS TBM É ESSENCIAL, PRINCIPALMENTE NA REGIÃO DE HYANNIS E VARMOUTH. A REGIÃO DO SEMAFORO ONDE ESTÁ O TREM TEM SEMPRE OBRAS E MUITO TRANSITO E PRECISA DE CUIDADO.

ENQUETE DE TRANSPORTE

Para nos ajudar na identificação de projetos de construção, favor selecionar cada objetivo abaixo relacionado de acordo com a importância:	Muito importante	Importante	Sem importância
Melhoria da segurança para veículos, ciclistas e pedestres	☐	☒	☐
Redução de congestionamento de automóveis (tempo de espera no trânsito)	☒	☐	☐
Reparos de estradas e pontes	☐	☒	☐
Melhoria nas condições para ciclistas e pedestres	☐	☒	☐
Melhoria do transporte urbano	☒	☐	☐

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Melhorias no tempo de espera p/ transporte, mais pontos de parada e mais onibus.
De Falmouth p/ Hyannis mais pontos de parada em Marhpee
Rt 151

Figure 2. Example Portuguese Comment Cards

TABLE 3. Regional Transportation Plan Meetings

CAPE COD METROPOLITAN PLANNING ORGANIZATION MEETINGS		
Meetings beginning in September 2022 and continuing through July 2023 Generally held once per month on a Monday at 1:00 PM, virtually		

CAPE COD JOINT TRANSPORTATION COMMITTEE MEETINGS		
Meetings beginning in September 2022 and continuing through July 2023 Generally held once per month on a Friday at 8:30 AM, virtually		

CAPE COD RTP SUBCOMMITTEE MEETINGS		
Regional Transportation Plan Subcommittee Meeting - Virtual	Wednesday, November 16	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Friday, January 13	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Wednesday, March 8	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Friday, April 14	1:00 PM

LISTENING SESSIONS/OUTREACH TABLE EVENTS/PUBLIC MEETINGS		
Hyannis Open Streets – Outreach Table	Sunday, October 16	12:00 PM
WXTK (95.1) Radio Interview	Monday, February 6	
The Harvard Club of Cape Cod	Thursday, March 9	11:30 AM
Truro Town Hall – Public Meeting	Monday, March 20	5:00 PM
Regional Transportation Plan Virtual Public Meeting	Tuesday, March 21	6:00PM
Hyannis Transportation Center – Public Meeting	Tuesday, March 21	11:00 AM
WCAI Radio Interview	Thursday, March 30	
RTP Bicycle Committee Meeting - Sandwich	Thursday, April 13	6:30 PM
TIP/UPWP Outreach Table – CCRT Trailhead, Station Ave, Yarmouth	Tuesday, May 9	3:00 PM
TIP/UPWP Outreach Table – OCRT at Stepping Stones Rd, Chatham	Thursday, May 11	9:00 AM
IPR Cape Cod Church	Sunday, May 21	9:00 AM

OTHER MEETINGS/ACTIVITIES		
Barnstable County Public Works Association	Thursday, November 3	11:00 AM
Retired Mens Club of Cape Cod	Thursday, November 3	12:30 PM
Nauset Neighbors	Thursday, November 10	3:00 PM
Outer Cape Council on Aging's	Thursday, January 26	10:00 AM
ESL Class – Dennis Public Library	Friday, March 24	12:00 PM
ESL Class – Falmouth Public Library	Tuesday, March 28	7:00 PM
Association to Preserve Cape Cod	Monday, April 24	4:30 PM
Barnstable County Economic Development Council Executive Committee	Tuesday, April 25	9:30 AM
CCAIOR Leadership Meeting	Tuesday, May 23	10:00 AM
Cape Cod Electric Vehicle Expo and Test Drive Event	Saturday, June 3	10:00 AM

Figure 3 shows a collection of photographs that were taken at various RTP outreach events.

Figure 3. Photographs of Outreach Activities

Other Outreach Strategies

In addition to the traditional outreach approaches, staff utilized a number of new strategies in an effort to increase public participation.

EXPANDED EMAIL OUTREACH DISTRIBUTION

In an effort to better connect with the various groups and agencies in the region that interact in different ways with the transportation system every day, an expanded email distribution list was created to share all notices and announcements on the development of the plan. This expanded outreach list including the following groups and agencies that were identified in the region:

- Bicycle and Pedestrian Committees and Advocate Groups
- Community & human services programs and providers
- Community centers
- Councils on aging
- Day care and child development programs
- Environmental and climate organizations
- English language media outlets (print and audio)
- Financial institutions
- Fire districts
- Hospitals and health centers
- Interested citizens (those who requested to be included in the list)
- Lesbian, gay, bisexual, and transgender (LGBT) organizations
- Libraries
- Local and area chambers of commerce
- Local and regional housing partnerships, authorities, and groups
- Local and regional transportation providers (all modes)
- Local community-based organizations
- Local financial development corporation and economic development corporations
- Local legislators
- Local police and fire departments
- MPO and CCJTC members
- Portuguese language media (print and radio)
- Public and private educational institutions and school departments
- Religious institutions
- Town clerks, managers, departments of public works directors, town planners, and other similar town personnel
- Town councils
- Transportation consulting firms
- Veterans services

PORTUGUESE-LANGUAGE COMMENT LINE

In an effort to ensure that anyone with questions or comments on the plan was heard, a Portuguese-language comment line was set up to field calls from Portuguese-speaking individuals. The recorded message, in Portuguese, thanked the caller for their interest in the plan and asked

that they leave their name and number so that staff, with the assistance of a translator, could respond to them.

PLAN WEBSITE AND SURVEY

The website dedicated to the development of the 2024 RTP was created as a place where the public could find general information about the plan development, learn about upcoming meetings, access materials from past meetings, complete the online survey, download the draft RTP, and provide comments. A link to the website was included on all project materials and linked from the Cape Cod MPO website. The website included a statement in Portuguese with contact information should they need the information in another language. A Portuguese-language version of the website was also provided through real-time Google translation.

BUS SIGNS

In addition to hosting an open house at the Hyannis Transportation Center, a regional intermodal hub, further efforts were made to ensure that transit riders had an opportunity to participate in the development of the document. Signs, as shown in Figure 3, were placed on all Cape Cod Regional Transit Authority buses and paratransit vehicles. The message on the sign was presented in both English and Portuguese.

Figure 4. Yard signs at the Hyannis Transportation

YARD SIGNS

Yard signs with a QR code to the RTP webpage were distributed throughout the region, including on the region's bike paths and bus stops. The two-sided yard signs included messaging in both English on one side and Portuguese on the other side. The yard signs assisted with an increase in response to not only the RTP webpage where viewers gained a general awareness of the development of the RTP, but also to the online survey and mapping tool.

OUTREACH FLYERS AND HANDOUTS

Business card-sized outreach cards were developed to hand out at all public events attended by staff during the development in the plan. A few versions were created through the process, including a version to guide people to the online survey, but included a link to the website where information was kept up to date. Similar information was contained on water bottles and a banner used in outreach activities.

Regional Transportation Plan Survey

To facilitate public input in the development of the RTP, an online survey was developed and advertised through several outreach techniques as discussed earlier in this chapter. The RTP survey was advertised at RTP and other local and regional meetings and open houses distributed through the extended email distribution list, social media platforms, and picked up by a number of local media outlets. The online survey was open from March 24, 2023, 2023 through April 19, 2023 , 2023 and a total of 382 responses were received.[2] A summary of results in presented in the section of the plan with additional data presented in Appendix O.

RTP VISION STATEMENT & GOALS

The online survey began with a draft vision statement and draft goals. In question 1 respondents were asked to provide any suggested additions or revisions. Responses were used in refining the vision statement included in this plan.

LIVE~WORK~PLAY

This section included a series of questions to better understand how respondents typically use the transportation system.

Question 2: "Where do you live?" There were 382 responses. All 15 Cape towns were represented with the highest frequency in Falmouth (67 responses) and Barnstable (50 responses).

Question 3. "Where do you typically work/go to school?" Respondents were presented with a drop-down list of Cape Cod town names, "N/A" and "Other." There were 374 responses to this question with the largest frequency of respondents selecting Off Cape (66) and "N/A" (62).

Question 4. "If you work in a hybrid mode, how many days do you typically work in the office?" Respondents were presented with a drop-down list with a range of options from less than once a week to 4+ days/week. Respondents could also select "N/A" as an option. There were 380 responses to this question. The most frequent answers were "N/A" (191) and 4+ days/week (74).

Question 5. "Have any of the following changes caused you to adjust the way you travel?" Respondents were instructed to check all that applied, in total there were 617 responses to this question. The most frequent answer was Congestion (207).

Question 6. "Besides home or work/school trips, what town do you spend most of your time? (Visit, shopping, entertainment …)" Respondents were presented with a drop-down list of Cape Cod town

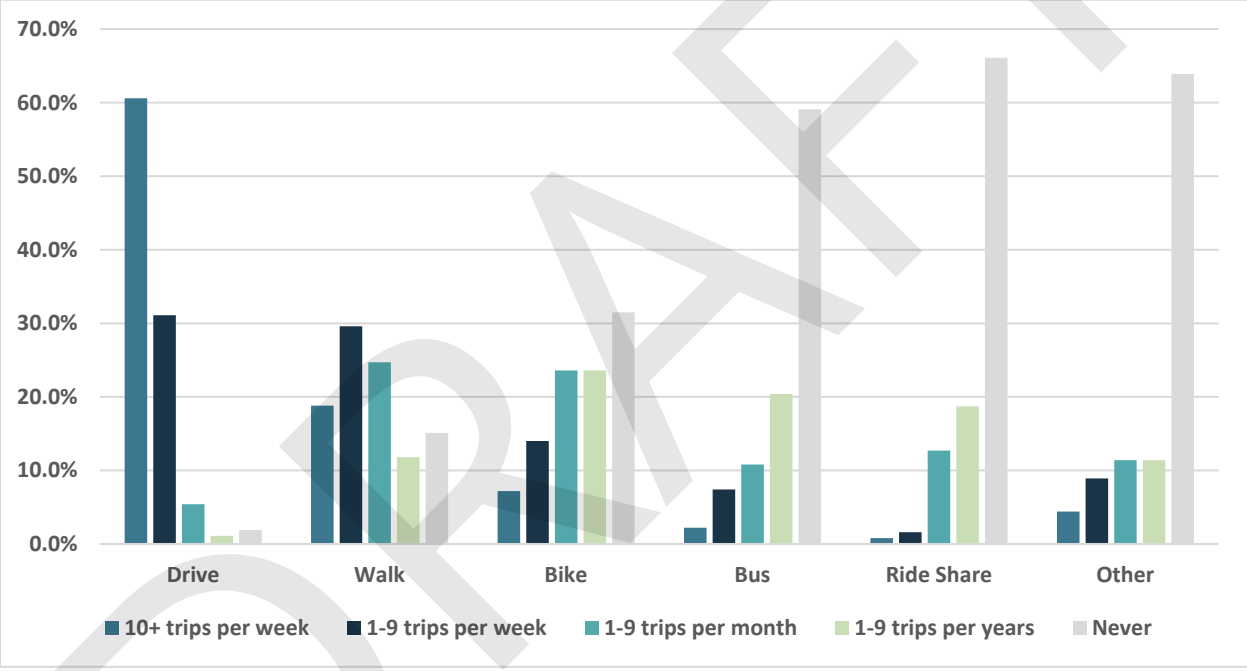
[2] Given the relatively small sample size and the potential for self-section bias, the survey results should not be assumed to be necessarily representative of the overall population of Cape Cod

names, Off Cape, and "Other." There were 377 responses to this question. The most frequently selected towns include Barnstable (82), Falmouth (61) and Off Cape (37).

Question 7. "How frequently do you travel by each of the following modes of transportation?" Possible choices included: Drive, Walk, Bike, Bus, Ride Share, Other. Choices of frequency included: 10+ trips per week, 1-9 trips per week, 1-9 trips per month, 1-9 trips per year, never.

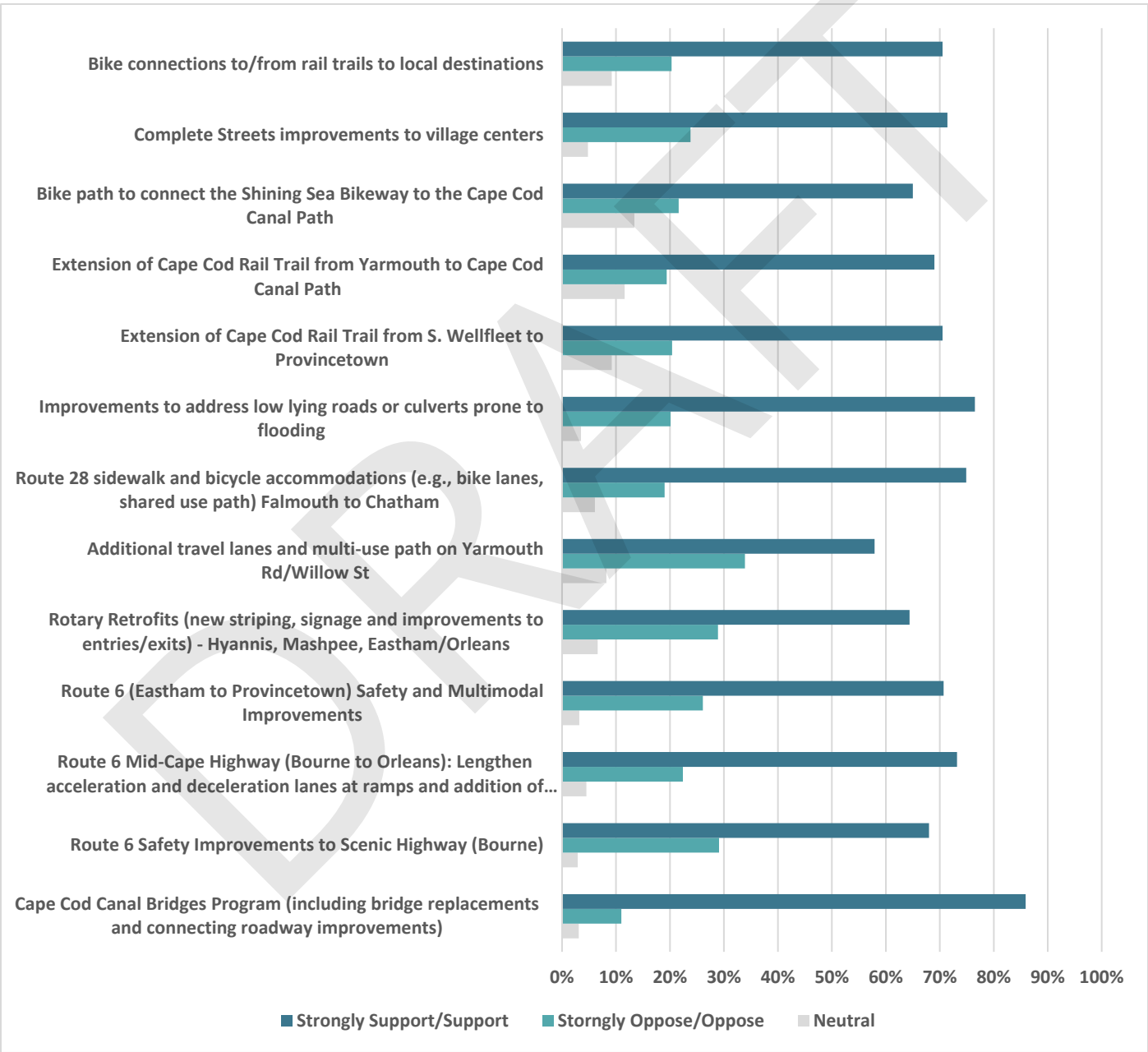
As shown in Figure 5. , the most frequently used mode of travel is to drive. Walking was generally the second most popular travel mode, followed by bicycling. Using the bus as a means of transportation has also seen an increase in response since the last RTP survey.

Figure 5. Responses: "How frequently do you travel by each of the following modes of transportation"



Question 8. "Support for Potential Transportation Projects". Respondents were then asked to indicate their support for the several projects. For each project, respondents were offered the following choices: Strongly oppose, Oppose, Neutral, Support, Strongly Support. Responses are summarized in Figure 6. .

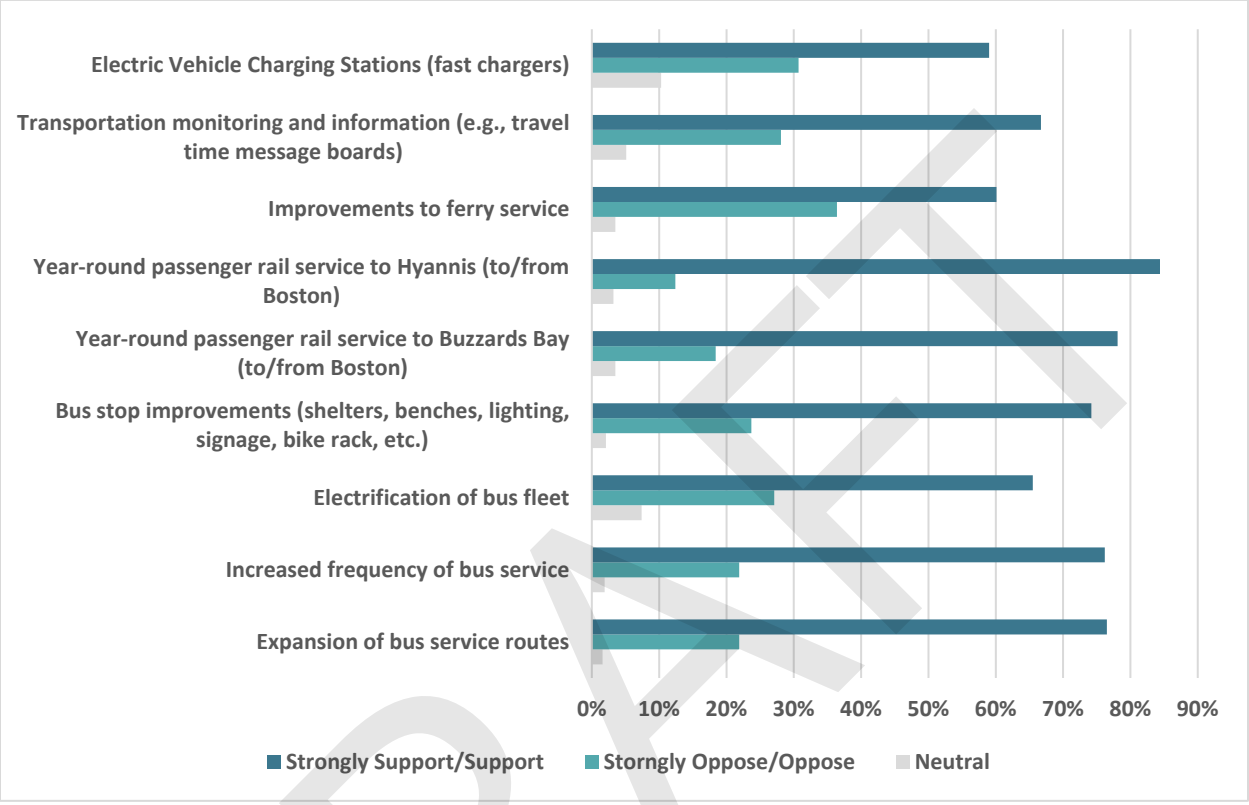
Figure 6. Level of Support for Potential Projects



Question 9. "Support for Potential Transit Projects". Respondents were asked to indicate their support for the several transit projects. For each project, respondents were offered the following

choices: Strongly oppose, Oppose, Neutral, Support, Strongly Support. Responses are summarized in 7.

Figure 7. Level of Support for Potential Transit Projects



Question 10. "Other Project Support". In response to question 8 and question 9, respondents were asked "Are there any other project(s) would you support?" There were 183 responses to this question. The responses to this question are presented at length in Appendix O.

BUDGET CHALLENGE

Recognizing that a limited amount of funding is available to address the transportation problems in the area, respondents were asked to indicate their level of support for the following types of transportation investment. For each investment type respondents could assign from 1 to 5 stars. Responses are summarized in Table 4.

TABLE 4. Level of Support by Type of Investment

INVESTMENT TYPE	LEVEL OF SUPPORT (STARS)
Roadway projects to correct safety issues	3.90
Roadway projects to reduce congestion/improve air quality	3.76
Roadway pavement maintenance	3.95
Bicycle/pedestrian improvements	3.78
Transit service	3.92
Intelligent transportation systems (e.g., travel time message boards, real-time traffic monitoring)	2.94
Climate Adaptation (Resiliency projects including addressing low lying roads)	3.18
Climate Mitigation (e.g. Electric vehicle charging stations, electric buses)	3.19

OTHER

Lastly, a final text box was provided for respondents to provide any additional comments or suggestions. A summary of these comments is available in Appendix O. Following this page, the respondents are taken to the Mapping Exercise.

MAPPING EXERCISE

Cape Cod Commission GIS staff prepared an online mapping tool to help respondents identify specific locations where proposed improvements by mode can be shared. As shown in Figure 8, nearly 100 unique locations were identified in the online mapping tool. A summary of the written comments is available in the appendix.

The responses gathered in this exercise will be shared with local Departments of Public Works Departments, MassDOT, the CCRTA, and other agencies.

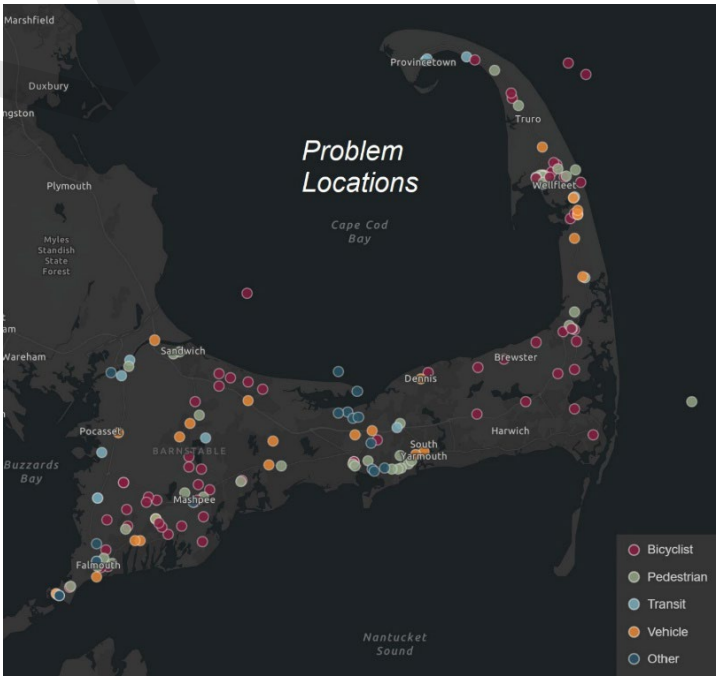


Figure 8. Identified Problem Locations - RTP Online Survey

Chapter 2: Goals, Objectives, and Performance Measures and Targets

The Regional Transportation Plan (RTP) was developed through a performance-driven, outcome-based approach. This chapter details the Vision, Goals, Objectives, and Performance Measures and Targets of the RTP. This chapter also includes Policies and Strategies for reaching the Performance Targets. Finally, this chapter provides a framework for tracking progress towards performance targets and, to the greatest extent possible with the available data, provides an assessment of the current state of the transportation system with respect to the performance targets.

PERFORMANCE-BASED PLANNING AND PROGRAMMING

Performance-based planning and programming (PBPP) refers to the application of performance management principles within the planning and programming processes of transportation agencies to achieve desired performance outcomes for the multimodal transportation system.[3]

The Cape Cod MPO's PBPP approach consideration and implementation of projects, strategies, and services that will address the following factors:

- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
- Increase the safety of the transportation system for motorized and non-motorized users;
- Increase the security of the transportation system for motorized and non-motorized users;
- Increase accessibility and mobility of people and freight;
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;
- Promote efficient system management and operation;
- Emphasize the preservation of the existing transportation system;

[3] Performance Based Planning Guidebook
http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

- Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation; and
- Enhance travel and tourism.

While PBPP has a key fixture of transportation legislation since Moving Ahead for Progress in the 21st Century (MAP-21), required that "the metropolitan transportation planning process shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals…."[4]

The seven national performance goals for the Federal Highway programs, as established by MAP-21 and continued the Fixing America's Surface Transportation (FAST) Act and current federal transportation legislation, the Infrastructure and Jobs Act (IIJA)/Bipartisan Infrastructure Law (BIL) are as follows:

- **Safety** - To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- **Infrastructure Condition** - To maintain the highway infrastructure asset system in a state of good repair
- **Congestion Reduction** - To achieve a significant reduction in congestion on the National Highway System
- **System Reliability** - To improve the efficiency of the surface transportation system
- **Freight Movement and Economic Vitality** - To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
- **Environmental Sustainability** - To enhance the performance of the transportation system while protecting and enhancing the natural environment.
- **Reduced Project Delivery Delays** - To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices[5]

The goals, objectives, and performance measures and targets set forth is this RTP reflect these national goals as well as priorities for the state and our planning region, including the US DOT's FFY 2022-2026 Strategic Plan and the Equity Action Plan. State, regional, and local plans, including Freight, Rail, Bicycle Transportation, and Pedestrian Transportation plans, identify a number of

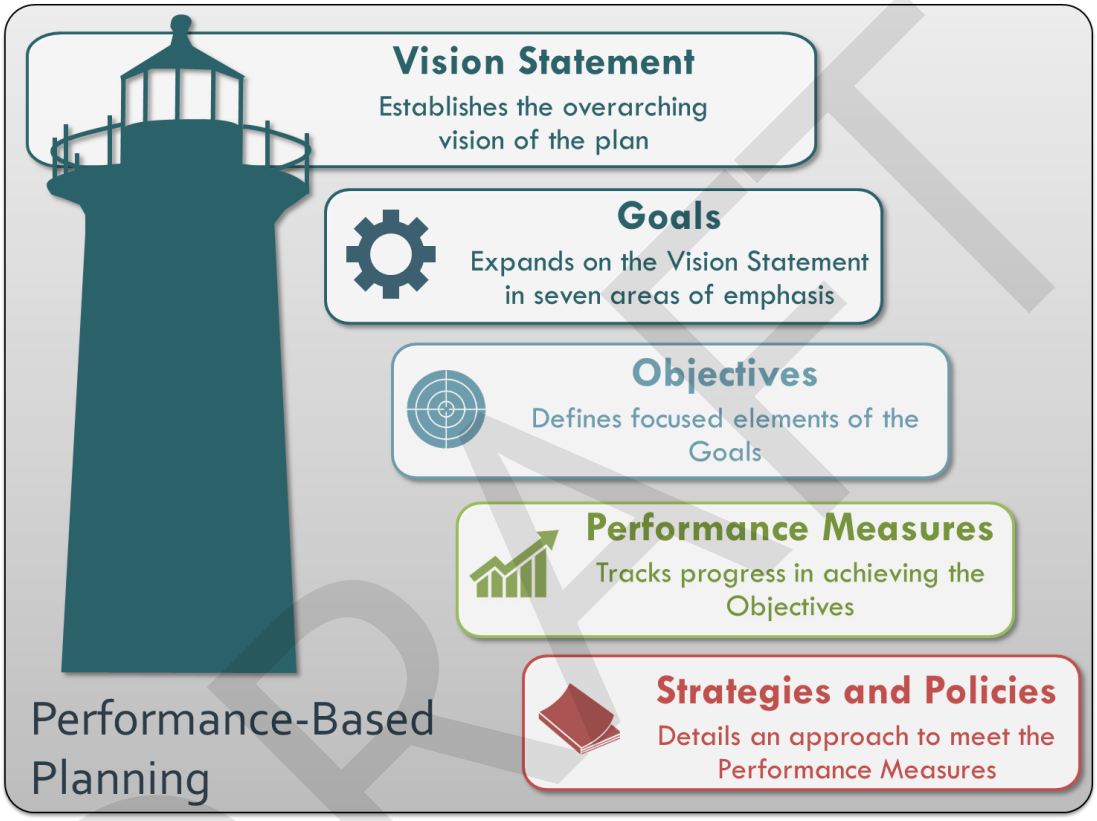
[4] 23 USC Section 134(h)(2); 49 USC Section 5303(h)(2)

[5] 23 USC Section 150(b)

these priorities and were considered in the development of goals, objectives, and performance measures and targets in this RTP. This coordination is detailed later in this chapter.

The relationship of goals, objectives, and performance measures as well as polices and strategies are depicted in Figure 9.

Figure 9. Performance-based Planning Structure



VISION STATEMENT

The RTP vision statement establishes the overarching vision of the document. The vision statement for the 2024 RTP is as follows:

The Cape Cod Metropolitan Planning Organization, informed by public input, envisions a multi-modal transportation system that supports the environmental and economic vitality of the region through infrastructure investment that focuses on safety, livability, sustainability, resiliency, equity, and preservation of the character that makes our special place special.

In support of this vision, the MPO identified the following goals for the 2024 RTP. As shown in Figure 10, although Equity is not a standalone goal, it will be considered throughout all of the RTP goals.

Figure 10. 2024 RTP Goals

GOALS AND OBJECTIVES

The goals and objectives discussed in the following sections reflect the collective vision of the MPO in consideration of the thoughtful input provided from a wide range of individuals throughout the development of the RTP.

One of the ways that the RTP most directly affects change on the transportation system is through TIP projects that are programmed consistent with the framework of the RTP. The TIP details specific transportation projects that are anticipated to be advertised for construction within the next four federal fiscal years. For each year in the TIP, there is a limited amount of regional discretionary funding from which the MPO selects what are generally referred to as "TIP target projects." Within any given year there may be additional projects from other funding sources such as statewide roadway maintenance and statewide bridge projects. These projects are generally identified through systematic statewide analysis. Both "TIP target projects" and projects from other funding sources effect change in the transportation system but, given the different level of MPO input involved in identifying each type of project, they are dealt with in slightly different manners relative to performance measures. All "TIP target projects" are evaluated using TIP Transportation

Evaluation Criteria which will be updated to reflect the goals, objectives, performance targets, and recommendation of this plan.

As our region, the state, and federal agencies gain more experience with performance measures there will likely be modification to these measures and targets. Additionally, as the region improves its ability to capture and analyze wider datasets, more robust performance measures and targets may be possible. These performance measures and targets, however, represent an important first step in in establishing a true performance-based planning approach.

Safety

While the number of traffic-related fatalities generally trends down nationally, it is important to recognize that any fatality is a tragic event and the public expects that all efforts will be taken to ultimately eliminate traffic-related fatalities. To that end, the Federal Highway Administration, Federal Motor Carrier Safety Administration, and National Highway Traffic Safety Administration are committed to the *Zero Deaths* and Safe System initiative.[6]

The MPO is also supportive of the *Zero Deaths* and Safe Systems and will be preparing the region's first Safety Action Plan grant later in 2024 as part of a FHWA Safe Streets For All grant. , The first goal of the RTP is Safety and continues to be a priority for the region.

GOAL 1: IMPROVE SAFETY FOR ALL MODES

Objectives:

- Reduce the number and severity of crashes associated with all modes of transportation
- Eliminate serious injuries and fatalities associated with all modes of transportation
- Apply a Safe Systems approach to investment decisions including a focus on safe speeds

The performance measures reflect both a commitment to use available resources to improve safety as well as specific targets to track progress. The tracking of fatal crashes and serious injury crashes and rates is consistent with federal guidance and the goals of the Massachusetts Strategic Highway Safety Plan.[7] The decision to specifically analyze crashes involving bicyclists and pedestrians in addition to motor vehicle crashes reflects that region's recognition of improving safety for these vulnerable road users.

Strategies aimed at achieving the objectives under this goal include:

[6] http://safety.fhwa.dot.gov/tzd/

[7] https://www.mass.gov/doc/massachusetts-shsp-2023/download

- **Continuously monitor** the condition of the transportation system to ensure that it is safe to travel on all modes throughout Cape Cod.
- Develop a **Cape Cod Regional Safety Action Plan** and adopt a Safe System approach, as part of the FHWA Safe Streets for All initiative.
- **Fully program** minimum HSIP targets each TIP year and seek to program Statewide HSIP funds when available/feasible for priority safety related projects.
- Reduce crashes, serious injury crashes, fatal crashes, and crashes involving older drivers, crashes involving younger drivers, and crashes involving bicycles and pedestrians by **10% in 10 years**.
- Reduce the fatality and serious injury rates by **10% in 10 years**.
- Focus attention on the **strategic initiatives** identified in Massachusetts Strategic Highway Safety Plan such as: speed management, public education and awareness, addressing top-risk locations/populations, safe vehicles design, pursue new technologies and research, and increase road safety audits,
- **Identify high priority safety locations** throughout Cape Cod and then determine measures to increase safety at those locations.
- **Separate high- and low-speed travel modes**, so that those traveling at slower speeds, such as bicycles and pedestrians, do not conflict with those traveling at higher speeds, such as rail and automobile traffic.
- Existing multilane roads (cross-sections of four or more lanes) are recommended to be modified via removal of unneeded lanes or installation of **landscaped median dividers** to provide a reasonable level of safety and access management.
- **Encourage safe use** of the transportation network through public awareness campaigns, promoting such things as seatbelts for motorists and helmet use for bicyclists.
- **Incorporate intelligent transportation systems**, such as variable message signs and other media alerts, into the emergency response system.
- Foster **communication and cooperation** between federal, state, and local agencies for the planning, practice, and implementation of emergency scenario plans.
- Designate and indicate, through road signs, **emergency evacuation routes and shelters**.
- Support enforcement of state and local **traffic laws**.
- Increase **surveillance and security efforts at transportation facilities** throughout Cape Cod, such as the Hyannis Transportation Center, Falmouth Bus Depot, Woods Hole port facilities, park-and-ride lots, and Cape Cod Canal Bridges.

Additionally, in support of this goal, the Cape Cod MPO supports the following policies:

- For proposed roadways with cross-sections of four or more lanes, **landscaped median dividers shall be included** to provide a reasonable level of safety and access management.
- To reduce injury crashes, when developing intersection improvements involving signalization of a previously unsignalized location, construction of a **modern roundabout** shall be considered as one of the alternatives.

Environmental and Sustainability

The importance to ensure Cape Cod's environment is sustainable and resilient in the long term is paramount. Future impacts of climate change within the region have been realized and we must now take action to protect our natural environment and mitigate the impacts of climate change. Any threat to Cape Cod's environment is a threat to the overall vitality of the region.

GOAL 2: MAINTAIN, PROTECT, AND ENHANCE THE NATURAL ENVIRONMENT AND REDUCE GREENHOUSE GAS EMISSIONS

Objectives:

- Minimize negative impacts of the transportation system on the natural environment
- Reduce Greenhouse Gas (GHGs) emissions in support of the state-wide net zero carbon target by 2050
- Accelerate the electrification of the transportation system
- Improve stormwater management and treatment to improve impaired fresh and marine water resources
- Improve resiliency of the transportation system to address critical low lying roads and design infrastructure to meet the challenges of our changing climate

Strategies aimed at achieving the objectives under this goal include:

- Develop strategies to **reduce vehicle miles traveled (VMTs)**
- Encourage efforts that allow people to **work from home** and support the development of **shared office space** in regional centers to reduce commuting traffic
- Encourage the use of **healthy transportation** modes that reduce air pollution, fuel consumption, and other environmental impacts such as greenhouse gas emissions.
- Pursue strategies that will get automobiles and trucks moving at **speeds that will minimize air pollution**.
- Replace public buses and vehicles with **fuel-efficient, electric, hybrid, or bio-diesel** vehicles that will reduce fossil fuel consumption.
- Continue to advocate for future year-round commuter rail service to Cape Cod.
- Design roadways to **drain and cleanse oil and gasoline runoff** away from aquifers and other sensitive environmental areas.
- Encourage design decisions and construction practices that **minimize resource consumption** such use of reclaimed materials in paving projects, use of energy efficient lighting fixtures, and choice of drought-tolerant, low-maintenance landscaping elements
- **Protect drinking water** from materials used in the design, construction, operation, and maintenance of transportation facilities, such as road salt.

- Implement projects in the Transportation Improvement Program (TIP) consistent with the goal. Specifically:
    - 50% of TIP target projects should reduce GHGs and provide overall benefits to the natural system
    - 50% of TIP projects outside of sensitive areas and 100% of TIP projects within sensitive areas should provide improved stormwater management and treatment
    - TIP projects should improve signal operations at 5 locations along key corridors every 5 years
    - TIP projects should close 5 gaps in the bicycle or pedestrian network every 5 years

Additionally, in support of this goal, the Cape Cod MPO supports the following policies:

- To reduce emissions from idling vehicles, when developing intersection improvements involving signalization of a previously unsignalized location, construction of a **modern roundabout** shall be considered as one of the alternatives.
- As roadway improvement projects are developed, **stormwater management** techniques shall be included to manage and treat surface runoff. Stormwater Best Management Practices (BMP), including Low Impact Development (LID) where feasible, shall be followed. Stormwater treatment benefits of all TIP projects shall be quantified by the design engineer and included in the design plans.

Livability and Economic Vitality

Livability and economic vitality are about supporting strong communities that people will want to live in now and in the future.

Livability is about fostering communities where coordinated transportation, housing, and commercial development give people access to affordable and environmentally sustainable transportation. Incorporating livability approaches into transportation, land use, and housing policies can help improve public health and safety, lower infrastructure costs, reduce combined household transportation and housing costs, reduce vehicle miles traveled, and improve air and water quality, among many other benefits.[8]

GOAL 3: SUPPORT LIVABLE COMMUNITIES AND VILLAGE CENTERS THAT STRENGTHEN THE LONG-TERM ECONOMIC VITALITY OF THE REGION

Objectives:

- Support mixed-use development in compact centers of activity

[8] http://www.fhwa.dot.gov/livability/fact_sheets/benefits.pdf

- Improve connections between housing, job, cultural centers, and essential services within and beyond the region
- Develop a transportation system that is consistent with the local character of Cape Cod for the region's residents and visitors
- Support land use strategies and investments in the roadway network that encourage walkability, public transit, and promote appropriate connections to housing

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Strategies aimed at achieving the objectives under this goal include:

- Support **community activity centers** with a broad range of transportation options, such as roadways, transit, bicycle and pedestrian facilities.
- Projects that **improve access to or within community activity centers** should be identified and prioritized.
- Focus on closing gaps in the bicycle and pedestrian network identified in previous analysis of **connections to community activity centers**.
- Projects that improve the transportation **system's resiliency** to the effects of sea level rise should be identified and prioritized.
- All transportation projects and programs must be **responsive to the natural and built environments** within which they are undertaken.
- Use **landscaping and noise barriers** to protect communities and minimize adverse impacts.
- Involve community and business leaders in transportation projects and programs to ensure that local concerns are addressed.
- Avoid, minimize or mitigate the impact of transportation improvements on parks, recreation areas, historic sites, and other **scenic or cultural resources** and minimize impact on overall community character.
- Support transportation projects consistent with **Local Comprehensive Plans**.
- Identify opportunities and seek funding to incorporate the art and local artists in the process of designing projects that reflect the Cape Cod community
- Implement age and dementia friendly designs into transportation projects
- Implement projects in the Transportation Improvement Program (TIP) consistent with the goal. Specifically:
    - 25% of TIP target projects should improve access to or within community activity centers
    - The potential impacts of sea level rise should be evaluated for all TIP projects during the 25% design review and adjustments to projects should be made as warranted
    - All TIP projects should provide opportunities for local input including public meeting prior to development of design plans and throughout the design process and take into consideration the project's Placetype location

- Develop a transportation system that supports the **economic vitality of Cape Cod** and its metropolitan areas
- Prioritize projects that are consistent with the **economic development goals** of the Regional Policy Plan (RPP)[9] and the **regional priority projects** detailed in the Comprehensive Economic Development Strategy (CEDS)[10]
- Work with the Executive Office of Housing and Economic Development to identify **Priority Development Areas and Priority Protection Areas** on Cape Cod

Additionally, in support of this goal, the Cape Cod MPO supports the following policies:

- Design of all TIP projects shall consider the **environmental, historic, and cultural context** in which a project they are being proposed. The eight Cape Cod Placetypes articulated in the RPP may be helpful in identifying the defining characteristics and context of a given project.
- Consistent with current MassDOT sign policy, **business logo signs** shall not be allowed on Route 6 east of the Cape Cod Canal. "Sponsor a highway" signs with business logos may be allowed at the discretion of the MassDOT District Office Director.
- For all TIP projects, potential **impacts of sea level rise**, any mitigating actions to be taken, and/or reasons such actions are infeasible shall be identified by the design engineer and included in the design plans.
- All TIP projects shall provide opportunities for **local input** including public meetings prior to development of design plans and throughout the design process.

Multimodal Options/Healthy Transportation

In October 2012 MassDOT announced an ambitious Mode Shift Goal of tripling mode share by walking, bicycling, and transit by 2030. In support of this goal, the Healthy Transportation Policy Directive was issued in September 2013 requiring that all MassDOT projects are designed and implemented in a way that all our customers have access to safe and comfortable healthy transportation options at all MassDOT facilities and in all the services. The recent Massachusetts Bicycle Transportation Plan[11] and Pedestrian Transportation Plan[12] build on these efforts with actionable recommendations.

[9] Available at: www.capecodcommission.org/rpp
[10] Available at: www.capecodcommission.org/ceds
[11] https://www.mass.gov/service-details/bicycle-plan
[12] https://www.mass.gov/service-details/pedestrian-plan

As a region, Cape Cod has always been supportive of varied and healthy transportation options. Whether by choice or necessity, moving around the region without a personal automobile is critical to many users of the transportation system.

GOAL 4: PROVIDES A VARIETY OF HEALTHY TRANSPORTATION OPTIONS TO ALL USERS

Objectives:

- Improve accessibility of all modes to all users
- Apply Complete Streets principles to all projects
- Expand and close gaps in the bicycle and ADA-accessible sidewalk networks
- Improve coordination between all modes
- Increase the share of travel by means other than the single occupancy vehicle

Strategies aimed at achieving the objectives under this goal include:

- **"Complete Streets"** designs are encouraged to accommodate all users including pedestrians, bicyclists, persons in wheelchairs or strollers, public transportation users, and motorists.
- Sufficient **mobility** must be provided to ensure that individuals and freight can travel safely and efficiently among the communities of Cape Cod and their neighbors.
- **Examine expansion of bus, rail and bicycle services** and infrastructure to villages and town centers currently un-served by alternative transportation modes.
- **Provide bicycle amenities**, such as racks and/or lockers, at park-and-ride lots, transit centers, and village centers that support bicycle networks.
- Assess ADA compliance of signalized and circular intersections and work to increase the number of **ADA-compliant intersections**.
- **Coordinate public transportation** services and schedules between regions and between providers to decrease wait times for users during connections.
- Continue to explore the potential for increased rail service to the region, including expanded seasonal rail service and **year-round commuter rail service**
- **Coordinate public transportation** services and schedules between regions and between providers to decrease wait times for users during connections.
- Focus on closing gaps in the bicycle and pedestrian network identified in previous analysis of **connections to transit routes and village centers**.
- Implement projects in the Transportation Improvement Program (TIP) consistent with the goal. Specifically:
    - TIP projects should increase the number of ADA-compliant signalized and circular intersections by 10% in 10 years
    - TIP projects should close 5 gaps in the bicycle or pedestrian network every 5 years

Congestion Reduction

Congestion has significant adverse impacts on the movement of people and goods. Delay and poor travel time reliability negatively impact the economy and can lead to driver frustration and safety concerns. Congestion affects all modes of travel including the personal automobile, public transportation vehicles, bicycles, and pedestrians. Additionally, congestion affects other entities, such as businesses that rely on transportation access for their employees and customers. Congestion also produces more air pollution and increases greenhouse gas emissions that contribute to global warming and decreases the overall attractiveness of the region.

The objectives and performance measures under this goal are a key part of a comprehensive Congestion Management Process (CMP) for the region.

GOAL 5: REDUCE CONGESTION AND IMPROVE TRAVEL TIME RELIABILITY

Objectives:

- Reduce delay for all modes
- Address congestion at bottleneck locations
- Improve connectivity and reliability for all modes of transportation
- Minimize the impacts of construction delays on all users, particularly impacts of Cape Cod Canal Bridge repair, maintenance and construction activities

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Strategies aimed at achieving the objectives under this goal include:

- Support the implementation of **advanced construction techniques** for Cape Cod Canal Bridge maintenance and construction projects to reduce impacts compared to standard construction practices
- Consider strategies to **address the behavioral causes** of traffic congestion such as VMT reduction strategies as well as changes to transportation infrastructure.
- Where possible, **incorporate the Congestion Management Process**, including new roadways, intersection improvements, park-and-ride, and transit capacity, into transportation projects and programs.
- **Support all strategies** for transportation demand management including, but not limited to, Transportation Management Associations, flexible hours, carpooling, bus pass programs, preferential parking, and telecommuting.
- Encourage **transit-oriented development** and provide alternatives to automobile travel by linking land use decisions with transit, bikeway, pedestrian, and park-and-ride investments.
- Consider the feasibility of **congestion pricing** on major routes on Cape Cod.
- Assess the capacity of Cape Cod's ports and harbors in accommodating ferry traffic and recommend strategies to solve existing **ferry congestion** or prevent future congestion.

- Examine the **road traffic around Cape Cod's ports and harbors** to determine the ability of the current infrastructure to accommodate ferry-related auto traffic
- Assess the capacity of Cape Cod's airports in accommodating air traffic and recommend strategies to solve existing **air traffic congestion** or prevent future congestion.
- Examine the **road traffic around Cape Cod's airports** to determine the ability of the current infrastructure to accommodate air-related auto traffic.
- **Coordinate public transportation** services and schedules between regions and between providers to decrease wait times for users during connections.
- Support efforts to reduce congestion during Cape Cod Canal Bridge maintenance and construction projects by providing **enhanced public transportation options** and public information and outreach with information on times to travel and modal options.
- Encourage the Army Corps of Engineers and MassDOT to implement all feasible **advanced construction techniques** for Cape Cod Canal Bridge maintenance and construction projects to reduce construction impacts in the surrounding area. This should include innovative construction contracted that incentives safety and minimizing delay and state-of-the-art traffic management practices
- Implement projects in the Transportation Improvement Program (TIP) consistent with the goal. Specifically: TIP projects should improve operations at 2 bottleneck locations every 5 years

Additionally, in support of this goal, the Cape Cod MPO supports the following policy:

- To reduce traffic congestion and facilitate free-flowing traffic, when developing intersection improvements involving signalization of a previously unsignalized location, construction of a **modern roundabout** shall be considered as one of the alternatives.

System Preservation

As transportation infrastructure on Cape Cod ages, maintenance and preservation efforts will be critical to maintaining a safe and functional transportation system. Many of the elements of the transportation system are near the end of their design life meaning that significant investments will be needed to extend their useful lives or replace these elements.

A critical look at allocating limited funding as well as a deployment of new and emerging technologies will be critical in meeting the challenges of future generations.

GOAL 6: PRESERVE, MAINTAIN, AND MODERNIZE THE EXISTING TRANSPORTATION SYSTEM

Objectives:

- Improve the condition of all state and municipally owned bridges

- Improve the pavement condition on all federal-aid eligible roadways
- Maintain and improve on and off-road bicycle and pedestrian facilities
- Use modern technology to improve the efficiency of the transportation system
- Improve coordination and cooperation between agencies throughout all phases of project development and implementation for all improvement and maintenance projects

Strategies aimed at achieving the objectives under this goal include:

- Reserve adequate funds for the maintenance of **alternative modes of transportation**, such as public transportation services, sidewalks, and bicycle paths.
- As transportation services are considered for areas subject to the effects of **sea-level rise**, new facilities shall be constructed with consideration to vulnerability.
- Create and implement asset management tools for **monitoring** and maintaining the existing transportation system. Include automatic traffic monitoring equipment as part of intersection upgrades.
- Support maintenance strategies and programs that **accommodate safe travel** throughout the transportation network, regardless of mode.
- Consider the **use of new technologies** that will lower costs, extend infrastructure life, lower environmental impacts, and reduce energy consumption and emissions.
- New transportation projects must consider inclusion of **intelligent transportation system (ITS)** elements, such as variable message signs, highway advisory radio, local television, web travel services, and smart signals that can provide travel data as well as react to changes in demand.
- Increase communications between agencies involved in transportation planning and utility operators to improve **coordination between utility planning and transportation planning**.
- Collaborate on the adoption of a memorandum of understanding between the MPO and MassDOT outlining how construction activities in the region (including maintenance projects) will be communicated to the MPO and how local input will be addressed by MassDOT

Freight Mobility

Safe and efficient movement of freight is critical to local economies.[13] The freight industry on Cape Cod is different from most areas because of the seasonal tourist industry, abundance of waterways, and historic culture. Congestion and poor travel time reliability affect the freight industry and, by extension, the local economics. Efforts to improve the freight network on Cape Cod will support

[13] https://www.mass.gov/files/documents/2018/09/04/Freight%20Plan508.pdf

long-term economic stability.[14] Truck travel time reliability performance measures can be found later in this chapter of the RTP.

GOAL 7: IMPROVE EFFICIENCY AND RELIABILITY OF FREIGHT MOVEMENT

Objectives:

- Reduce delays and improve travel time reliability on the freight network
- Minimize the impacts of Cape Cod Canal bridge repair, maintenance and construction activities
- Utilize the most efficient freight modes and technologies to minimize impacts on the community and the environment

Strategies aimed at achieving the objectives under this goal include:

- **Enhance the transportation of freight on Cape Cod** to decrease travel times, increase reliability and lower costs for freight transportation providers, with minimal disruption to other transportation activities.
- Where possible, work to **consolidate freight** to move goods in the most efficient manner.
- Make available **multiple modes for freight transportation**, with infrastructure and facilities that are designed to support quick and efficient changes in mode.
- Consider inclusion of alternatives to freight traffic over the bridges (increased airport freight, short sea shipping, etc.)

SUMMARY OF POLICIES

As a collection, the policies contained within this document are an important element of the approach needed to achieve the overall vision of the region:

- For proposed roadways with cross-sections of four or more lanes, **landscaped median dividers shall be included** to provide a reasonable level of safety and access management.
- When developing intersection improvements involving signalization of a previously unsignalized location, construction of a **modern roundabout** shall be considered as one of the alternatives.
- As roadway improvement projects are developed, **stormwater management** techniques shall be included to manage and treat surface runoff. Stormwater Best Management Practices (BMP), including Low Impact Development (LID) where feasible, shall be followed.

[14] http://www.capecodcommission.org/resources/transportation/2015-Freight_Study_02132015.pdf

Stormwater treatment benefits of all TIP projects shall be quantified by the design engineer and included in the design plans.

- Consistent with current MassDOT sign policy, **business logo signs** shall not be allowed on Route 6 east of the Cape Cod Canal. "Adopt a highway" signs with business logos may be allowed at the discretion of the MassDOT District 5 Highway Director.
- For all TIP projects, potential **impacts of sea level rise**, any mitigating actions to be taken, and/or reasons such actions are infeasible shall be identified by the design engineer and included in the design plans.
- All TIP projects shall provide opportunities for **local input** including public meetings prior to development of design plans and throughout the design process.

COORDINATION WITH STATEWIDE TRANSPORTATION AND OTHER REGIONAL PLANS

The RTP was developed in coordination with the following statewide and regional planning documents which served as guidance to establishing the region's vision and overall goals.

MassDOT Statewide Pedestrian Transportation Plan

The 2019 Pedestrian Transportation Plan is the State's roadmap to make walking a safe, comfortable, and convenient option for short trips for all people. The Vision, Goals and Principles identified in this Plan informed development of the RTP. The six specific initiatives identified in the Plan "*with the ultimate goals of eliminating pedestrian fatalities and serious injuries, and increasing the percentage of short trips made by walking*" inform the development of studies in the UPWP and projects in the TIP.

MassDOT Statewide Bicycle Transportation Plan

The 2019 Bicycle Transportation Plan is the State's roadmap to make biking a safe, comfortable, and convenient option for everyday travel and includes planned future investments for advancing walking and biking in the Commonwealth. As with the Statewide Pedestrian Plan, the Vision, Goals and Principles identified in this Plan informed development of the RTP. The RTP seeks to deliver, within the Cape Cod region, on the priorities identified in the Initiatives and Action Plan section of the document.

MassDOT Freight Plan

The 2023 Massachusetts Freight Plan is currently in a 30-day public comment period which ends on June 29, 2023. The Freight Plan is a planning document that will define short and long-term vision for the freight system in the Commonwealth. The principles of the draft plan are reflected in the Freight Mobility goal in the RTP.

MassDOT Rail Plan

The 2018 Massachusetts Rail Plan outlines the Commonwealth's long-term plan for the statewide rail system and identifies near term priorities and a long-term investment strategy. Published before the Cape Rail Study[15], the study identifies the infrastructure and existing freight and seasonal passenger rail service that serves Cape Cod. We look forward to future Rail Plan considering the provision of commuter rail service to Cape Cod.

Strategic Highway Safety Plan

The 2023 Massachusetts Strategic Highway Safety Plan (SHSP) is a data-driven, strategic plan that identifies key safety needs to directs funding to reduce highway fatalities and serious injuries on all public roads. The SHSP informed the development of the Safety goal of the RTP and the development of studies in the UPWP and projects in the TIP.

Cape Cod Regional Policy Plan

The Cape Cod MPO is unique in that it is staffed by Cape Cod Commission (CCC) staff who operate subject to state enabling legislation, the Cape Cod Commission Act, Chapter 716 of the Acts of 1989, as amended (the "Act"). In addition to serving as the region's regional planning agency, the Act directs that the purpose of the Cape Cod Commission shall be to:

"...further: the conservation and preservation of natural undeveloped areas, wildlife, flora and habitats for endangered species; the preservation of coastal resources including aquaculture; the protection of groundwater, surface water and ocean water quality, as well as the other natural resources of Cape Cod; balanced economic growth; the provision of adequate capital facilities, including transportation, water supply, and solid, sanitary and hazardous waste disposal facilities; the coordination of the provision of adequate capital facilities with the achievement of other goals; the development of an adequate supply of fair affordable housing; and the preservation of historical, cultural, archaeological, architectural, and recreational values."

As a result, in every endeavor, Cape Cod Commission staff strive to balance growth, the provision of adequate capital facilities and the protection of the natural resources of the Cape Cod region.

The Cape Cod Commission prepares the Cape Cod Regional Policy Plan, the regional land use policy plan for Barnstable County. The Regional Policy Plan provides a growth policy that supports the vision for the future of Cape Cod as a place of vibrant, sustainable, and healthy communities and a protected natural environment. Growth should be focused in centers of activity and areas supported by adequate infrastructure and guided away from areas that must be protected for ecological, historical or other reasons. Development should be responsive to context allowing for

[15] See www.capecodcommission.org/CapeRailStudy

the restoration, preservation and protection of the Cape's unique resources while promoting economic and community resilience.

Comprehensive Economic Development Strategy

In 2009, Cape Cod was designated an Economic Development District creating new regional opportunity for Federal Economic Development funding for projects and programs consistent with the Comprehensive Economic Development Strategy (CEDS) for Cape Cod. This important and valued designation followed an intense stakeholder driven regional planning effort to adopt a CEDS for Cape Cod, an economic blueprint for the region. The CEDS is an operational plan typically built on the policies and goals of the Regional Policy Plan thereby ensuring that the priorities, programs, and projects supported by the plan make advancements economically without undermining the region's most valuable and sensitive resources.

The CEDS is required by the US Economic Development Administration (EDA) to access funding for economic development planning and infrastructure construction. Together, the Cape Cod Commission and the Barnstable County Economic Development Council serve the governing board of the Cape Cod Economic Development District and jointly approve a CEDS 5-year plan, oversee implementation and approve annual reports documenting progress supporting the region's Economic Development Strategy. The CEDS identifies many priority transportation projects and initiatives including the replacement of the Bourne and Sagamore Bridge given how critical they are to the region's economy.

Cape Cod Section 208 Area Wide Water Quality Management Plan

The Cape Cod Section 208 Area Wide Water Quality Management Plan (208 Plan Update), certified and approved by the Governor of the Commonwealth of Massachusetts and the US Environmental Protection Agency (US EPA) in 2015, provides a path forward to define watershed-based solutions for the restoration of the waters that define Cape Cod. Watersheds, however, rarely follow political boundaries. As the regional planning agency, the Commission was able to work across municipal boundaries and bring towns together to deal with this problem at the most effective and appropriate level—the watershed. The plan recommends actions to streamline the regulatory process, make complex information more transparent and available to citizens, abate nitrogen-induced costs already impacting the region, provide more support to local community water quality efforts, and eliminate unnecessary costs.

Consistent with the 208 framework, many towns are in the process of implementing wastewater projects including installing miles of sewer pipes under roads across the region. These projects present opportunities for coordination where transportation, wastewater, and other utility improvements can be done in a way that minimizes cost and disruption.

Cape Cod Climate Action Plan

The Climate Action Plan was developed during a time of increasing concern about the changing global climate and potentially devastating local effects of widespread inaction. The Plan is the result of an intensive effort by the Cape Cod community to address a regional challenge of such significance that 79% of the region's residents believe it will impact their family's well-being. It was developed as the Commonwealth of Massachusetts took significant strides shifting the state toward a net-zero carbon emissions goal, issuing an update to the Massachusetts Clean Energy and Climate Plan and passing An Act Creating a Next-generation Roadmap for Massachusetts Climate Policy (Chapter 8 of the Acts of 2021).

Aligned with the Commonwealth's goals, the Climate Action Plan identifies strategies and actions to reduce GHG emissions and enhance local and regional resiliency to climate threats present today and increasing in severity and intensity. It was guided by several principles that shaped the approach to identifying and prioritizing solutions. The principles recognize the urgency needed in taking action and reflect consideration for the long-held regional goals that have shaped Cape Cod's growth policies and planning decisions in recent decades, as well as the considered and deliberate nature of thoughtful and responsible planning.

Transportation aspects of the Climate Action Plan are further detailed in Chapter 4 and Appendix H.

Regional Housing Strategy

Affordable and attainable housing for people with various income levels and needs is key to a vibrant, healthy, and resilient region. Cape Cod is facing a significant challenge in providing affordable and attainable housing for current and future Cape Cod residents. This impacts not only those seeking housing but also our economy, as employers may struggle to find employees locally. The region's highly constrained housing market is unaffordable to many Cape Cod residents; a problem which has only become more acute over the past few years as home prices have increased significantly.

The Regional Housing Strategy will address the housing supply, affordability, and availability issues facing the region by identifying appropriate areas for housing development and crafting policies and strategies to further its goals. Successful implementation of the Regional Housing Strategy will provide residents with safe and attainable housing and will provide a more reliable workforce and customer base for our local businesses.

FEDERALLY REQUIRED PERFORMANCE MEASURE SUMMARY

The US Department of Transportation (USDOT), in consultation with states, MPOs, and other stakeholders, established measures in performance areas relevant to the national goals. Table 5 lists federally required performance measures for the highway system and Table 6 lists federally required performance measures for the transit system.

TABLE 5. Federally Required Highway Performance Measures

NATIONAL GOAL	HIGHWAY PERFORMANCE AREA	PERFORMANCE MEASURE
Safety	Injuries and Fatalities	■ Number of fatalities ■ Fatality rate per 100 million vehicle-miles traveled ■ Number of serious injuries ■ Serious injury rate per 100 million vehicle-miles traveled ■ Number of non-motorized fatalities and non-motorized serious injuries
Infrastructure Condition	Pavement Condition	■ Percent of pavements on the Interstate System in good condition ■ Percent of pavements on the Interstate System in poor condition ■ Percent of pavements on the non-Interstate NHS in good condition ■ Percent of pavements on the non-Interstate NHS in poor condition
Infrastructure Condition	Bridge Condition	■ Percent of NHS bridges by deck area classified as in good condition ■ Percent of NHS bridges by deck area classified as in poor condition
System Reliability	Performance of the National Highway System	■ Percent of person-miles traveled on the Interstate System that are reliable ■ Percent of person-miles traveled on the non-Interstate NHS that are reliable
System Reliability, Freight Movement, and Economic Vitality	Freight Movement on the Interstate System	■ Truck Travel Time Reliability Index
Congestion Reduction	Traffic Congestion	■ Annual hours of peak hour excessive delay per capita (for travel on NHS roadways) ■ Percent of non-single-occupant vehicle travel
Environmental Sustainability	On-Road Mobile Source Emissions	■ Total emissions reductions

TABLE 6. Federally Required Transit Performance Measures

NATIONAL GOAL	TRANSIT PERFORMANCE AREA OR ASSET CATEGORY	PERFORMANCE MEASURE
Safety	Fatalities	■ Total number of reportable fatalities and rate per total vehicle revenue-miles by mode
Safety	Injuries	■ Total number of reportable injuries and rate per total vehicle revenue-miles by mode
Safety	Safety Events	■ Total number of reportable events and rate per total vehicle revenue-miles by mode
Safety	System Reliability	■ Mean distance between major mechanical failures by mode
Infrastructure Condition	Equipment	■ Percent of vehicles that have met or exceeded their Useful Life Benchmark (ULB)
Infrastructure Condition	Rolling Stock	■ Percent of revenue vehicles within a particular asset class that have met or exceeded their ULB
Infrastructure Condition	Infrastructure	■ Percent of track segments with performance restrictions
Infrastructure Condition	Facilities	■ Percent of facilities within an asset class rated below 3.0 on the Federal Transit Administration's Transit Economic Requirements Model scale

Targets for federally required performance measures must be set according to timelines established in the current federal transportation legislation.

Safety Performance Measures (PM1)

The Cape Cod MPO has chosen to adopt the statewide safety performance measure targets set by MassDOT for Calendar Year (CY) 2023. In setting these targets, MassDOT has followed FHWA guidelines by using statewide crash data and Highway Performance Monitoring System (HPMS) data for vehicle miles traveled (VMT) in order to calculate 5 year, rolling average trend lines for all FHWA-defined safety measures.

Due to higher rates of speeding caused by decreased vehicle miles traveled (VMT) amid pandemic shutdowns in 2020 and the lingering impacts in 2021, 2020 and 2021 fatalities and serious injuries increased relative to previous years. This increase means MassDOT was unable to use a pure trendline approach to set CY2023 targets that "demonstrate constant or improved performance" as required by the Infrastructure Investment and Jobs Act (IIJA). Rather than adopt a target that depicts an increase in the trend line, MassDOT developed targets by projecting 2022 and 2023 fatalities and serious injuries numbers based on a rate of change consistent with recent trends. This methodology was developed to project a future downward trend without it being significantly influenced by the lingering impacts of the pandemic.

In recent years, MassDOT and the Cape Cod MPO have invested in "complete streets," bicycle and pedestrian infrastructure, and safety improvements in both the Capital Investment Plan (CIP) and Statewide Transportation Improvement Program (STIP) to address increasing mode share and to incorporate safety mitigation elements into projects. Moving forward, the Cape Cod MPO, alongside MassDOT, is actively seeking to improve data collection and methodology for bicycle and pedestrian VMT counts and to continue analyzing crash clusters and crash counts that include both motorized and non-motorized modes in order to address safety issues at these locations. In all safety categories, MassDOT has established a long-term target of "Toward Zero Deaths" through MassDOT's Performance Measures Tracker and will be establishing safety targets for the MPO to consider for adoption each calendar year. While the MPO is not required by FHWA to report on annual safety performance targets, FHWA guidelines require MPOs to adopt MassDOT's annual targets or to establish their own each year.

The safety measures MassDOT has established for CY23, and that the Cape Cod MPO has adopted, are as follows:

1) Fatalities: The target number of fatalities for years CY 2023 is 355, down from an average of 360 fatalities for the years 2017-2021. [See Figure 11 and Figure 12 for the Cape Cod trend and statewide trend for this performance measure]
2) Rate of Fatalities per 100 million VMT: The target fatality rate for years CY 2023 is 0.59, equivalent to the 0.59 average for years 2017-2021. [See Figure 11 and Figure 12 for the Cape Cod trend and statewide trend for this performance measure]
3) Serious Injuries: The target number of incapacitating injuries for CY 2023 is 2,569, down from the average of 2,626 for years 2017-2021. [See Figure 13 and Figure 14 for the Cape Cod trend and the statewide trend for this performance measure]
4) Rate of Incapacitating Injuries per 100 million VMT: The incapacitating injury rate target for CY 2023 is 4.25 per year, down from the 4.30 average rate for years 2017-2021. [See Figure 13 and Figure 14 for the Cape Cod trend and the statewide trend for this performance measure]
5) Total Number of Combined Incapacitating Injuries and Fatalities for Non-Motorized Modes: The CY 2023 target number of fatalities and incapacitating injuries for non-motorists is 437 per year, down from an average of 467 for years 2017-2021. [See Figure 15 and Figure 16 for the Cape Cod trend and the statewide trend for this performance measure]

Figure 11. Cape Cod Fatalities Trend (5-year Averages)

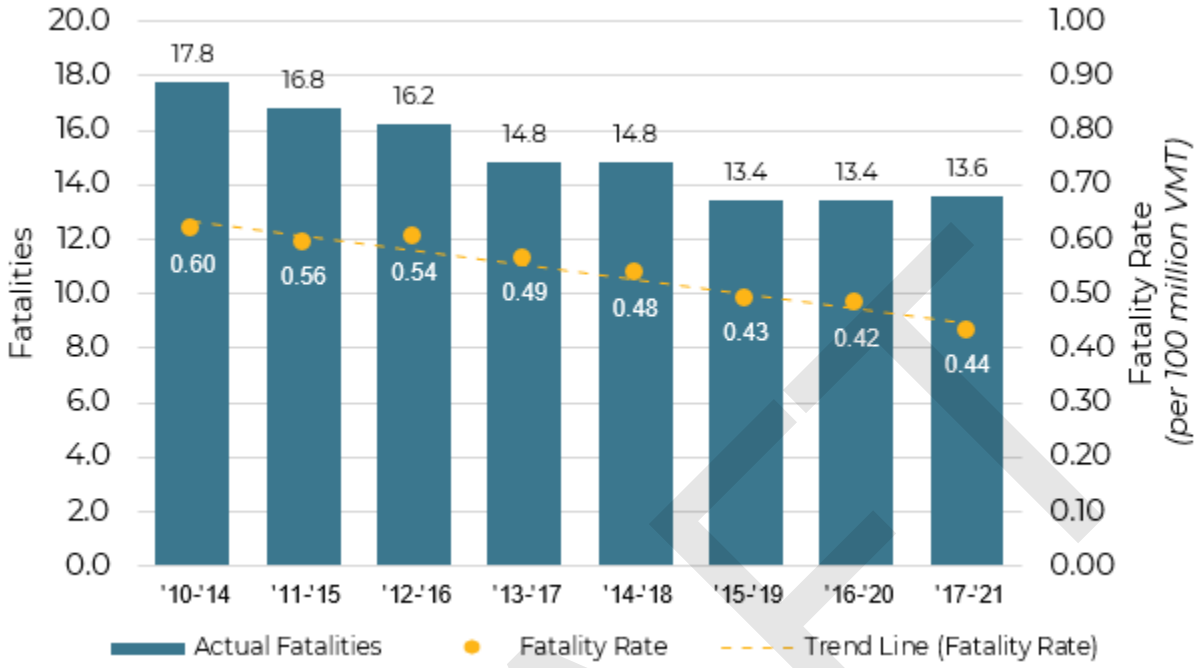


Figure 12. Statewide Fatalities Trend (5-year Averages)

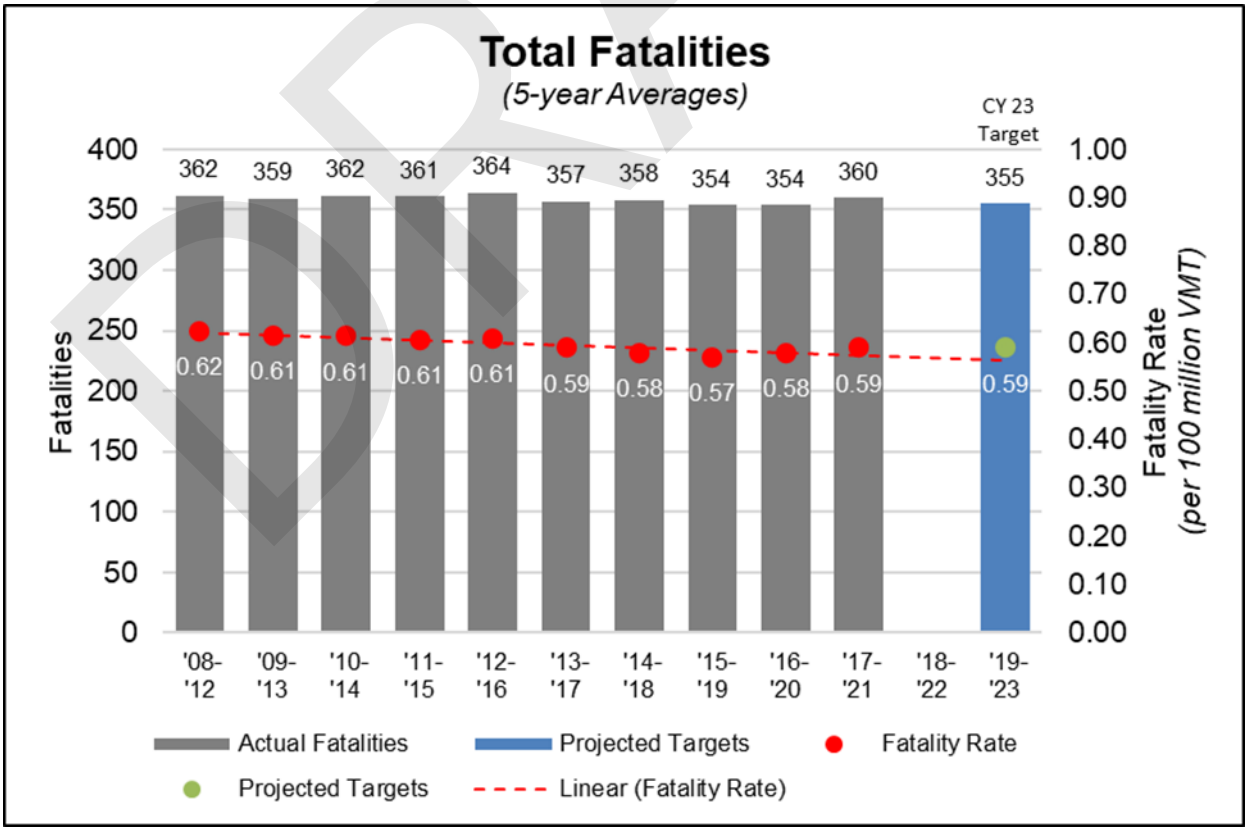


Figure 13. Cape Cod Incapacitating Injury Trend (5-year Averages)

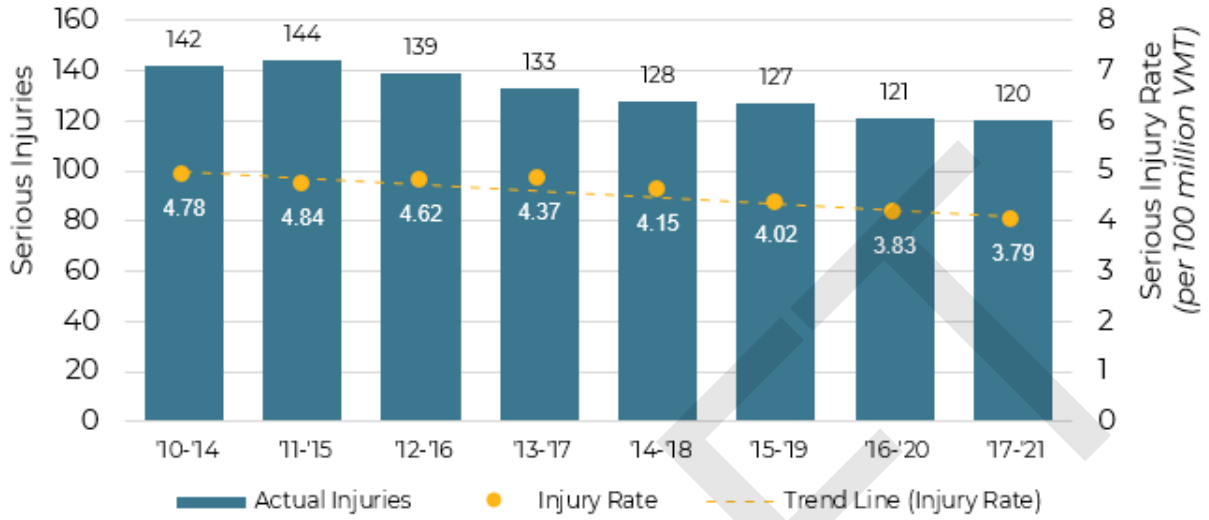


Figure 14. Statewide Incapacitating Injury Trend (5-year Averages)

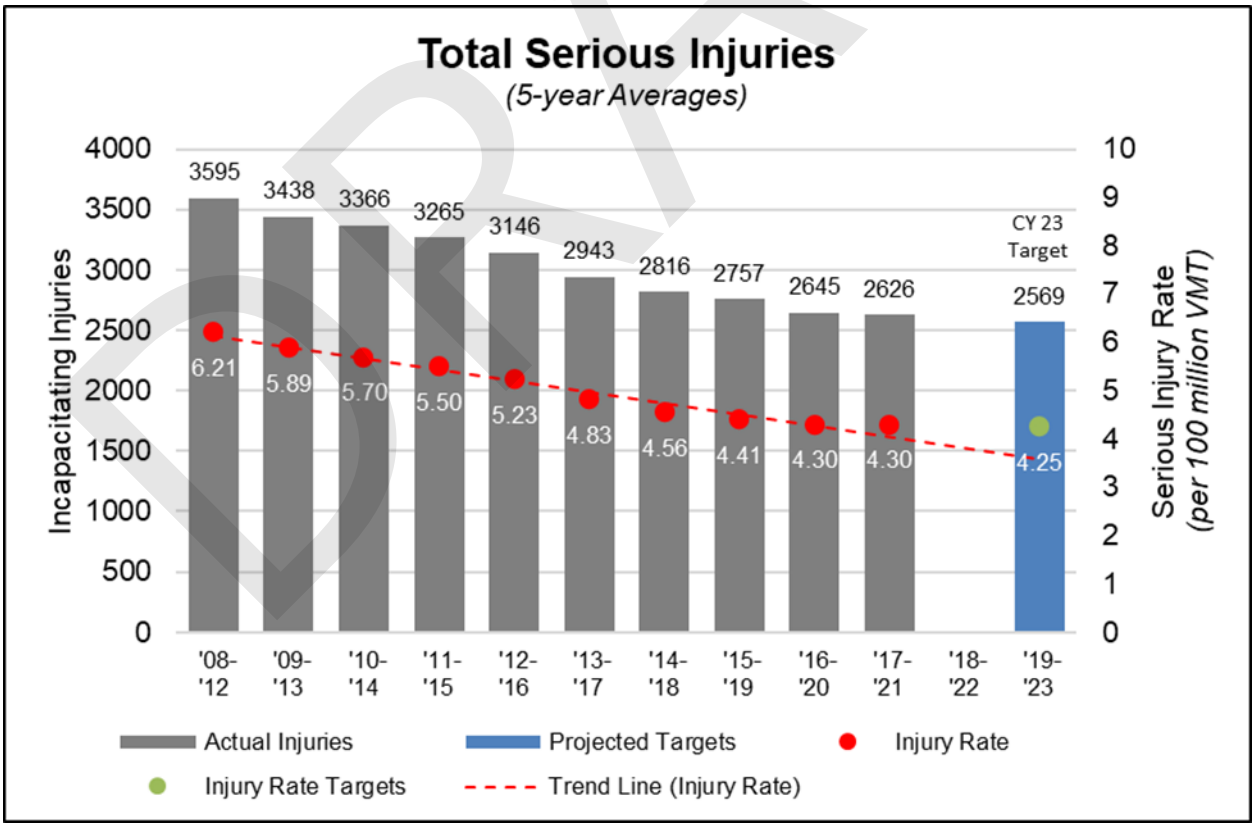


Figure 15. Cape Cod Non-Motorized Injury and Fatality Trend (5-year Averages)

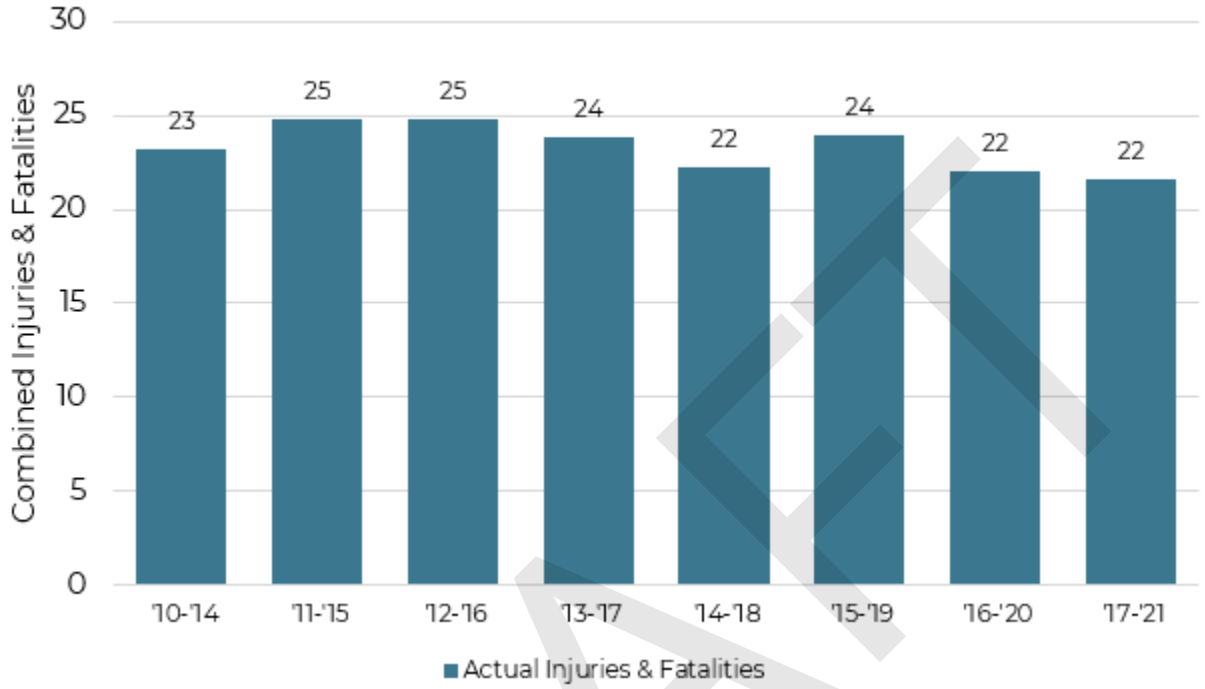
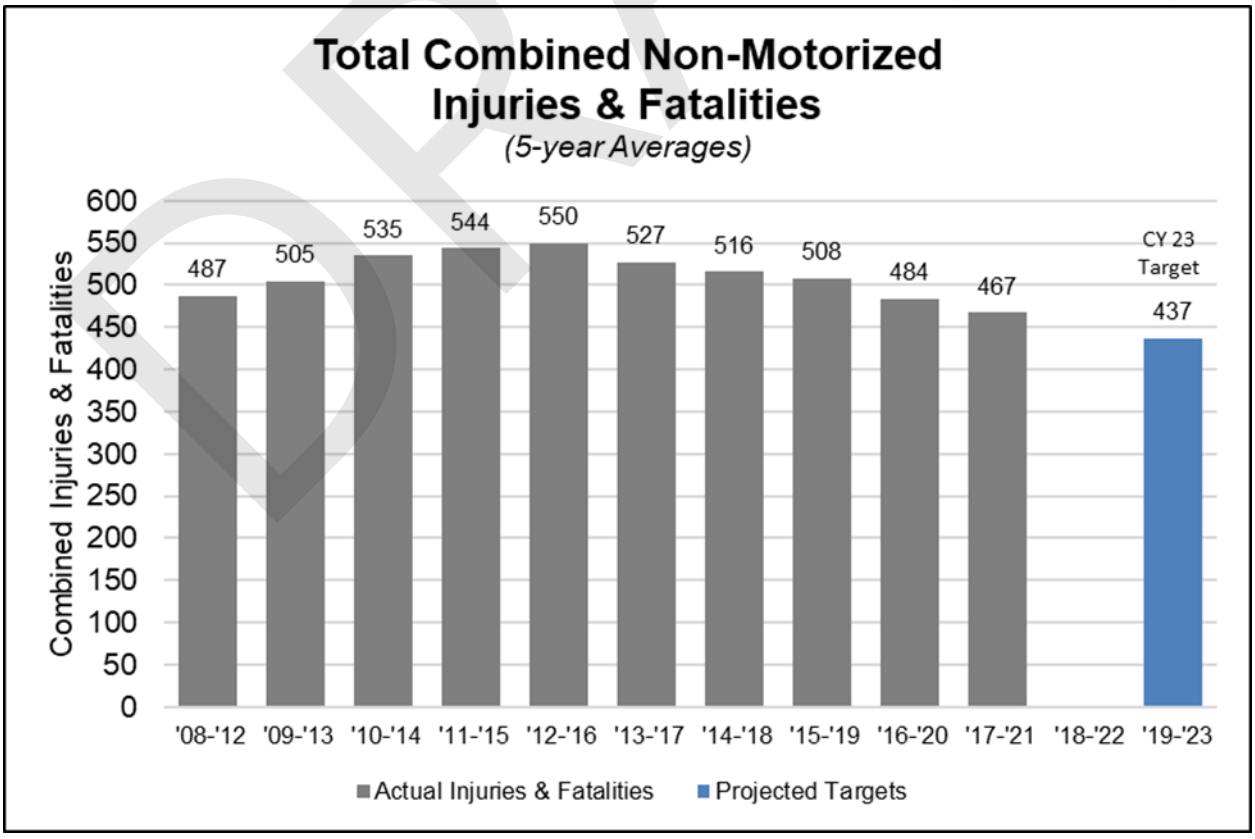


Figure 16. Statewide Non-Motorized Injury and Fatality Trend (5-year Averages)



Projects and programs identified in the Cape Cod Regional Transportation Plan and the Cape Cod Transportation Improvement Program are one way for the region to make strides towards achieving the region's safety targets. Anticipated motorist and non-motorist safety impacts are important criteria in the evaluation of projects considered for inclusion in the Cape Cod Transportation Improvement Program. The Cape Cod Regional Transportation Plan and the Cape Cod Transportation Improvement Program include projects that are anticipated to improve safety in a number of locations with demonstrated crash problems.

Bridge & Pavement Performance Measures (PM2)

The Cape Cod MPO has chosen to adopt the 2-year (2024) and 4-year (2026) statewide bridge and pavement performance measure targets set by MassDOT as shown in Table 7. MassDOT was required to adopt a statewide target by December 16th, 2022. In setting these targets, MassDOT has followed FHWA guidelines by measuring bridges and pavement condition using the 9-point National Bridge Inventory Standards (NBIS); the International Roughness Index (IRI); the presence of pavement rutting; and the presence of pavement cracking. 2-year and 4-year targets were set for six individual performance measures: percent of bridges in good condition; percent of bridges in poor condition; percent of Interstate pavement in good condition; percent of Interstate pavement in poor condition; percent of non-Interstate pavement in good condition; and percent of non-Interstate pavement in poor condition. All of the above performance measures are tracked in greater detail in MassDOT's 2022 Transportation Asset Management Plan (TAMP).

Targets for bridge-related performance measures were determined by identifying which bridge projects are programmed and projecting at what rate bridge conditions deteriorate. The bridge-related performance measures measure the percentage of deck area, rather than the total number of bridges.

Performance targets for pavement-related performance measures were based on a single year of data collection, and thus were set to remain steady under the guidance of FHWA. These measures are to be revisited at the 2-year mark (2024), once three years of data are available, for more informed target setting.

MassDOT continues to measure pavement quality and to set statewide short-term and long-term targets in the MassDOT Performance Management Tracker using the Pavement Serviceability Index (PSI), which differs from IRI. These measures and targets are used in conjunction with federal measures to inform program sizing and project selection.

TABLE 7. Bridge & Pavement Performance Measures (PM2) Target Summary

PERFORMANCE MEASURE	CURRENT (2021)	2-YEAR TARGET (2024)	4-YEAR TARGET (2026)
Bridges in good condition	16%	16%	16%
Bridges in poor condition	12.2%	12%	12%
Non-Interstate Pavement in good condition	n/a	30%	30%
Non-Interstate Pavement in poor condition	n/a	5%	5%

Note: Performance targets related to the Interstate System are not included in this table since there are no interstates in the Cape Cod region.

Projects and programs identified in the Cape Cod Regional Transportation Plan and the Cape Cod Transportation Improvement Program are one way for the region to make strides towards achieving the region's bridge and pavement performance targets. Asset condition is an important criterion in the evaluation of projects considered for inclusion in the Cape Cod Transportation Improvement Program. The Cape Cod Regional Transportation Plan and the Cape Cod Transportation Improvement Program include projects that are anticipated to improve roadway and pavement condition.

Reliability, Congestion, & Emissions Performance Measures (PM3)

The Cape Cod MPO has chosen to adopt the 2-year (2024) and 4-year (2026) statewide reliability, congestion, and emissions performance measure targets set by MassDOT as shown in Table 8. MassDOT was required to adopt a statewide target by December 16, 2022, with MPOs either adopting the statewide target or establishing their own by June 2023.

MassDOT followed FHWA regulation in measuring Level of Travel Time Reliability (LOTTR) on both the Interstate and non-Interstate NHS as well as Truck Travel Time Reliability (TTTR) on the Interstate system using the National Performance Management Research Dataset (NPMRDS) provided by FHWA. These performance measures aim to identify the predictability of travel times on the roadway network by comparing the average travel time along a given segment against longer travel times. For LOTTR, the performance of all segments of the Interstate and of the non-Interstate NHS are defined as either reliable or unreliable based on a comparison between the 50th percentile travel time and the 80th percentile travel time, and the proportion of reliable segments is reported. For TTTR, the ratio between the 50th percentile travel time and the 90th percentile travel time for trucks only along the Interstate system is reported as a statewide measure.

Emissions reduction targets are measured as the sum total of all emissions reductions anticipated through CMAQ-funded projects in non-attainment or air quality maintenance areas (currently the cities of Lowell, Springfield, Waltham, and Worcester, and the town of Oak Bluffs) identified in the Statewide Transportation Improvement Program (STIP). This anticipated emissions reduction is calculated using the existing CMAQ processes.

TABLE 8. Reliability, Congestion, & Emissions Performance Measures (PM3) Target Summary

PERFORMANCE MEASURE	CURRENT (2021)	2-YEAR TARGET (2023)	4-YEAR TARGET (2025)
Non-Interstate LOTTR	87.2%	85.0%	87.0%
TTTR	1.61	1.80	1.75

Note: Performance targets not applicable to Cape Cod have been excluded from this table

Transit Asset Management Measures and Targets

Transit Asset Management (TAM) is a business model that uses the condition of assets to guide optimal prioritization of funding at transit properties in order to keep our transit networks in a state of Good Repair (SGR).

Federal legislation requires all recipients of FTA funding to develop a TAM Plan and update the plan every four years. The Cape Cod Regional Transit Authority (CCRTA) is required to develop agency-specific TAM targets and the Cape Cod MPO is required to develop regional targets. The Cape Cod MPO last adopted CCRTA's FY 2020 CCRTA TAM targets for the Cape Cod region as represented in Table 9 and will review once new TAM targets are finalized.

TABLE 9. Cape Cod Transit Asset Management Performance Measures and Targets

CATEGORY	CLASS	NUMBER	MEASURE	FY2022 PERFORMANCE	FY2023 TARGET
Rolling Stock	Bus	28	% at or past ULB	0%	0%
Rolling Stock	Cutaway Bus	100	% at or past ULB	0%	10%
Rolling Stock	Vans	7	% at or past ULB	9.52%	0%
Equipment	Service Vehicle/Trucks	10	% at or past ULB	0%	10%
Facilities	Maintenance	1	% under 3.0 on TERM scale	0%	0%
Facilities	Passenger Facilities	1	% under 3.0 on TERM scale	0%	0%

Note: Useful Life Benchmark (ULB) is defined by FTA as "the expected lifecycle of a capital asset for a particular transit provider's operating environment, or the acceptable period of use in service for a particular transit provider's operating environment." The CCRTA uses the FTA benchmark criteria for its analyses. For example, FTA's default ULB value for a bus is 14 years. FTA's Transit Economic Requirements Model (TERM) scale, which pertains to the facilities measure, is a rating system that describes asset condition. The scale values are 1 (poor), 2 (marginal), 3 (adequate), 4 (good), and 5 (excellent).

Transit Safety Performance Targets

The CCRTA prepared its Public Transportation Agency Safety Plan (PTASP) in December 2022 which outlines its safety training program, establishes safety performance targets, a safety management policy and safety performance monitoring. CCRTA has established the safety targets below by reviewing historic safety data, with the goal of operating to maximum safety, proactively addressing hazards as they are identified. The Cape Cod MPO adopted the transit safety performance targets for the Cape Cod region in March 2023 as summarized in Table 10.

TABLE 10. Cape Cod Transit Safety Performance Targets

MODE OF TRANSIT SERVICE	FATALITIES (TOTAL)	FATALITIES (PER 100K VRM[1])	INJURIES (TOTAL)	INJURIES (PER 100K VRM[1])	SAFETY EVENTS (TOTAL)	SAFETY EVENTS (PER 100K VRM[1])	SYSTEM RELIABILITY (MMBF[2])
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles
Paratransit	0	0.00	4	0.1	8	0.2	150,000 miles
Human Service Transportation/ Demand Taxi	0	0.00	6	0.5	12	1.0	100,000 miles
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles

[1] Vehicle Revenue Miles, [2] Mean Miles Between Failures

REGIONAL TRANSPORTATION PLAN PERFORMANCE MEASURES

In order to determine if the objectives of the RTP are being achieved, progress must be tracked in reaching the performance targets. By preparing and regularly updating a performance report annually, adjustments to the approach can be made. MassDOT's annual performance management report, Tracker, provides an assessment of all statewide and performance measures and targets across all MassDOT divisions.

Table 11 presents regional performance measures and targets derived from the goals and objectives of the RTP. Many of the performance measures identified are tied to multiple goals.

Baseline (2021) performance is reported for performance measures where data is currently available. Some data will be utilized from MassDOT's Annual Performance Management Report Tracker[16]. A near-term action item will be the development of baseline assessments for performance measures where data is currently unavailable.

[16] https://www.mass.gov/lists/tracker-annual-performance-management-reports

TABLE 11. Regional Performance Measures and Targets

SYSTEM MEASURES	EXISTING 2021	2030 TARGETS	% CHANGE	LONG-TERM TARGET/DESIRED TREND
Number of serious injury crashes (per year)[1,2]	120	108	-10%	Zero
Serious injury crash rate per 100 Million VMT[1,2]	3.79	3.411	-10%	Zero
Number of fatal crashes (per year)[1,2]	13.6	12.24	-10%	Zero
Fatal crash rate per 100 Million VMT[1,2]	0.44	0.396	-10%	Zero
Younger driver fatal and serious injury crashes (per year)[1,2]	1,371	1,234	-10%	Zero
Older driver fatal and serious injury crashes (per year)[1,2]	1,465	1,319	-10%	Zero
Bicycle and/ pedestrian crashes (per year)[1,2]	130	117	-10%	Zero
Percent of signalized intersections with pedestrian signal heads[3]	68%	78%	+10%	100% with full ADA compliance
Percent of Route 28 corridor that does not have sidewalks[4]	42%	32%	-10%	Decease
Travel to work by means other than single-occupancy vehicle[5]	27.9%	37.9%	+10%	Decease
Mode share - walking, bicycling, and transit[5]	1.9%	5.7%	X 3	Increase
Population[6] within a half-mile of fixed route transit service	68%	73%	+5%	Increase
Travel Time Reliability on the Congestion Management Plan (CMP) Network	TBD			Improve
Number of structurally deficient bridges	3	0	-3	Zero
Percent of roadway mileage[7] in fair or better condition	90%	95%	+5%	>95%
Number of active permanent counting stations	11	21	+10	Increase
Number of Public Electric Vehicle (EV) charging plugs[8]	145	1,154	X 8	Increase

[1]Based on 5-year rolling average, [2]Existing based on most recent available data (2017-2021), [3]Some improvements may still be needed for full Americans with Disabilities Act (ADA) compliance, [4]Excludes section with no or limited access, [5]2021 American Community Survey Data, [6]2020 Census population, [7]Federal-aid eligible roadways, [8]Existing public Level 2 and DC Fast plugs per US Department of Energy (December 2022), target consistent with Cape Cod Climate Action Plan aggressive electrification scenario

Chapter 3: Cape Cod and Transportation: Past, Present, and Future

Cape Cod and its transportation system is a story of a continually evolving community with ever-changing transportation needs. This chapter will touch on how the region arrived where it is today, what today's transportation landscape looks like, and what are the challenges and opportunities that lie ahead. Throughout the chapter there will be references to the appendices of the document where additional detail on any particular topic can be found.

PAST - HISTORICAL CONTEXT

The following sections highlight some of the key developments in the transportation network on Cape Cod with thanks to the Massachusetts Historical Commission for much of the research work.[17] Additional detail is provided in Appendix A as well as available on Cape Cod Commission Chronology viewer available at: www.capecodcommission.org/chronology/

Early Trail and Road Network

EARLY TRAILS

Before European settlers landed on Cod Cape, Native Americans, including the Mashpee Wampanoag Tribe, had established a network of trails throughout the region. Linking up key geographic locations and important natural resources, many of these trails evolved into roadway connections we are familiar with today.

CONTACT (1500 - 1620) AND PLANTATION (1620 - 1692) PERIODS

By the time the Pilgrims arrived, there was an extensive trail network stretching from one end of the region to the other. Even this far back, we can see connections that would eventually become the road network of Cape Cod. As Native Americans and Europeans used the network more extensively; trails were upgraded to cartpaths or roadways. Portions of present-day Route 6A took shape as County Road.

[17] *Historic & Archeological Resources of Cape Cod & the Islands*. Massachusetts Historical Commission. Originally published August 1986. PDF reprint version, 2007.

Expansion of Water Routes

COLONIAL (1692 - 1775) AND FEDERAL (1775-1830) PERIODS

As local transportation and commerce increased, water routes were the life blood of the region. Land routes were improved, widened, and expanded to support connection to the ports. Figure 17. shows the expansion of the road network during the Colonial Period.

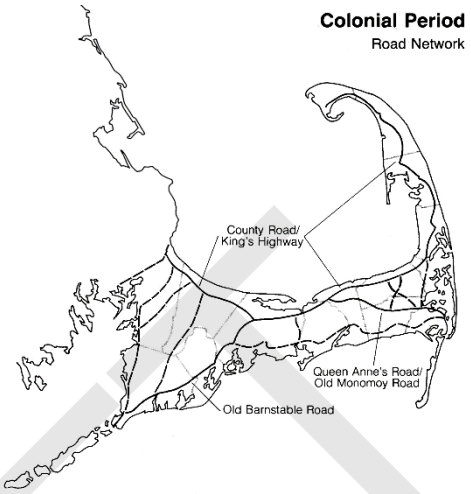


Figure 17. Expansion Land Connections on Cape Cod[17]

Expansion of Railroads

EARLY AND LATE INDUSTRIAL PERIODS (1830-1915)

The industrial period saw the development and expansion of railroads across the region. Still tied to major ports, as shown in Figure 18 rail served both freight needs as well as the emerging tourism market.

This period saw multiple expansions of the rail network ultimately including connections to almost every town on Cape Cod. As the rail network expanded, development grew up around the train depot. These pockets of development thrived while rail transportation dominated the region. As the predominance of rail waned, some of these developments evolved to meet new needs while others did not.

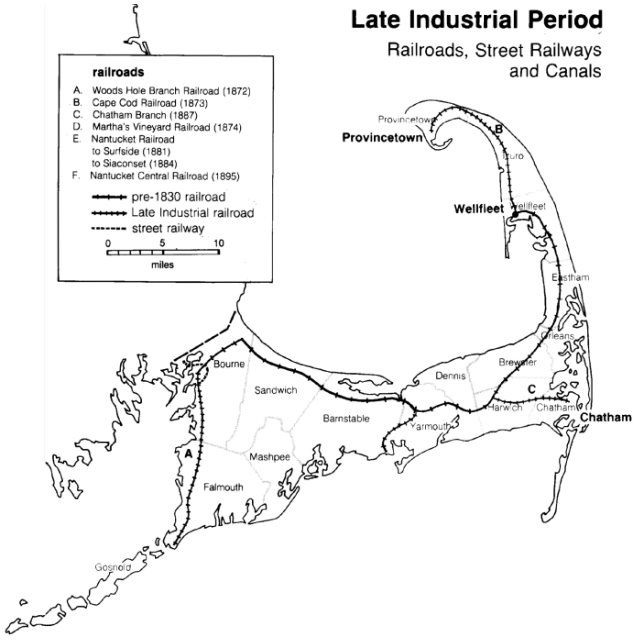


Figure 18. Rail Expansion[17]

Age of the Automobile

MODERN PERIOD TO PRESENT DAY (1915-)

The emergence of the automobile and tourism industry on Cape Cod forever changed the transportation network of the region. Construction of the Cape Cod Canal redefined the transportation landscape of the region. Expanding from the Cape Cod Canal, the transportation system was significantly expanded and modernized during the 20th century. As shown in Table 12, some of greatest expansions occurred in the 1950's.

TABLE 12. Industrial Period Infrastructure Expansion

YEAR	MILESTONE
1935	Bourne, Sagamore, and Railroad bridges over the Cape Cod Canal
1943	General MacArthur Boulevard – 4 lanes
1950	Rt. 6: Sagamore Bridge to Hyannis (exit 6) – 2 lanes
1954	Rt. 6: Sagamore Bridge to Hyannis (exit 6) – 4 lanes
1955	Rt. 6: Hyannis (exit 6) to Dennis (exit 9) – 2 lanes
1956	Rt. 6: Dennis (exit 9) to Harwich/Brewster (exit 11) – 2 lanes
1958	Rt. 6: Harwich/Brewster (exit 11) to Orleans (exit 12) – 2 lanes
1959	Rt. 6: Orleans (exit 12) to Orleans/Eastham Rotary – 2 lanes
1961	Route 28 Falmouth Expressway – 4 lanes
1967	Rt. 6: Hyannis (exit 6) to Yarmouth (exit 7) – 4 lanes
1971	Rt. 6: Yarmouth (exit 7) to Dennis (exit 9) – 4 lanes
1987	Route 25: East Wareham (I-195) to Bourne Bridge – 6 lanes

Sixty-five years after that great expansion, the region is struggling to face tomorrow's challenges with an aging transportation network. Most notably with the impending replacement of the Bourne and Sagamore Canal Bridges at the forefront. While there is debate over whether we are still in the age of the automobile, it is clear that investments in all modes are required to meet the region's future transportation needs.

PRESENT – EXISTING CHALLENGES AND OPPORTUNITIES

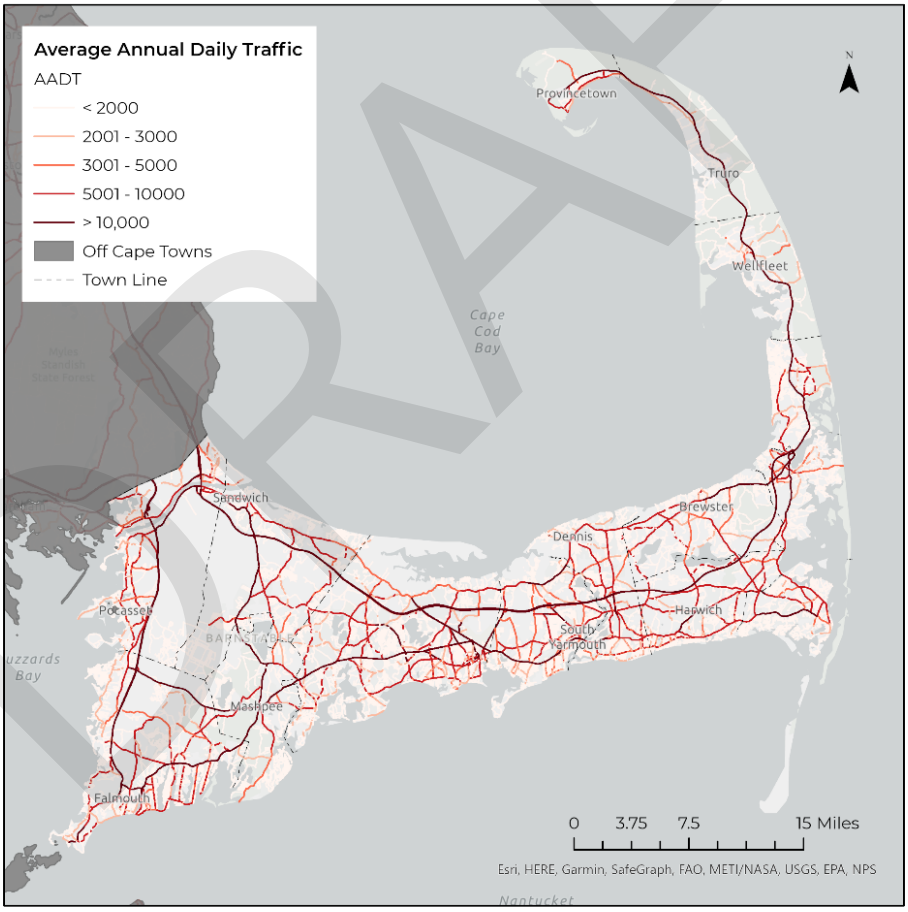
Existing Infrastructure

The transportation network on Cape Cod is made up of a wide variety of infrastructure that support travel by all modes. Summarized in this section, the existing condition of the transportation network is detailed in Appendix B.

VEHICLE INFRASTRUCTURE

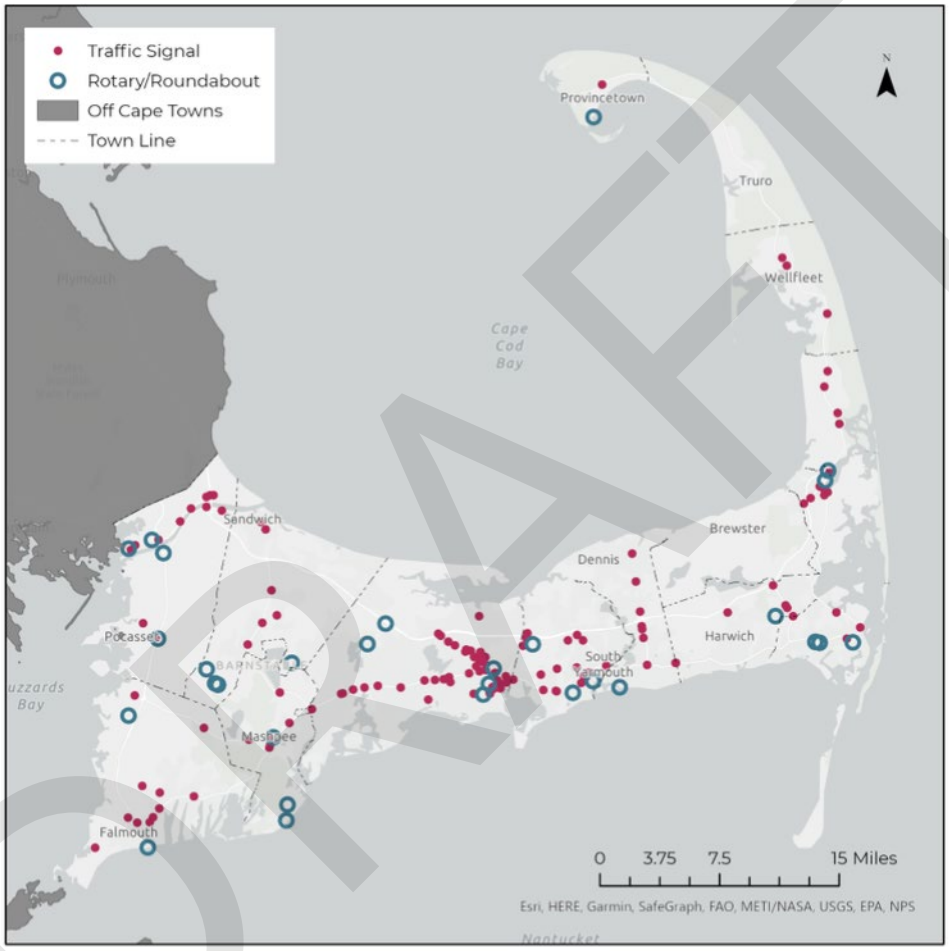
Roads: Cape Cod's three major routes, Route 6, Route 28, and Route 6A, comprise less than 6% of Cape Cod's roads by mileage. Over 80% of the roadways on Cape Cod are local roadways. The volumes of vehicles on the roadways of Cape Cod are shown in Figure 19.

Figure 19. Annual Average Daily Traffic



Intersections: As shown in Figure 20. There are approximately 135 signalized intersections and 31 circular intersections on Cape Cod. Circular intersections refer to rotaries and roundabouts. Rotaries tend to be larger in diameter, and their interior travel speed is often faster than a modern roundabout. Roundabouts are identified by smaller diameters and approaches that enter at a greater angle than rotaries – encouraging slower speeds and improved safety.

Figure 20. Intersections



Bridges: There are 107 municipal and state-owned bridges on Cape Cod including bridges over roadways (49), over railways (12), and over water (42). Out of these 107 bridges, three are classified as structurally deficient based on the National Bridge Inventory rating scale.[18][19]

[18] http://www.fhwa.dot.gov/bridge/nbi.cfm

[19] Based on 2022 FHWA national bridge inventory

Intelligent Transportation Systems (ITS) are now an important piece of infrastructure that exists within the region. Along Route 6 (Mid-Cape Highway) and on Route 28 in Falmouth and Bourne, permanent message boards display travel time to exits/major intersections on the roadway. These signs are not only helpful to display the travel times during the congested summer peak periods but during Canal Bridge maintenance activities. Figure 21 shows one of these roadside signs. This information is processed using Bluetooth technology to calculate drive times. This information has been effective at reducing distraction and driver confusion by presenting valuable information to automobile drivers outside of content received by cellphones or GPS devices. Signage also exists on Route 25 and Route 3 approaching the Cape Cod Canal Area.

Figure 21. Travel Time Signs

BUS INFRASTRUCTURE

Intermodal facilities and sites are important locations where travelers can make seamless transfers between different mode of travel including regional bus service and intercity bus service. These include the Hyannis Transportation Center, MacMillan Pier and Bus Depot, Falmouth Bus Depot, Woods Hole and Hyannis Steamship Authority Piers, Sagamore Park-and-Ride Lot, Barnstable Park-and-Ride-Lot, Harwich Park-and-Ride Lot, and Hyannis Park-and-Ride Lot.

Interregional bus service transports travelers to and from Cape Cod. Some examples are bus service from Hyannis to New York City, or Boston to Provincetown. Users of interregional bus service include commuters who work in Boston, Logan Airport users, and those traveling or vacationing. The Plymouth and Brockton Street Railway Company, as well as Peter Pan, serve Cape Cod's interregional bus service needs.

The Cape Cod Regional Transit Authority (CCRTA) is the agency in charge of operating and maintaining public transit services on Cape Cod. The CCRTA offers several types of services, including fixed route service, flexible route service, and demand-response or paratransit service. Some paratransit and demand response services are contracted services. Year-round fixed services routes include the Barnstable Villager, the Bourne Run, the Flex Route, the H2O Line, the Sandwich

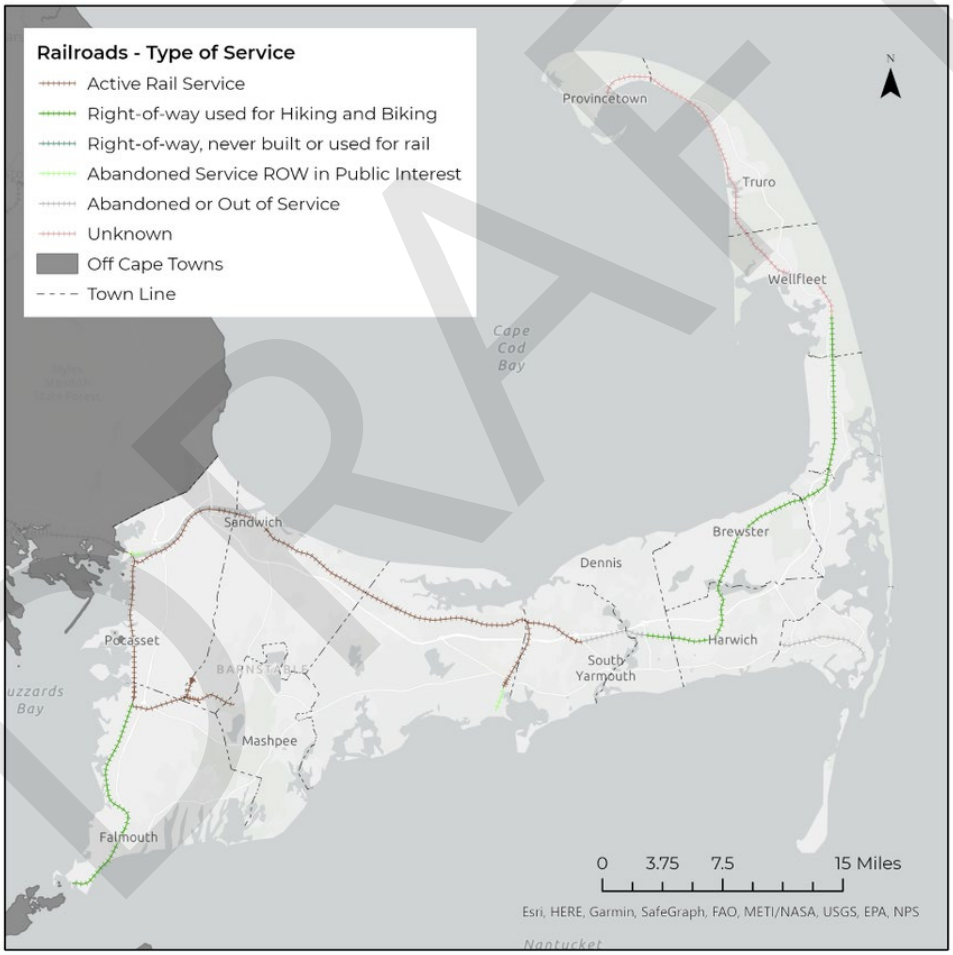
Line, and the Sealine. Seasonal services include the Hyannis Shuttle, the Provincetown/Truro Shuttle, and the WHOOSH Trolley. Demand-response service includes Dial-A-Ride Transportation (DART), SMART DART and ADA Paratransit Service.

The Greater Attleboro-Taunton Regional Transit Authority (GATRA) also operates one line, the Onset-Wareham Link (OWL), with stops in Bourne.

RAIL INFRASTRUCTURE

Railways: Cape Cod has a single rail line, the Cape Cod Line, with three branches as shown in Figure 22 Together, they form a network of rail infrastructure to serve the freight services, scenic rail excursions, and CapeFLYER seasonal, weekend passenger service.

Figure 22. Cape Cod Rail Infrastructure



Rail infrastructure extended along the entire length of Cape Cod, from Bourne to Provincetown, in the first half of the 1900s. Service was also available along the western end, extending from Bourne to Woods Hole in Falmouth, and to Chatham. Today the expanse and usage of rail is reduced. Active rail still exists starting in Bourne and ending in three locations, Joint Base Cape Cod, Hyannis, and Yarmouth.

Road Crossings: Exclusive rights-of-way can limit the interaction of rail and other modes, making rail transportation safer and faster. However, crossing at roadways can pose problems if the intersection is not properly signed and designed. Currently on Cape Cod, there are 66 at-grade roadway intersections along active rail lines. Some, such as the railroad crossing at Route 28 in Barnstable, can actually interfere with roadway traffic and cause congestion and delays. Of those, 21 are not gated, signalized or signed. Although most of these are minor roadways, they do represent a potential for danger. Moreover, there are 18 grade separated roadway crossings, as well as 5 bridges over waterways along active rail lines. These bridges and overpasses must be maintained in order to ensure continued use. If rail service on Cape Cod is to be increased, further study of railroad crossings may be necessary to ensure safety and prevent interruptions to roadway traffic.

AVIATION INFRASTRUCTURE

For Cape Cod travelers, air transportation provides an important link from Cape Cod to Boston, New York, and the islands of Martha's Vineyard and Nantucket. Six airfields and airports serve Cape Cod as a base for air transportation (see Table 13).

TABLE 13. Airports and Airfields of Cape Cod

NAME	FAA IDENTIFIER	FACILITY TYPE
Cape Cod Gateway Airport	HYA	Scheduled Air Carrier Service
Provincetown Municipal Airport	PVC	Scheduled Air Carrier Service
Chatham Municipal Airport	CQX	General Aviation
Falmouth Airpark	5B6	General Aviation
Cape Cod Airfield	2B1	General Aviation
Cape Cod Coast Guard Air Station	FMH	Military

The commercial service airports, Cape Cod Gateway Airport and Provincetown Municipal Airport, supply data on total enplanements to the Federal Aviation Administration (FAA). In 2021, Cape Cod Gateway reported 19,520 enplanements and Provincetown Municipal Airport reported 7,707 enplanements.[20]

MARITIME INFRASTRUCTURE

Cape Cod has approximately 586 miles of tidal coastline, with many inlets and bays that provide marine access to the land. Major channels including the Cape Cod Canal, the Woods Hole Channel, and Nantucket Sounds Channels provide important connections for vessels. Major harbors including Woods Hole Harbor, Hyannis Harbor, Provincetown Harbor, Falmouth Harbor,

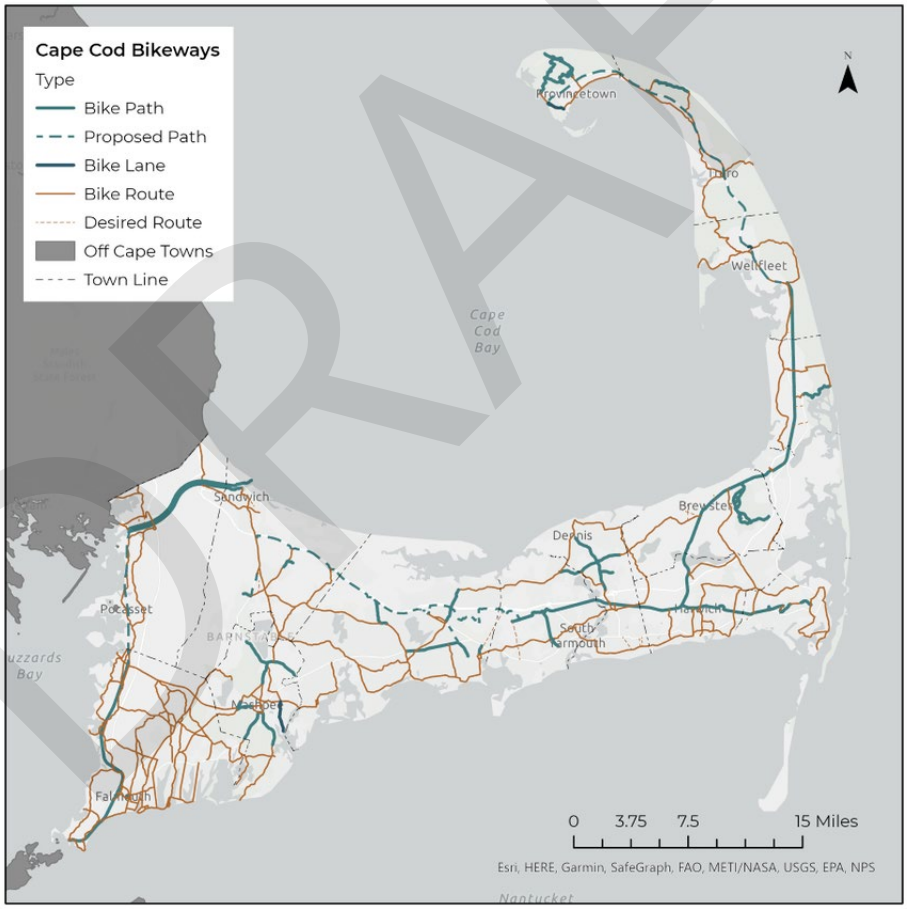
[20] 2021 Air Carrier Activity Information System data

Saquatucket Harbor (Harwich Port), Wellfleet Harbor, Stage Harbor (Chatham), Barnstable Harbor, Sandwich Marina, Red Brook Harbor (Bourne), and Sesuit Harbor (Dennis) provide connections to land-based transportation. The nine ferry routes provide connection from Falmouth (Falmouth Harbor and Woods Hole), Hyannis (Hyannis Harbor), Provincetown (Fisherman's Wharf), and Harwich Port (Saquatucket Harbor) to Martha's Vineyard, Nantucket, Boston, and Plymouth.

BICYCLE AND PEDESTRIAN INFRASTRUCTURE

There are numerous destinations and pathways for bicyclists and pedestrians to use on Cape Cod. There are three basic types of bicycle infrastructure: paths, lanes, and routes. Paths generally have their own separated right-of-way and follow certain standards for width, grade, and accessibility. Bicycle lanes are separate lanes within roadways marked for bicycle use. Bicycle routes are roadways with wide shoulders that have been designated for bicycle use. Figure 23 shows these facilities on Cape Cod.

Figure 23. Bicycle Paths and Routes

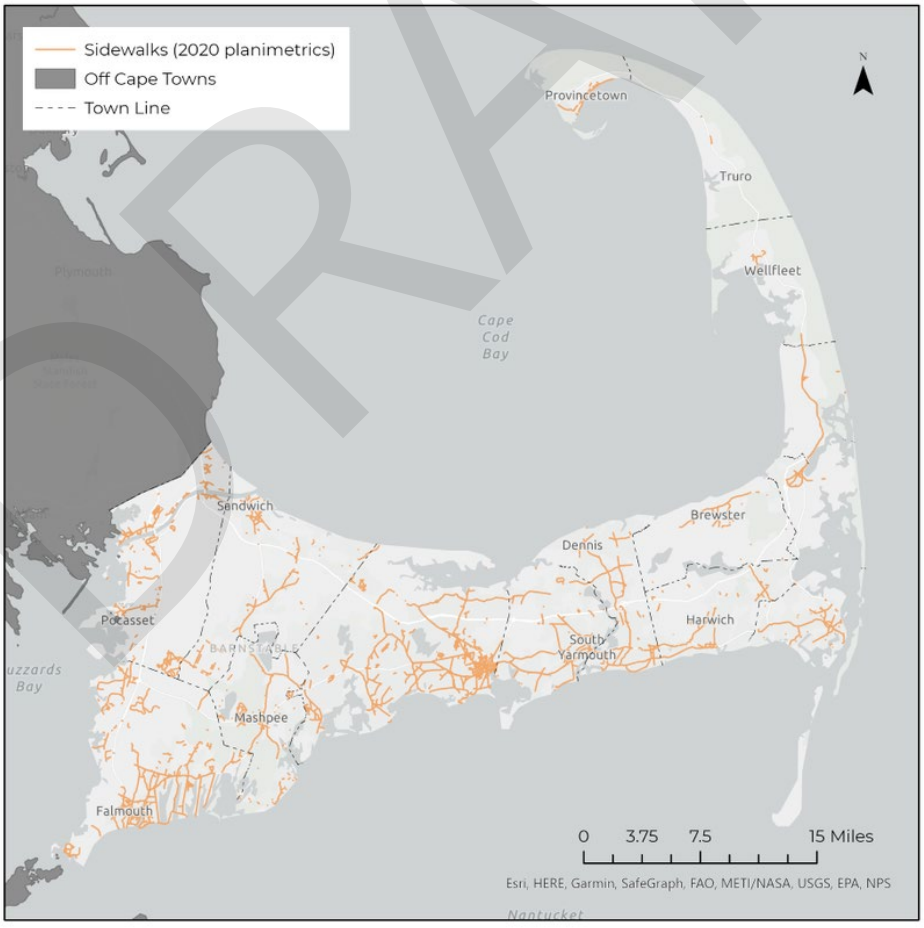


There are over 90 miles of multi-use paths on Cape Cod with the longest being the Cape Cod Rail Trail, Cape Cod Canal Bike Paths, Shining Sea Bikeway, and numerous paths in the Cape Cod National Seashore and Nickerson State Park.

Many bicycle routes exist on Cape Cod, some of which are better signed than others. They allow bicycle users a wide network of travel across Cape Cod. The Claire Saltonstall Bikeway, or State Bicycle Route 1, is a series of bicycle paths and on-street routes that travel from Boston to both Provincetown and Woods Hole. The Cape Cod section of the Claire Saltonstall Bikeway is 98.3 miles in length. The Bourne to Provincetown portion is about 75.4 miles long, while the Bourne to Woods Hole portion is 22.9 miles long. MassDOT is currently planning a signage wayfinding project to re-sign the Claire Saltonstall Bikeway and reflect its latest routing which is proposed to generally follows shared use paths where present including the Cape Cod Rail Trail.

Pedestrians utilize shared use paths and sidewalks. Facilities of this type support village centers and local businesses and encourage travelers to walk instead of drive. The Americans with Disabilities Act requires sidewalk curb cuts to be large enough and shallow enough for wheelchair usage. Telephone poles, road signs, and other architectural barriers must also be removed in order to create an unobstructed path for walking. In Massachusetts, bicyclists may ride on sidewalks outside business districts unless otherwise prohibited by local ordinances. As shown in Figure 24, over 90% of Cape Cod roadways do not have sidewalks.

Figure 24. Cape Cod Sidewalk Network



The sidewalk network also includes crosswalks. Crosswalks provide a safe means for pedestrians and other sidewalk users to cross roadways. Generally, crosswalks located on lower volume roads have no traffic control devices, or a sign telling motorists to yield to pedestrians. However, many crosswalks have crossing signals that stop traffic, allow pedestrians to cross, and warn pedestrians when traffic is about to resume. Typically, crossing signals are located with traffic signals at roadway intersections.

Safety

The concern over safety is made clear in the first goal of the Regional Transportation Plan:

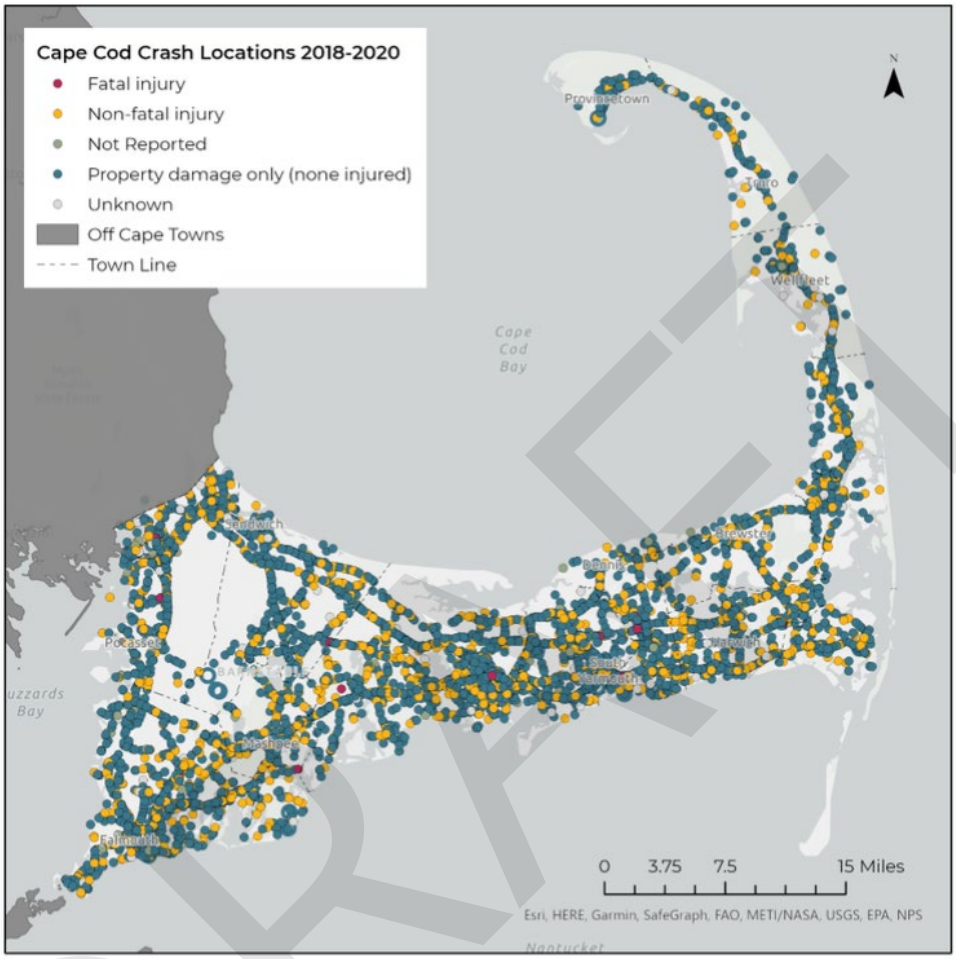
"PROVIDE SAFE TRAVEL OPTIONS FOR ALL USERS"

Transportation users have a right to a transportation system where their person and possessions will arrive at their destinations unharmed and undamaged. Summarized in this section, Appendix B, provides additional detail on the seasonal and year-round issues affecting transportation safety on Cape Cod.

BARNSTABLE COUNTY HIGH CRASH LOCATIONS

In 2022, the Cape Cod Commission completed an effort to rank the top intersections of critical safety concern across Cape Cod. Before the data could be gathered and sorted into any particular order or rank, it was necessary to specify the characteristics that signify an intersection as a safety concern. The Commission decided that there are several ways to interpret crash data – meaning, several possible ways to determine which intersections are of highest safety concern. Base data for this analysis was provided by the Massachusetts Department of Transportation (MassDOT) in the form of geographically located crash clusters for the most recently available three years of data (2018-2020). The data provided by MassDOT included the number of reported crashes at each location and the severity of the crashes. It should be noted, however, that this dataset only includes incidents whose reports contained enough information to accurately locate them. Of the 14,405 crash reports collected by the Massachusetts Registry of Motor Vehicles, 13,753 incidents were located by MassDOT. The incidents are mapped on the following Figure 25.

Figure 25. Cape Cod Located Crashes (2018-2020)



CAPE COD DRIVERS

The demographics of Cape Cod depict a typical year-round resident that is older than the average population in the United States. A large and increasing percentage of Cape drivers are 65 and older. According to the Census Bureau 2017 estimates, 28.5% or 60,860 residents of Barnstable County, are aged 65 or older. This steadily increasing proportion of drivers will experience declining vision, slowed decision making and reaction times, additional difficulty in dividing attention between potential conflicts and traffic information, and reductions in strength, flexibility, and overall fitness. In many cases, these difficulties will outweigh the additional experience that older drivers have operating an automobile. The large majority of drivers who suffer from age-related driving deficiencies are not aware that a problem exists.

Recommendations to accommodate older drivers include:

- Considering protected left turn phases at signalized intersections;

- Maintaining delineation through more frequent restriping and street cleaning;
- Improving signage standards to include larger lettering;
- Improving lighting level standards, in particular at intersections. Consider placing utilities underground and installing breakaway safety poles for lighting;
- Considering "all red" phases for signalized intersections;
- Establishing driver education programs for older drivers; and
- Providing education on other options for mobility.

On the roads with these older drivers is another group of drivers with a unique set of characteristics, younger drivers. Younger drivers are more prone to risk-taking behavior and are subject to influences of youth culture and peer pressure. Considering their exposure, young drivers involved in more fatal crashes than any other age group. There are slight differences between younger and older drivers in the types of crashes they experience. For example, young drivers have more speeding and alcohol-related crashes. Younger drivers' crashes are frequently caused by inexperience, poor judgment, and risk taking, while older drivers' crashes are more often related to reduced physical and cognitive capabilities.

Recommendations to accommodate younger driver safety issues are divided between residents and visitors:

- Increased education for local young drivers.
- Additional enforcement and warnings during the busy traffic season to reach out to young visitor drivers.
- Develop and implement an advertising campaign and roadside signage reminding drivers that traffic and drunk-driving laws are strictly enforced on Cape Cod.

SAFETY ANALYSIS AND RECOMMENDATIONS

Further analysis of crash data along with recommendations for reducing crashes on Cape Cod roadways is included in Appendix B. Additionally, analysis of bicycle and pedestrian crash and recommendations are presented in the Appendix F.

Security

Security is an important consideration when discussing the region's transportation network. Summarized in this section, Appendix D includes a discussion of the ways in which the transportation system is prepared to handle threats of any nature including natural events such as hurricanes as well and man-made hazards.

The most frequently identified security concern is the threat of a weather-related event such as a hurricane. In many cases, Cape Cod residents and visitors "shelter in place," a term that refers to staying in homes or local shelters that are supplied with food, water, etc. Residents should heed warnings of public safety officials and evacuate accordingly. A "Cape Cod Emergency Traffic Plan"

has been developed by the Massachusetts State Police in cooperation with the Massachusetts Emergency Management Agency and several other agencies to facilitate the egress of a high volume of traffic from Cape Cod in the event of a hurricane, particularly during peak tourist season.

Discussions of emergency traffic planning, public transportation security, air travel security, and intelligent transportation systems are also included in Appendix D.

Freight

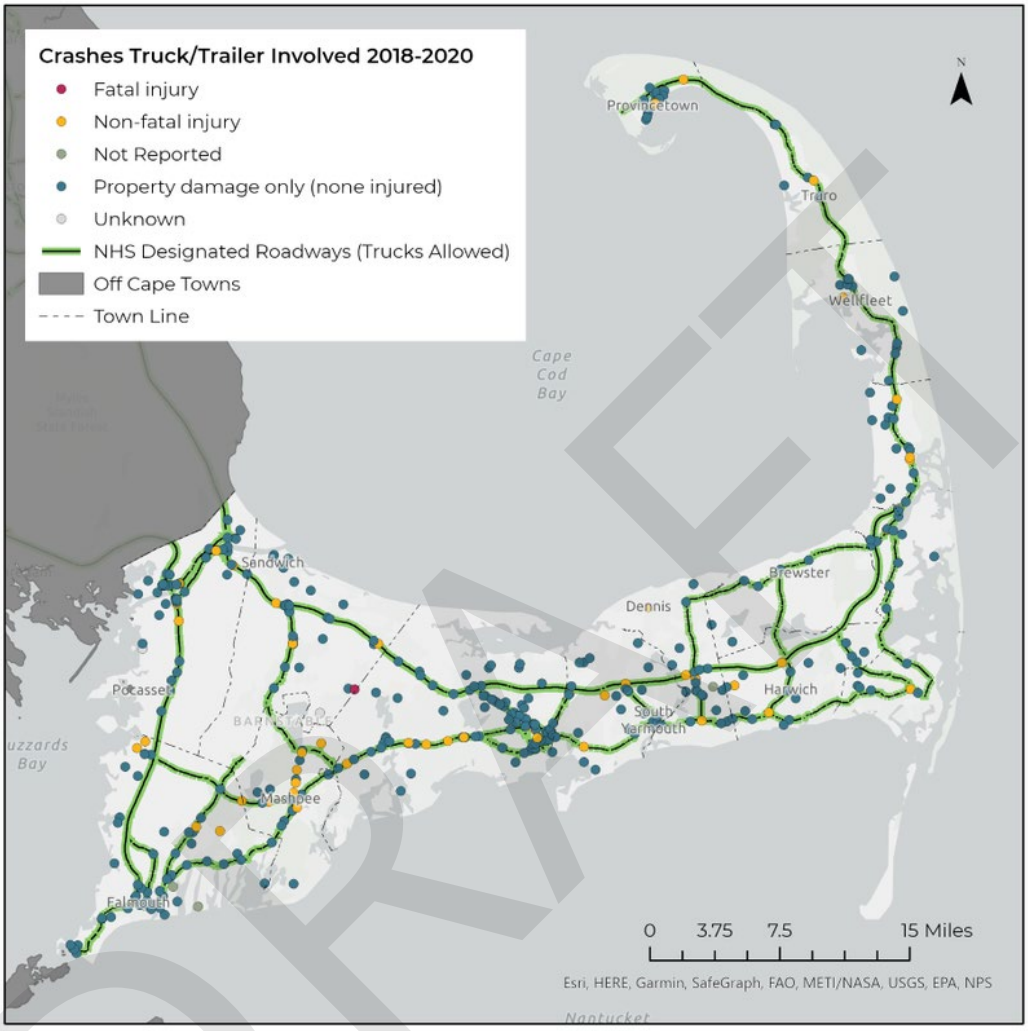
Safe and efficient movement of freight is critical to the local economies. Recognizing the importance of freight to the regional, the Cape Cod Commission conducted regional Freight Study in 2014. Summarized in this section, Appendix E, details some of the unique challenges the movement of freight on Cape Cod faces as well as identifies potential opportunity to improve the freight network on Cape Cod identified in the Freight Study.

There are no National Highway Freight Network (NHFN) roadways on Cape Cod, but there are over 250 miles of designated truck routes on Cape Cod. There are three sections that are designated as Critical Freight Corridors by BIL. Two urban sections are located in Barnstable on Route 132 and Yarmouth Road and a rural section is located on Route 6 in the towns of Wellfleet and Truro. Freight transportation also relies on many roadways off their freight routes to make connection to their ultimate destinations.

Freight transportation presents unique safety challenges and crashes involving commercial motor vehicles deserve special consideration. As shown in Figure 26, freight crashes occur both on and off the designated truck routes on Cape Cod. Based on the MassDOT 2023 Freight Study, which was released for public review in June 2023, there is a roadway segment along Route 6 in Eastham that has a history of crashes involving freight with three crashes recorded between 2017 and 2021.

Freight by all modes, including truck, rail, and water are covered in Appendix E along with the results of a Freight Survey conducted as part of the 2014 Freight Study.

Figure 26. Truck Routes and Reported Crashes



Bicycle & Pedestrian

Bicyclists and pedestrians, while having a minimal impact on the environment, are our most vulnerable users and the most in need of a safe transportation network. Summarized in this section, Appendix F, details crashes, road safety audits, pedestrian safety and planning studies, planning tools, and planning efforts related to bicycles and pedestrians on Cape Cod.

CAPE COD BICYCLISTS AND PEDESTRIANS

To varying degrees, all travelers at some point in their journey are pedestrians. This occurs in the short walking trip from a parked car to a destination (or from a parked bicycle or after disembarking from a bus).

BICYCLE AND PEDESTRIAN CRASHES

Bicyclists and pedestrians face a number of challenges on Cape Cod roadways. The mixture of narrow roadways, high traffic volumes, and inconsistent accommodations create a great deal of difficultly for vehicle-bicycle and vehicle-pedestrian interactions. There was a total of 406 such crashes involving non-motorists between 2018-2020.[21] Additional crashes may have occurred between bicyclists and between bicyclists and pedestrians, but they often go unreported.

SHARED-USE PATH VISION

A priority for the region is improving both on-road and off-road accommodation for all non-motorists.

One means of improving these accommodations is by expanding the off-road shared-use path network, known as Vision 88, as envisioned in Figure 27. Vision 88 is a long-term goal to have a off-road shared use path on Cape Cod from Woods Hole to Provincetown, totaling 88 miles. There is also the goal to connect the Cape Cod shared use path vision with the bicycle paths planned in the adjacent regions. The Southeastern Planning and Economic Development District (SRPEDD) has a shared use path vision that will end in Wareham and it is envisioned that a connection via the Cape Cod Canal path can be constructed to connect to towns northwesterly of Cape Cod. Similarly, the Old Colony Planning Council (OCPC) has a goal to provide bicycle connections to the Cape Cod region via Plymouth and will likely connect on State Road (Route 3A) or Herring Pond Road.

Improved accommodation also comes from improved on-road shared use path routing and signage. MassDOT completed a Cape Cod Route 28 Corridor Study in September 2020, which summarizes a vision for the build-out of multi-modal infrastructure along the entire Route 28 network from Falmouth to Orleans. Figure 28 shows an example of the recommended cross section for a section of Route 28 that is classified as a Suburban Commercial Center.

[21] MassDOT Registry of Motor Vehicle Crash Records

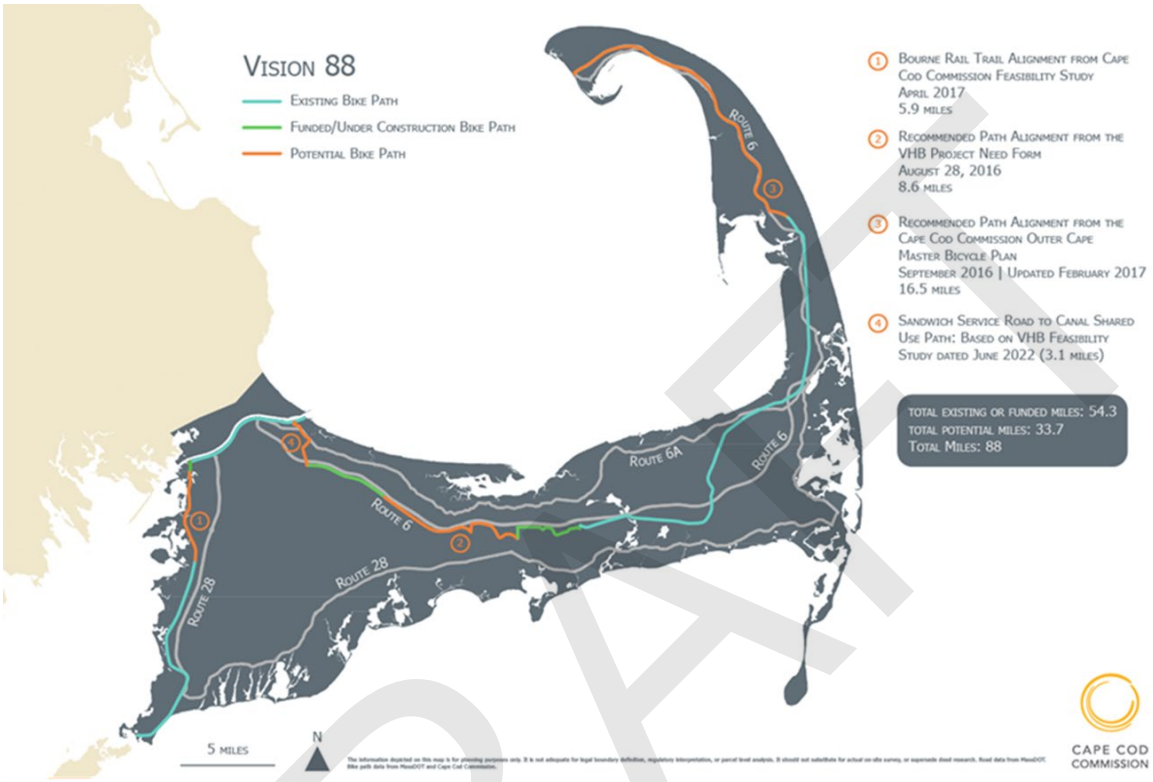


Figure 27. Shared-Use Path Vision Map (Vision 88)

Figure 28. MassDOT Route 28 Corridor Study complete streets recommendations

Congestion Management

In conjunction with the 2024 Regional Transportation Plan (RTP), an updated Congestion Management Program (CMP) was developed for the Cape Cod Region as described in brief below and detailed in Appendix G. The CMP network focuses on the two main routes in the Cape Cod Region; Route 6 and Route 28. Route 6 and Route 28 provide access to all 15 towns within the region. Both corridors experience regular congestion with known crash history year-round, but also account for the corridors with the greatest potential to provide increased multi-modal options within the region. They are both also important freight corridors connecting goods to all 15 towns.

Modeled after FHWA guidance, the Cape Cod CMP includes the following eight action items:

- Develop Regional Objectives
- Define CMP Network
- Develop Multimodal Performance Measures
- Collect Data/Monitor System Performance
- Analyze Congestion Problems and Needs
- Identify and Assess Strategies
- Program and Implement Strategies
- Evaluate Strategy Effectiveness [22]

The Cape Cod CMP has focused on the following three (3) goals and objectives:

Goal 1: Improve Safety

Objective: Reduce crashes on Route 28 and Route 6 for all modes of travel.

Goal 2: Increase Multi-modal Accommodations

Objective*:* Increase multi-modal options for non-motorists along Route 28 and Route 6 to reduce single occupancy vehicles and reduce congestion.

Goals 3: Reduce Congestion

Objective: Aim to reduce congestion at specific bottleneck intersections on Route 28 and Route 6 on Cape Cod.

The CMP will be monitored with the following multi-modal performance measures:

[22] Congestion Management Process: A Guidebook. Federal Highway Administration. April 2011. Report No. FHWA_HEP_11_011.

- Traffic Volumes
- Travel Time Reliability and Planning Time Index
- Number of Crashes (all modes)
- RITIS Bottleneck Ranking Data
- Transit Ridership
- Park-and-Ride lot usage
- Walkability Rating
- Transportation Demand Management

Data collection efforts will focus on the CMP performance measures and will be summarized to assist in identification and assessment of potential strategies to meet the goals of the CMP. Potential strategies to reduce congestion within the Cape Cod region range from:

- Management and expansion of park-and-ride lots
- Geometric improvements for certain bottleneck intersections
- Bicycle and pedestrian improvements
- Optimization of signal timings
- Increased transit service (including rail and inter-city bus)
- Leverage transit technology
- Access Management

Stormwater Management

Stormwater runoff is caused by precipitation from rain and snowmelt events which flows over land or impervious surfaces and is unable to percolate into the ground. In natural systems, precipitation may be directly infiltrated into the subsurface, stored in natural depressions, or reintroduced to the atmosphere through evapotranspiration. However, development such as buildings, roads, sidewalks, and paved driveways increase impervious surface area and alter natural hydrology. The increase in impervious cover that accompanies development results in two main issues related to stormwater: 1) greater volume and peak flows of runoff and 2) transportation of contaminants into water bodies.

WATER QUANTITY

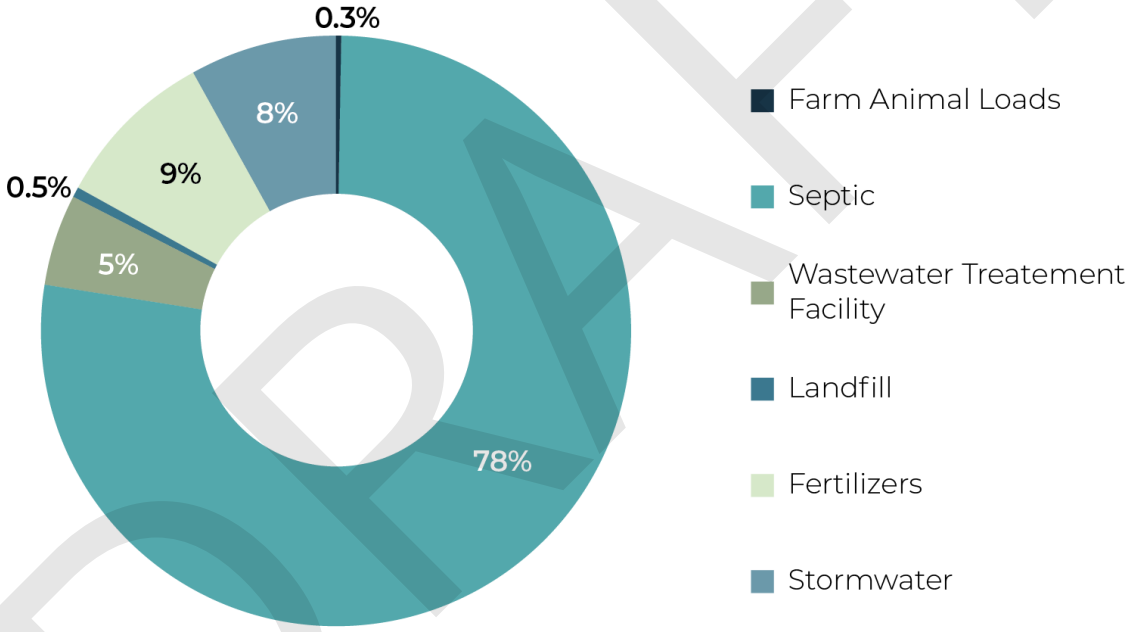
What makes Cape Cod a unique area for stormwater management is the combination of highly porous native soils left by the retreating glaciers and shallow groundwater levels, which are especially prevalent in coastal communities. Well-drained soils readily infiltrate runoff, providing excellent volume reduction of stormwater. A consequence of this rapid infiltration is that minimal natural reduction of nutrients and pollutants is provided, which, in combination with the high water table, can result in negative impacts to groundwater quality.

WATER QUALITY

Where most efforts to manage stormwater focus on moving the volume of water off roadways, stormwater management on Cape Cod also requires addressing the quality of stormwater that infiltrates to the Cape's groundwater (drinking water) resources and the Cape's coastal estuaries.

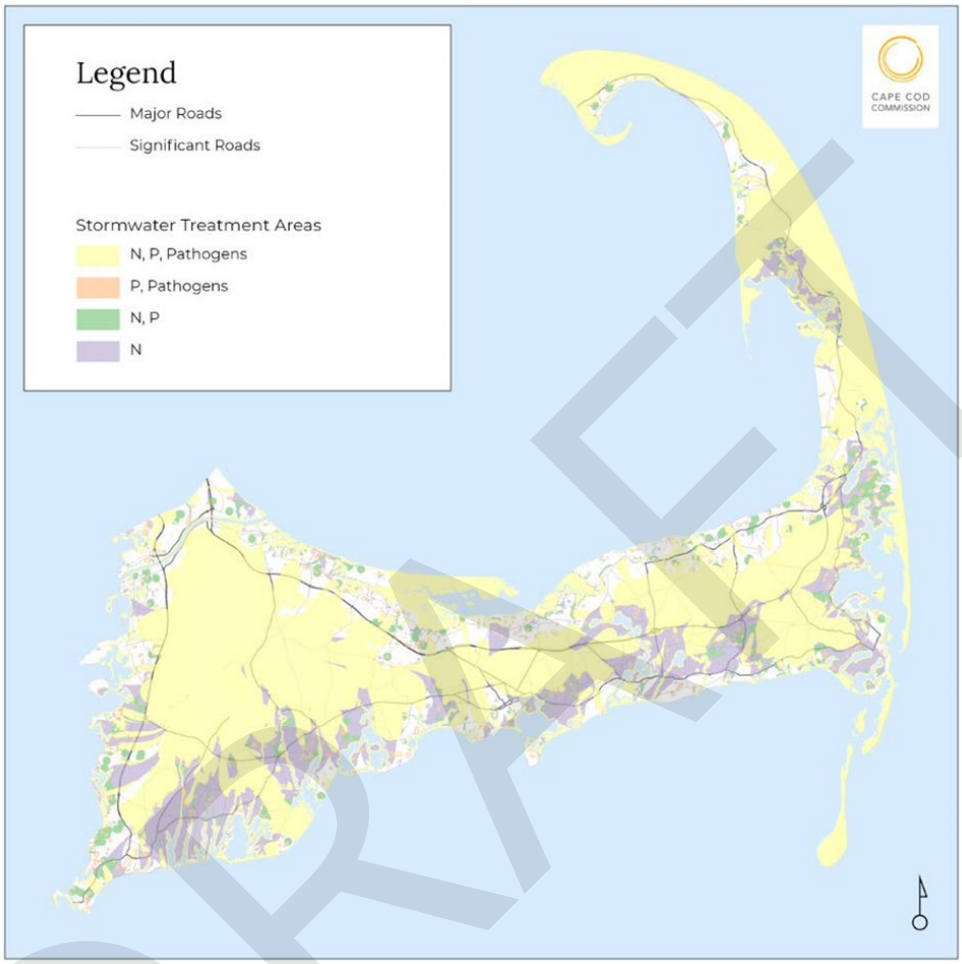
Of particular concern to the coastal estuaries is the introduction of additional nitrogen, a nutrient that through eutrophication can lead to hypoxia, fish kills, loss of eel grass, and aesthetically unpleasant conditions. While the largest share of nitrogen entering the Cape's embayments comes from septic systems, as shown in Figure 29. Eight percent of the controllable nitrogen entering embayments Cape-wide comes from stormwater runoff. Stormwater's nitrogen contribution is significant, and in certain individual watersheds the stormwater contribution may be significantly larger than the Cape-wide average.

Figure 29. Controllable Nitrogen by Percentage



While nitrogen is the primary stormwater component of concern in marine waters, phosphorous is a similar concern for Cape Cod's freshwater resources, while bacteria and pathogens impact fresh and marine resources alike. Figure 30 presents several resource areas and pollutants of concern associated with them. These sensitive areas are detailed in Appendix I, and include (among others) pond buffers, river buffers, wetlands area, and watersheds requiring nitrogen removal to meet water quality standards.

Figure 30. Stormwater Sensitive Areas



LOW-IMPACT DEVELOPMENT AND STORMWATER BEST MANAGEMENT PRACTICES

Low-impact Development (LID) is a comprehensive, conservation-based approach to stormwater management systems. A LID approach is appropriate both at the site level as well as in roadway design. Environmentally sensitive roadway design involves incorporating LID techniques to prevent the generation of stormwater and non-point source pollution by reducing impervious surfaces, disconnecting flow paths, treating stormwater at its source, maximizing open space, minimizing disturbance, protecting natural features and processes, and/or enhancing wildlife habitat.

Best management practices (BMPs) are control measures to limit untreated, polluted stormwater runoff from reaching waterbodies. BMPs can be categorized in to two categories: structural and non-structural BMPs.

Non-structural BMPs include street sweeping, environmentally conscious road salting procedures, maintenance of stormwater utilities, and education and public outreach programs.

Structural BMPs that have potential applicability on the Cape's roadways include:

- Porous pavement (other)
- Leaching Catch Basins (infiltration)/ Infiltration Basins (infiltration)
- Sub-surface Sediment Chambers (pretreatment + infiltration)
- Retention Pond (treatment)
- Bioretention (treatment)
- Advanced Bioretention (treatment)
- Water Quality Swales (conveyance, treatment, infiltration)
- Constructed Stormwater Wetlands (treatment)

BMP costs, removal efficiencies, and maintenance notes are presented in Appendix I.

Figure 31. Bioswale/Rain-Garden in at the Hyannis Transportation Center

A comprehensive approach to stormwater management and treatment both at the site level and on the Cape's roadway network is essential to the long-term viability of the region's natural environment. Stormwater infrastructure management is an important long-term investment for maintaining the region's roadway safety and the quality of its water resources. When integrated into larger planning and design efforts, it can fit seamlessly into the local character of the region, help meet stormwater permit requirements, and take advantage of cost savings. The bio-swale, shown in Figure 31. with long-maintenance ornamental grasses, provides an added green element to the streetscape. [23]

[23] Source: Bridgewater, CT

Pavement Management

Pavement Management is the practice of planning for pavement repairs and maintenance with the goal of maximizing the value and life of a pavement network. There are distinct advantages to managing pavement condition and significant cost savings that can take place with preventative or rehabilitation measures rather than waiting until a road is in need of reconstruction (see Figure 32).

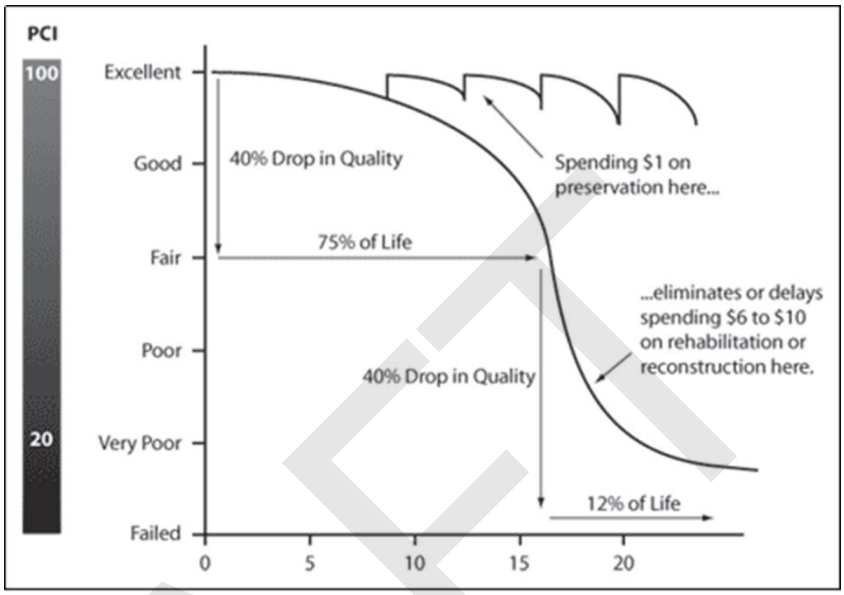


Figure 32. Pavement Deterioration Curve (FHWA)

The pavement condition of roadways under the jurisdiction of MassDOT is monitored by MassDOT. The pavement condition on municipally owned roadways is monitored by each town following varying methodologies. Most use commercial pavement management systems while others rely on local knowledge.

To supplement any data collected by MassDOT on roads under their jurisdiction and the data collected locally, Cape Cod Commission staff conducts regional pavement analysis on the federal-aid eligible municipal road network. Covering one-third of the road mileage each year, a three-year cycle provides an overall view of the pavement condition federal-aid eligible municipal roadways on Cape Cod. Table 14 presents the latest pavement conditions for federal-aid eligible municipal roadways on Cape Cod. Evaluation criteria procedure and evaluation criteria are presented in Appendix J.

TABLE 14. Pavement Condition on Federal-aid Eligible Municipal Roadways[24]

TOWN	VERY GOOD TO EXCELLENT	GOOD TO VERY GOOD	FAIR TO GOOD	POOR TO FAIR	POOR	TOTALS
Barnstable	3.1	12.2	87.7	7.9	0.3	111.2
Bourne	1.3	2.7	29	8.7	0.2	41.9
Brewster	2.6	10.1	9.8	2.7	1.4	26.6
Chatham	0.0	0.4	11.5	0.9	0.0	12.8
Dennis	0.4	10.6	33.9	0.5	0.0	45.4
Eastham	0.5	2.3	12.4	1.7	0.0	16.9
Falmouth	2.4	11.3	60.7	10.7	0.3	85.4
Harwich	0.3	9.2	30.4	3.2	0.0	43.1
Mashpee	0.0	1.4	23.2	5.0	0.0	29.6
Orleans	0.6	3.6	12.1	0.6	0.0	16.9
Provincetown	0.0	1.4	11.4	0.6	0.0	13.4
Sandwich	0.7	7.5	24.0	5.1	0.7	38.0
Truro	0.0	2.5	6.4	3.5	0.0	12.4
Wellfleet	0.7	2.9	15.5	0.6	0.0	19.7
Yarmouth	1.6	12.6	37.2	0.7	0.0	52.1
Total:	14.2	90.7	405.2	52.4	2.9	565.4

Access to Essential Services and Regional Cooperation

Safe and convenient access to essential housing, employment, healthcare, education, recreation and transportation services or facilities on Cape Cod are critical to the region's residents and visitors. The location and access opportunities and challenges to these services or facilities are detailed in Appendix K.

[24] From the 2022 Cape Cod Pavement Management Report available at: www.capecodcommission.org/pavement

In order to improve access to and between these essential services the following will be addressed through various efforts outlined in this plan:

- Reduce congestion for all modes,
- Improve travel time reliability for all modes,
- Improve safety for all modes,
- Increase connections opportunities between different modes,
- Close gaps in the bicycle and pedestrian network, and
- Improve transit options.

As detailed in the discussion of RTP development in Chapter 1, this and other planning efforts include or consideration of a wide range of federal, state, and local agencies and organizations. As detailed in Appendix K, the partnerships within and beyond the region are critical to ensuring that the region maintains a comprehensive and inclusive approach to transportation planning.

FUTURE – REGIONAL TRENDS AND A VISION FOR 2050

Regional Trends

Reviewing historic regional demographic trends, the future for Cape Cod is in many ways uncertain. While the regional experienced decades of growth through the 20th century, the population saw a slight decline between 2000 and 2010, before growing between 2010 and 2020. There are many unique dynamics in play on Cape Cod and, as a result, projecting the Cape Cod population out to 2050 is a challenging task.

To assist the MPOs in preparing their RTPs, MassDOT provided population projections for each region. The MassDOT projections are largely based on the forecast work of the UMass Donahue Institute (UMDI) with adjustments made by the MassDOT Office of Transportation Planning. In reviewing the MassDOT population projections, Cape Cod MPO staff raised concerns that these projections do not effectively capture the factors that make Cape Cod's population patterns distinct from the many year-round working communities in Massachusetts. As a retirement destination, the Cape's population and economy is far more impacted by migration than by natural growth; we do not feel that the Mass DOT projections effectively account for future migration and retirement patterns and thus underestimates population and employment growth on Cape Cod going forward. The unique characteristics of the region became particularly apparent when the region experienced significant growth compared to the rest of the state during the COVID-19 pandemic. "Population estimates developed by the U.S. Census Bureau suggest that the seasonal areas of Massachusetts, including the Cape and Islands and southern Berkshires, all experienced dramatic

population growth near the time of the 2020 Census count, which is consistent with stakeholder observations describing an influx of residents during the pandemic." [25].

In parallel to the development of the of RTP, the Cape Cod Commission contracted with UMDI to conduct a Cape Cod Regional Housing Needs Assessment[26]. As part of this effort regional population estimates were developed including a "standard," consistent with the MassDOT statewide projects, and an alternative "high" projection series. As detailed by UMDI in the Cape Cod Regional Housing Needs Assessment.[27] "Assumptions in each series differ based on how each one factors the abrupt population growth experienced in the region at the start of the COVID-19 pandemic into future migration rates. While both the standard series and the high series use the robust Census 2020 population counts for the 2020 "launch" – or starting point – populations, the high series also incorporates the large increase in population growth that occurred shortly before and during the 2020 Census count into its migration rates, and assumes those trends will continue in the future. In contrast, the standard series assumes that the 2019-to-2020 period represents an off-trend year of population change and, instead, incorporates the population change observed through 2019 and extrapolated to 2020 into future migration rates. The rationale for developing two distinct rates is that the COVID-19 pandemic had a profound effect on domestic migration in the region, but there is uncertainty as to whether that migration represents a short-term phenomenon or is instead indicative of a "new normal.""

To reflect these concerns and the uncertainty of population projections out to 2044, Figure 33 shows both the MassDOT statewide projection for the Cape Cod region as well as an alternative "high" projection. Thre

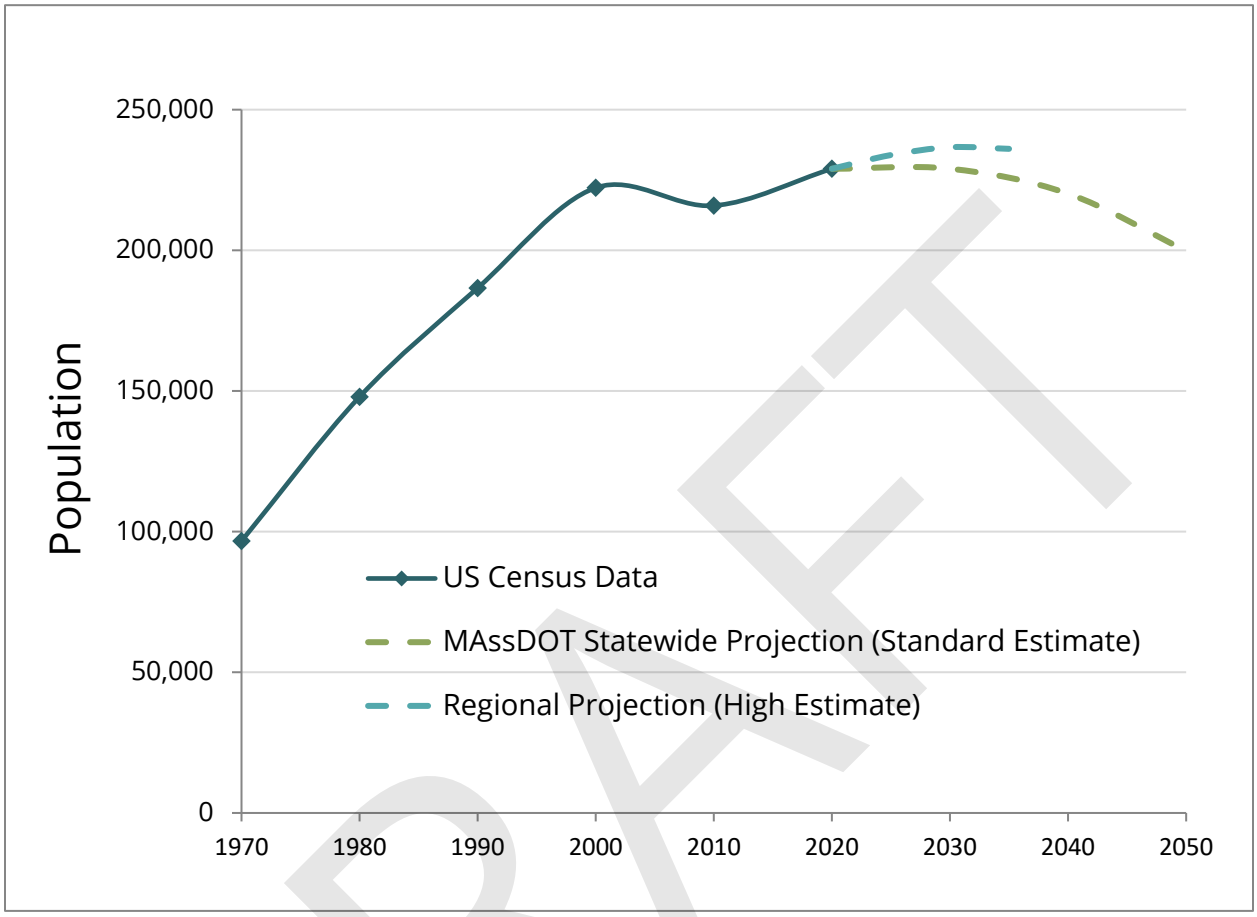
Regardless of how the region changes over the next 20 years and beyond, the Cape Cod MPO is committed to supporting a transportation system that best serves the residents and visitors to the region.

[25] Cape Cod Regional Housing Needs Assessment (2023). Available at www.capecodcommission.org/housing

[26] Cape Cod Regional Housing Needs Assessment (2023). Available at www.capecodcommission.org/housing

[27] Available at www.capecodcommission.org/housing

Figure 33. Cape Cod Population Trends and Projections



Additional details on the population, employment, and housing are presented in Appendix P.

Cape Cod Canal Bridges Program

The Bourne and Sagamore Bridges provide the only vehicle crossings of the Cape Cod Canal for motorists, pedestrians, bicyclists, and goods. The bridges have served as a vital economic link to Cape Cod since they were first opened to traffic in 1935. The United States Army Corps of Engineers (USACE) owns and maintains the Cape Cod Canal, areas surrounding the canal, and the Bourne, Sagamore, and Railroad Bridges. The Massachusetts Department of Massachusetts (MassDOT) owns and maintains most of the roadway infrastructure approaching the Bourne and Sagamore Bridges.

At the time of adoption of this plan, MassDOT, in partnership with the Federal Highway Administration (FHWA) and the New England District of the USACE, is advancing the Cape Cod Bridges Program (Program) in the town of Bourne, Barnstable County, Massachusetts. The Program proposes replacement of the Bourne and Sagamore highway bridges and reconfiguration of the highway approach networks north and south of the Cape Cod Canal to align with the replacement highway bridges. The replacement bridges, and their interchange approaches will accommodate shared use pedestrian and bicycle paths that connect to the local roadway network on both sides of Cape Cod Canal in the town of Bourne. This Program is a continuation of previous studies conducted by the MassDOT and the USACE to evaluate the current condition and recommend improvements to the Cape Cod Canal bridges and roadways.

CAPE COD CANAL BRIDGES PROGRAM: BACKGROUND

MassDOT Office of Transportation Planning (OTP) Cape Cod Canal Transportation Study

MassDOT's Cape Cod Canal Transportation Study[28], completed in October 2019, was launched to identify existing and future multimodal transportation deficiencies, and needs around the Cape Cod Canal area. This conceptual planning study's findings provide recommendations for improving multimodal connectivity and reliability across the Canal.

USACE Major Rehabilitation Evaluation (MRE) Study and Decision

The purpose of the study was to determine whether major rehabilitation or replacement of the Bourne and/or Sagamore Highway Bridges would provide the most reliable, fiscally responsible solution for the future. The Study culminated in the Major Rehabilitation Evaluation Report[29] (MRER) which was published in March 2020.

On April 3, 2020, an official decision was made by the USACE and the Assistant Secretary of the Army for Civil Works to replace the current Sagamore and Bourne bridges with two new bridges

[28] Study available at: https://www.mass.gov/cape-cod-canal-transportation-study

[29] Study available at: https://www.nae.usace.army.mil/Missions/Projects-Topics/Cape-Cod-Canal-Bridges-Major-Rehabilitation-Study/

built to modern day standards. MassDOT will be evaluating this recommendation in our own public process.

Memorandum of Understanding (MOU) between MassDOT and the USACE

On July 7, 2020 an MOU[30] was executed between MassDOT and the USACE regarding the Sagamore and Bourne bridges. The below bullets outline the commitments of the MOU in the event that the bridges are replaced.

USACE will:

- Own, operate and maintain the existing bridges until Program completion
- Share information, provide technical support and facilitate transfer of ownership of the bridges to MassDOT

MassDOT will:

- Lead program delivery to complete the feasibility study and alternatives analysis, preliminary design and environmental permitting process, and conduct bridge construction.
- Own, operate, and maintain the completed bridges and approaches

CAPE COD CANAL BRIDGE PROGRAM: PURPOSE AND NEED

The purpose of the Program is to improve cross-canal mobility and accessibility between Cape Cod and mainland Massachusetts for all road users and to address the increasing maintenance needs and functional obsolescence of the aging Bourne and Sagamore highway bridges, which are owned, operated, and maintained by the USACE, as part of the Cape Cod Canal Federal Navigation Project.

In order to fulfill the purpose of the Cape Cod Bridges Program, the following transportation-related problems and unsatisfactory conditions need to be addressed within the project area:

- Structural condition of the Bourne and Sagamore bridges and their frequent maintenance requirements
- Substandard design of the Bourne and Sagamore bridges, including the approaches and their interface with the adjacent roadway network, and
- Peak period congestion and traffic operations

Data supporting each of these identified transportation needs is provided below.

CAPE COD CANAL BRIDGE PROGRAM: MAJOR MILESTONES

Construction is anticipated to commence after MassDOT completes preliminary design and environmental permitting. There are many factors that will influence schedule, including but not limited to: identification of construction funding, determination of the National Environmental Policy Act (NEPA) Class of Action, public feedback, packaging of construction contracts and construction

[30] Information on the MOU available at https://www.mass.gov/news/memorandum-of-understanding-reached-between-massdot-and-the-us-army-corps-of-engineers-regarding-bourne-and-sagamore-bridges

procurement methodology, and more. This information will develop as the program progresses and will be communicated in future rounds of public engagement.

Estimated Program milestones that are subject to change include:

- Phase 1: Beginning in June of 2021, efforts have involved public outreach and involvement and data collection to include environmental conditions and traffic patterns.
- Phase 2: Based on public input, MassDOT develops and refines bridge and roadway options.
- Phase 3: MassDOT identifies preferred options. Environmental documentation process begins.
- Design development.
- Phase 4: MassDOT completes preliminary design and environmental permitting.
- Phase 5: Construction underway.
- Delivery: The Cape Cod Bridges Program is completed.

At the time of publishing this plan, five rounds of public engagement have been completed including meetings attended by nearly 4,200 individual, over 1,700 comments received, over 4,000 contacts included in Program database, and stakeholder meetings occurring with each round of engagement. Topics in these engagements have included: Purpose and Need, Bridge type, Bridge lane configuration, Bridge locations, and Interchange alternatives.

A major milestone was reached in April 2023 when an Environment Notification Form (ENF) was filed for the Program with the Massachusetts Environmental Policy Act (MEPA) Office. It was published in the Environmental Monitor on May 10, 2023 and a Massachusetts Secretary of Energy and Environmental Affairs Certificate on the ENF and Scope of Draft Environmental Impact (DEIR) is expected in July 2023.

CAPE COD CANAL BRIDGE PROGRAM: FUNDING

One of the largest considerations for the Program is sourcing the necessary funding. USACE and MassDOT are working to identify potential modes of funding as federal policies change and new opportunities become available. Some major funding milestones to date include:

- On November 15, 2021, President Biden signed into law the Infrastructure Investment and Jobs Act (IIJA). This authorized $1.2 Trillion for transportation and infrastructure spending. Much of the IIJA funding is available through competitive grant programs.
- The United States Army Corps of Engineers (USACE), in partnership with MassDOT, submitted a grant application under the Multimodal Project Discretionary Program for the National Infrastructure Project Assistance (Mega) and the Nationally Significant Multimodal Freight and Highways Projects grant (INFRA) program as well as the Bridge Investment Program funding for year 1 of 5 for these federal discretionary programs.
- In January 2023, it was announced that the Program, through the USACE, will receive an approximately $1.6 million Bridge Planning grant.

- In President Biden's 2024 Budget Proposal recommends "an initial $350 million for replacement of the Cape Cod Canal bridges, toward a commitment of $600 million, and a legislative proposal that would allow the Corps to transfer those funds to the Commonwealth of Massachusetts, which is better suited to design and construct the replacement bridges." The budget proposal further "proposes authorizing the Corps to transfer ownership of these bridges to the Commonwealth, which would be responsible for their future operation and maintenance."[31]
- In May 2023, Massachusetts Governor Healy indicated an intent to double the state's contribution to the Program, from the $350 million included in the Transportation Bond Bill, up to $700 million.
- Going forward, MassDOT and USACE will continue to monitor developments at the federal level for future grant opportunities.

CAPE COD CANAL BRIDGE PROGRAM: LOOKING AHEAD

The Cape Cod MPO is encouraged by the continued dialog at the federal, state, regional, and local levels regarding Cape Cod Canal infrastructure and looks forward to implementation of solutions, including all modes of transportation, that meets the needs of the regional and the travelling public. Continued dialogue and coordination between the with the US Army Corps, MassDOT, towns potentially impacted by the project, and the entire region should occur as the projects move forward into the design phase. With the majority of potential infrastructure changes and potential direct impacts occurring within the Town of Bourne, particular attention should be paid to ensuring that the Town is well-presented throughout the design and decision-making process.

Figure 34. Cape Cod Canal Bridges Draft Bridge Type

[31] https://www.whitehouse.gov/omb/budget/

A Vision for the Future

Cape Cod's transportation system has both shaped and been shaped by development patterns of the region. As our regional economy has evolved so too has our transportation infrastructure. From a reliance on ports and marine transport, to a steady growth by rail, and explosion of change fueled by the automobile – our region has undergone dramatic changes. All the while, our connection with our environment and our past has continued to define us. What will define our region for the next 20 years?

As a region, Cape Cod we face a number of challenges that will have to be addressed over the coming decades. The Cape Cod Canal Bridges are in need of replacement along with the adjacent roadway infrastructure. The region faces limited vacant land, a lack of housing inventory and affordability, potential loss of habitat as a result of development pressure, impaired watershed from excess nitrogen loading, tourism dependence with a lack of year-round jobs paying a living wage, automobile dependence, and the impacts of climate change. In different ways, smart transportation investment decisions can help to address these challenges facing the region.

While many uncertainties exist about the future, strength of the transportation infrastructure will undoubtedly be a key to our long-term vitality. As a region, we must establish a vision for our region's transportation system and identify our priorities for investing financing resources in maintaining and improving this system. The 2024 Regional Transportation Plan (RTP) sets forth this vision for the region and sets the framework for making smart transportation investments within the region through 2044 and beyond.

Chapter 4: Livability, Climate Change Planning, and Scenario Planning

Livability, climate change planning, and scenario planning are important planning concepts that are incorporated through the region's transportation planning process and directly into the Regional Transportation Plan (RTP).

LIVABILITY

Livability is about tying the quality and location of transportation facilities to broader opportunities such as access to good jobs, affordable housing, quality schools, and safer streets and roads. Livability can be supported through funding transportation related projects and sponsoring activities like Context Sensitive Solutions and public involvement that help enable people to live closer to jobs, save households time and money, and reduce pollution. This principle reinforces the growth policy in the updated RPP, which promotes guiding new development and redevelopment into existing centers of activity. Focusing development in areas of existing centers of activity can provide more opportunities for people to live closer to jobs, friends and family, and activities, and can allow for more efficient use of resources and infrastructure.

As part of the United States Department of Transportation's (USDOT) Livability Initiative, the Federal Highway Administration (FHWA) works within the Interagency Partnership for Sustainable Communities to coordinate and leverage federal housing, transportation, water, and other infrastructure policies and investments. The Partnership for Sustainable Communities developed the following principles to guide efforts:

1. Provide more transportation choices
2. Promote equitable, affordable housing
3. Enhance economic competitiveness
4. Support existing communities
5. Coordinate policies and leverage investment
6. Value communities and neighborhoods[32]

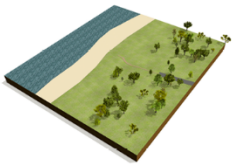
[32] http://www.fhwa.dot.gov/livability/

Livability directly benefits people who live on, work on or visit Cape Cod, increases property values and business activity, and can improve public health and safety. Transportation decisions can have a major impact on livability and the region's character.

The character of Cape Cod is a critical component of the communities and livability of the region. Many different and unique places with varying character exist across the region. The 2018 Regional Policy Plan identifies eight Cape Cod Placetypes—areas with similar natural and built characteristics—that illustrate the different character areas and contexts found throughout the region: Natural Areas, Rural Development Areas, Suburban Development Areas, Historic Areas, Maritime Areas, Community Activity Centers, Industrial Activity Centers, and Maritime and Transportation Areas. Each Placetype has its own vision, as well as a description of its defining characteristics and development patterns. To ensure that transportation projects protect the existing character of the region and foster greater livability, the context of a project must be considered and integrated into the design of the project. The Cape Cod Placetypes provide a framework for such context-sensitive design. The Cape Cod Placetypes are illustrated in Figure 35.

Transportation projects within and connecting Community Activity Centers will be key to improving the livability of the region. Because Community Activity Centers already have a concentration of commercial and community activity and compact form, there exists an opportunity for people to live, work, and play in a smaller area. Streetscapes within and connecting Community Activity Centers need to be attractive, safe, and suitable for a variety of transportation modes (particularly walking). Further developing these centers of activity and their transportation networks can create opportunities for people to meet and interact, helping to create community networks, reduce traffic and the amount of resources needed for transportation infrastructure, improve public health by promoting pedestrian activity and reducing pollution, all of which are components of livability. Additionally, integrating context-sensitive design into the transportation project process will help preserve environmental and historical assets, which are critical components of the region's character, economy, and livability. Context-sensitive design and Community Activity Centers are central to the Livability and Sustainability goal and associated objectives and performance measures discussed in Chapter 2.

Figure 35. Cape Cod Placetypes



NATURAL AREAS

Natural Areas are generally the region's least developed and most sensitive areas.

RURAL DEVELOPMENT AREAS

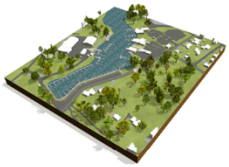
Rural Development Areas are defined by a high percentage of open lands and sparse building development patterns that contribute to the unique rural and scenic character of the region.

SUBURBAN DEVELOPMENT AREAS

Suburban Development Areas include residential neighborhoods built primarily between the 1950s and 1990s as well as automobile-oriented commercial and light industrial development established during the same time period.

HISTORIC AREAS

Historic Areas consist of concentrations of historic structures, including local and/or National Register districts located in a small-scale village setting.



MARITIME AREAS

Maritime Areas are clusters of commercial and mixed-use development that contribute to Cape Cod's working waterfronts and harbors.

COMMUNITY ACTIVITY CENTERS

Community Activity Centers are areas with a concentration of business activity, community activity, and a compact built environment. Buildings are generally smaller in scale and connected by a network of streets, ways or alleys.

INDUSTRIAL ACTIVITY CENTERS

Industrial Activity Centers are lands containing industrial uses that are suitable for future industrial activity as well as emerging industries.

MILITARY AND TRANSPORTATION AREAS

Military and Transportation Areas consist of large land areas developed with and devoted to infrastructure such as airports, transfer stations, waste disposal facilities, and Joint Base Cape Cod.

CLIMATE CHANGE PLANNING

The CCMPO's approach to climate change is based on FHWA's policies on climate change, defined by a vision for improved coastal resiliency, and includes the following initiatives:

- **Adaptation** - Preparing for the impacts of global climate change on the nation's transportation infrastructure and systems;
- **Sustainability** - Ensuring that balanced choices are made among environmental, economic, and social values that will benefit current and future road users;
- **Mitigation** - Identifying strategies that reduce greenhouse gas (GHG) emissions from transportation sources.
- **Energy** - Promoting the use of alternative and renewable fuels, and vehicle technologies to reduce oil dependence, vehicle pollution and energy use.[33]

Impacts and Vulnerabilities

Scientists have concluded that some level of climate change has already occurred, weather patterns are changing, and these changes are expected to continue or accelerate in the future[34]. Additionally, past weather and climate patterns appear to be much less reliable indicators of future weather and climate than in recent decades, which necessitates greater flexibility in planning and decision-making processes. As stated in the USDOT Policy Statement on Climate Adaptation, DOT shall integrate consideration of climate impacts and adaptation into the planning, operations, policies, and programs of DOT in order to ensure that taxpayer resources are invested wisely and that transportation infrastructure, services, and operations remain effective in current and future climate conditions.

The DOT recognizes that climate variability and change pose potential threats to U.S. transportation systems and Cape Cod is no exception. The range of impacts from these threats may include roadway deterioration, flooding, limited waterway access, and weakened structures. Severe conditions may reduce the life of capital assets and increase operational disruptions. Some consequences may require changes in the design, construction, and maintenance of infrastructure.

Building resilience to, and mitigating, climate change and weather-related risk is common sense management to protect current and future investments and to maintain safe operational capabilities. Mitigating and adapting to climate change and its impacts can include adjusting how transportation infrastructure is planned, designed, built and operated. Making climate change

[33] http://www.fhwa.dot.gov/environment/climate_change/

[34] See USGCRP, Global Climate Change impacts in the United States, particularly pp.27-40. http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/full-report

mitigation and adaptation a standard part of agency planning can ensure that resources are invested wisely, and that services and operations remain effective.

Cape Cod Climate Action Plan

In 2021, the Cape Cod Commission developed the Cape Cod Climate Action Plan[35] (CAP), which provides a way forward for the region to mitigate and adapt to our changing climate and aligns with the Commonwealth's goal of reaching net-zero emissions by 2050. The CAP is the result of an intensive effort, coordinated by the Cape Cod Commission, to engage the Cape Cod community, identify paths toward climate resiliency, and further develop partnerships necessary to implement climate actions.

The Climate Action Plan identifies strategies and actions that can aid in reducing greenhouse gas emissions (GHG) and enhance local resiliency to climate threats. The identified strategies and actions will require significant changes in how we build, rebuild, work, travel, plan for and implement our infrastructural investments. More detail on the Climate Action Plan is presented in Appendix H.

Climate Change Adaptation

Climate change mitigation and adaptation involves adjusting the way the transportation community plans, designs, constructs, operates, and maintains transportation infrastructure to reduce greenhouse gas emissions and protect against the impacts caused by changes in climate and extreme weather events.

Adaptation strategies for coping with extreme events and future climate change are most likely forms of coastal engineering and planning already utilized today[36]. However, the challenges facing today's engineers and planners may be among the greatest ever because of the on-going migration of people to coastal areas and the projected rise of sea level to elevations unprecedented in modern times. Adaptation strategies to respond to coastal infrastructure problems related to natural hazards and climate change may be categorized as follows:

- Maintain existing infrastructure for optimal performance and manage the response to extreme events through advanced preparation.
- Increase redundancy of the transportation system by ensuring that services provided by infrastructure can be supplied by other means or alternatives.
- Protect the existing system by providing physical barriers to climate stressors and extreme events.

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[35] More information is available at www.capecodcommission.org/climate

[36] Highways in the Coastal Environment: Assessing Extreme Events, US Department of Transportation and Federal Highway Administration Publication No. FWHA-NHI-14-006, October 2014

- Accommodate by modifying or redesigning infrastructure to better coexist in a climate-stressed environment.
- Relocate infrastructure away from the coast to lessen or eliminate exposure to climate stressors.

HAZARD PLANNING

The Commission has worked with several towns throughout the region to develop Multi-Hazard Mitigation Plans. Development of these plans includes a vulnerability assessment of critical infrastructure and assets within the town, as well as specific actions to reduce the vulnerability of critical infrastructure and improve its resilience. For example, a town may include widening a culvert to prevent flooding of a key roadway as an action to improve resiliency. Currently, the Commission is also working with several towns to carry out the Municipal Vulnerability Preparedness Program. This program involves an intensive stakeholder process to identify vulnerabilities, and strengths, in the community and actions to mitigate or adapt these features to increase their resiliency to priority hazards such as flooding and sea level rise. The Commission also created an online Sea Level Rise Viewer that highlights impacted roadways, and other past work on vulnerability assessments. These efforts supplement past vulnerability assessments carried out using the FHWA Climate Change & Extreme Weather Assessment Framework and past work with the John A. Volpe National Transportation Systems Center.

TIDAL STREAM CROSSINGS

Culverts and bridges that are too small to pass the full tidal range are known as tidal restrictions, and their impacts can be severe. By limiting tidal flow, restrictions alter water levels and chemistry, diminish exchange of ocean nutrients, and can degrade entire upstream aquatic systems. When properly designed, replacing a tidally-restrictive crossing with a larger culvert or bridge restores the natural tidal flow needed to sustain healthy tidal wetland habitats.

FRESHWATER STREAM CROSSINGS

Undersized or improperly placed crossings impact natural stream processes and prevent fish and wildlife from moving about the watershed. Stream crossings can disrupt stream continuity and impact freshwater ecosystems in the following ways:

- Undersized crossings restrict water flow, particularly during storms. These crossings may contribute to extensive channel scour, bank erosion, flooding, and crossing failure. Undersized crossings may be too small, and the flow may be too fast, to pass fish or wildlife.
- Shallow crossings have water depths that are too shallow for fish and other aquatic life to migrate through.
- Perched crossings have an outlet that is elevated above the level of the stream bed at the downstream end. Perched crossings block fish and wildlife from moving upstream.

The Massachusetts Division of Ecological Restoration (MassDER)[37] leads the charge for restoring aquatic ecosystems in the Commonwealth and has been an invaluable partner to the region. In providing much of the language for this section, as well as additional analysis Appendix H, MassDER is involved in numerous tidal restoration projects currently ongoing in the region.

Restoring river and stream crossing has a number of economic and community benefits and are important projects for the region. A MassDER study[38] found that each $1.0 million dollars spent on its restoration projects (including stream barrier removals, as well as salt marsh restoration) supported 10 to 13 jobs and $1.5 to $1.8 million in regional economic output (2009 dollars). Such projects are a particular benefit to the region when coupled with roadway improvements projects. Appendix H details a number of ongoing and potential river and stream crossing restoration projects that should be considered by the region either as part of planned transportation improvements or as standalone projects.

Climate Change Mitigation

Climate change mitigation and adaptation involves adjusting the way the transportation community plans, designs, constructs, operates, and maintains transportation infrastructure to reduce greenhouse gas emissions and protect against the impacts caused by changes in climate and extreme weather events.

While actions taken to mitigate climate change may not be able to fully stop climate change, they can help the effort to slow the rate of change and provide more time for the region to adapt to a changing climate and its impacts. Climate change mitigation strategies related to transportation focus around reducing greenhouse gas emissions through actions including trip reduction, electrification of vehicles, improved and expanded transit systems, and improved and expanded bicycle and pedestrian networks to reduce the amount of vehicle trips in an area.

Actions within this strategy include:

- Encourage investments in EV charging infrastructure – To accelerate the adoption of EVs, additional investment in charging infrastructure is required. Residential and commercial developments and redevelopments should be designed and built with EVs in mind. While the majority of EV charging may take place at home there is a clear need for public charging stations, particularly for a region where a significant proportion of motorists on the roadway are visitors. This will require action from both the public and private sectors.

[37] More information on the MassDER available at: http://www.mass.gov/eea/agencies/dfg/der/

[38] Massachusetts Division of Ecological Restoration. "The Economic Impacts of Ecological Restoration in Massachusetts." March 2012

- Support programs that incentivize EV adoption – With lower operating and maintenance costs, the lifetime cost of owning an EV could be less than a gas-powered vehicle. Unfortunately, the higher upfront cost of EVs still presents a barrier to ownership for many. While advances in technology are expected to ultimately make the EV the most economical choice, in the near- and medium-term, rebates and other incentives can help to promote EV adoption. These incentives are particularly important to ensure equitable access to EVs. Additionally, the local availability of dealers and repair facilities for EVs will be important for large-scale adoption.
- Explore opportunities for electrification of public transit and fleet vehicles and vessels – As technology advances, EV options will become more feasible for public transit vehicles, municipal vehicles, school buses, police vehicles, delivery vehicles, and various marine vessels. Feasibility studies could help inform decision-makers of the current opportunities, barriers, costs, and grant options for electrification.

GREENHOUSE GASES ANALYSIS

The transportation system is a critical component of the Commonwealth of Massachusetts' infrastructure; it facilitates economic development, access to goods and services, and social interaction and enrichment. While the system has numerous benefits that users depend upon daily, it also contributes over one-third of the Bay State's greenhouse gas (GHG) emissions, a key cause of climate change. Sprawling development patterns and automobile dependence also contribute to physical inactivity, which is associated with various negative health outcomes, while motor vehicle pollution contaminates the air, causing respiratory and other health conditions.

Cape Cod's 2017 GHG emissions were estimated to equal 3,564,875 $MTCO_2e$, approximately 4-5% of Massachusetts state emissions. Transportation is the highest local contributing sector of emissions, accounting for 55.5% of total Cape Cod emissions. The second highest contributing sector locally is stationary energy use, which is responsible for 39% of total inventory emissions. The remaining 5% of emissions come from the waste (3%), industrial processes (1.9%), and agriculture (0.4%) sectors.

Transportation accounts for 55.5% of GHG emissions for the region, compared with 45.7% of state emissions. On-road vehicles account for 43% of the region's emissions and nearly 80% of transportation emissions.

GLOBAL WARMING SOLUTIONS ACT AND THE ROLE OF METROPOLITAN PLANNING ORGANIZATIONS

The Global Warming Solutions Act (GWSA), which was signed into law in August 2008, makes Massachusetts a leader in setting aggressive and enforceable GHG reduction targets, and implementing policies and initiatives to achieve these targets. In keeping with the law, on December 29, 2010 the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, released the Massachusetts Clean Energy and Climate Plan for 2020. In December 2014, DEP issued new regulations that require MPOs to quantify impacts from project investments, track, progress towards reductions, and consider

impacts in the prioritization of project investments. The targets for overall statewide GHG emissions were:

- By 2020: 25 percent reduction below statewide 1990 GHG emission levels
- By 2050: 80 percent reduction below statewide 1990 GHG emission levels

A more recent iteration of that plan was released in June 2022, with more aggressive carbon reduction goals:

- By 2025: 33 percent reduction below statewide 1990 GHG emission levels
- By 2030: 50 percent reduction below statewide 1990 GHG emission levels
- By 2050: net zero GHG emissions

The Commonwealth's MPOs are integrally involved in supporting the GHG reductions mandated under the GWSA. The MPOs are most directly involved in helping to achieve the GHG emissions reductions through the promotion of healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments – and assisting smart growth development patterns through the creation of a balanced multi-modal transportation system. This is realized through the transportation goals and policies espoused in the 2024 Regional Transportation Plans (RTPs); the major projects planned in those RTPs; and the mix of new transportation projects that are programmed and implemented through the TIPs. GHG tracking and evaluation processes enable the MPOs to identify anticipated GHG impacts of planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects.

Additional information air quality conformity can be found in Appendix N.

ALTERNATIVE AND RENEWABLE ENERGY

There are numerous projects in Barnstable County that are investing public resources to conserve energy, implement efficiency measures, and produce or purchase renewable energy, such as:

- Cape Cod Regional Transit Authority (CCRTA) is currently meeting 94% of the energy needs of its intermodal center and maintenance facility with solar and wind power and is pursuing grant funding to deploy low or no emissions vehicles on some of its routes.
- CCRTA is moving to a zero emissions fleet and a study for implementation of this transition is currently underway with a study. CCRTA has a zero-carbon footprint goal by 2030.
- Cape Cod Gateway Airport has implemented many alternative and renewable energy projects in recent years. The new 35,000 square-foot passenger terminal building was constructed with multiple energy saving design features including white roofs, high performance windows, high efficiency HVAC systems, point of service water heaters, and fluorescent lighting.

- Solar Collection Field at the Cape Cod Gateway Airport: Nearly 25,000 photovoltaic modules were installed across 18.8 acres of airfield. Energy from the solar array will benefit the airport, the Barnstable Fire District and eventually, rate payers in Barnstable and other jurisdictions.
- Future Cape Cod Gateway Airport Smart Microgrid project will generate and distribute clean, reliable power to the airport and facilitate reliable charging of electric ground fleet vehicles (including buses) and in the future, aircraft. This project was awarded a discretionary SMART grant from FHWA in FY22 associated with the planning, permitting and design of this project.
- Cape Cod Commission Electric Vehicle Charging Stations and Siting Analysis Tool and Model Municipal Electric Vehicle Bylaw to bring further awareness and support on where current electric vehicle charging infrastructure is located and potential future siting locations.

The Commission also supports development of appropriate renewable energy resources, as demonstrated by the energy goal and objectives and action items in the updated RPP, which are part of a framework for future planning work and development project regulatory review. The energy goal in the RPP is "to provide an adequate, reliable, and diverse supply of energy to serve the communities and economies of Cape Cod," and is supported by three objectives:

- Support renewable energy development that is context-sensitive
- Increase resiliency of energy generation and delivery
- Minimize energy consumption through planning and design (including energy efficiency and conservation measures)

Additionally, two action items in the updated RPP include conducting GIS analyses to identify potential electric vehicle charging station locations and appropriate potential solar photovoltaic array or energy storage facilities sites to encourage development of on-site renewable energy.

SCENARIO PLANNING

Transportation and land use are inextricably linked and only with a shared vision for both can the ultimate visions of a region be achieved. Scenario planning is one way in which these disciplines can be looked at in a comprehensive way.

FHWA defines scenario planning an analytical tool that can help transportation professionals prepare for what lies ahead. Scenario planning provides a framework for developing a shared vision for the future by analyzing various forces (e.g., health, transportation, economic, environmental,

land use, etc.) that affect growth.[39] This framework has been used and continues to be an important tool for the region.

Climate Change Scenario Planning - Adaptation

The Cape Cod Commission has developed two tools to help illustrate both different potential climate change scenarios and ways of mitigating the impacts of climate change: the Sea Level Rise Viewer and the Cape Cod Coastal Planner. The Sea Level Rise viewer is an online tool that allows a user to see what the impacts of sea level rise of one, two, three, four, five, or six feet would be on critical facilities and roadways in the region.[40] This tool shows that with one foot of sea level rise, over 50 miles of roads become disconnected or isolated, limiting emergency and day-to-day access to these locations. With three feet of sea level rise, this number jumps up to almost 160 miles and with six feet of sea level rise, over 700 miles of the region's roadways become disconnected. Being able to look at the impacts of possible future sea level rise and climate change scenarios can help inform future planning efforts so that ways to address these potential access and safety issues are incorporated into future projects. Further analysis using this tool's data shows that at one foot of sea level rise, almost 1,300 residences may be inaccessible, at three feet of sea level, over 6,200 residences are potentially isolated or inaccessible, and this number jumps to over 26,000 with six feet of sea level rise.

While the Sea Level Rise viewer identifies potential vulnerabilities, the Cape Cod Coastal Planner, built by the Cape Cod Commission and its partners, is an interactive map-based communication and decision-support tool to help residents and decision makers understand the relative environmental and socio-economic effects of implementing different adaptation strategies and scenarios to address sea level rise, storm surge, and erosion. The tool integrates research on potential adaptation strategies for Cape Cod communities and how ecosystem services are impacted by hazards and strategy selection. Cape Cod Coastal Planner's development was also informed by an extensive stakeholder process, integrating feedback from potential users across the region, and is being tested through a pilot project with the Town of Barnstable. Using these two tools can help guide future projects and efforts by identifying vulnerable areas and providing ways to test different ways to address those vulnerabilities.

Climate Change Scenario Planning - Mitigation

As part of the development of the Cape Cod Climate Action Plan, future GHG emissions scenarios were developed to help better understand how the region could contribute to GHG emissions

[39] http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/

[40] Analysis conducted using 2012 road data

reductions in support of the Commonwealth's GHG emissions reductions goals to reduce GHG emissions to 50% below 1990 levels by 2030 and to 85% below 1990 levels by 2050.

The future emissions scenarios provide context for the extent of actions necessary within each modeled sector to contribute to achievement of the Commonwealth's goals. For each of the scenarios, several key metrics were modeled, which will help the region understand the necessary magnitude of change—and progress toward it—to play its part in achieving the Commonwealth's GHG emissions reduction targets.

All decarbonization scenarios require significant growth in the share of new, light-duty electric vehicle (EV) sales. Even an aggressive energy efficiency scenario (SER2), with reduced vehicle miles traveled (VMT) relative to the other decarbonization cases, requires 63% of new vehicle sales to be EVs by 2030. An increased year-round population scenario (SER3) requires 85% by 2030. The aggressive electrification scenario (SER1) and the carbon neutral scenario (CEN) each require 93% of new sales to be EVs by 2030. By 2050, all decarbonization scenarios require 100% of new vehicle sales to be EVs.

To accommodate about 214,000 light-duty EVs on the road by 2050 (as required to reach 2050 emissions goals in the SER1 scenario), 8,800 public charging stations will need to be installed, which is nearly 4,000 more (at an additional cost of around $10 million) than would be needed in a sustained policy case.

Land Use Scenario Planning

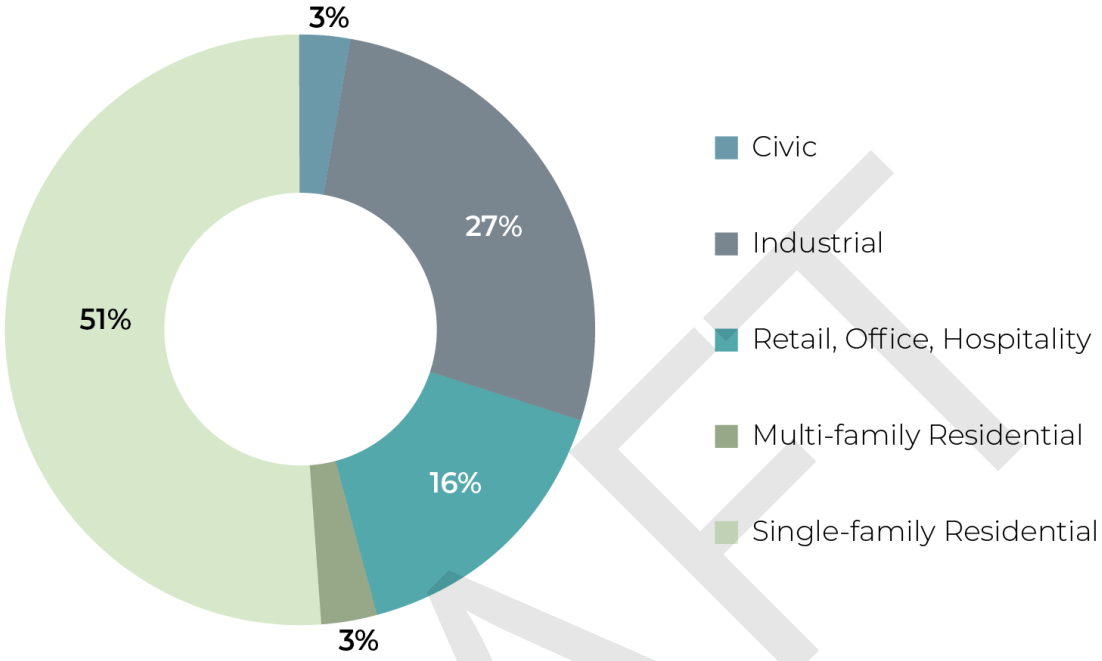
Where the RTP sets the regional vision for transportation, the Regional Policy Plan (RPP) sets the overarching regional vision for how Cape Cod will grow and develop in the future. An updated RPP was adopted in January 2019. As part of the update process, stakeholders engaged in a regional scenario planning exercise conducted using the Envision Tomorrow suite of regional planning tools.[41]

Using this software, users are able to test multiple development scenarios and then compare the impacts of each development scenario. The business as usual, or the "Trend Scenario," answers the question: "What happens if current land use policies remain unchanged?" Based on existing zoning and constraints such as wetlands, the Trend Scenario builds on existing vacant land to see what Cape Cod would look like in 2030.

The Trend Scenario was largely characterized by the development of large single-family homes as shown in Figure 36.

[41] http://www.envisiontomorrow.org

Figure 36. RPP Trend Scenario (Land Use Mix – Percent of Total Acres)



The results of these continued development patterns for the regions are characterized by more sprawling development resulting in a loss of habitat, perpetuation of unaffordable housing, and continued wastewater challenges, in addition to climate change challenges. Focusing just on the transportation impacts, the Trend Scenario results in disperse, auto-dependent development that would result in a significant need for new infrastructure including:

- Over 300 miles of new roadway construction – enough to stretch from the Sagamore Bridge to the Provincetown Monument five times
- Over 80,000 new parking spaces – the equivalent of paving over all of the 700-acre Shawme-Crowell State Forest for parking

The updated RPP articulates a growth policy that promotes guiding new development and redevelopment to existing centers of activity. During the RPP update process, the Envision Tomorrow tool was used to construct an alternate scenario more aligned with the RPP growth policy, which focuses on guiding development and redevelopment to more compact centers of existing activity. The resulting development would be denser with more redevelopment, putting 70% more development in already developed areas, requiring 80% less impervious surface and 13 times less land than the trend scenario, which would result in less habitat loss. In the trend scenario, much of the additional housing developed would be multi-family housing, which would also be more affordable for households earning $50,000-$75,000 per year. In particular, because most of the development would occur in areas already developed, this alternate scenario would

utilize existing infrastructure, requiring 90% fewer miles of new roadway than the trend scenario. Additionally, the alternate scenario of more compact and dense development allows for greater walkability as people can live closer to jobs and amenities.

Planning for the Future of the Cape Cod Economy: Comprehensive Economic Development Strategy

In 2009, Cape Cod was designated an Economic Development District creating new regional opportunity for Federal Economic Development funding for projects and programs consistent with the Comprehensive Economic Development Strategy (CEDS) for Cape Cod. This important and valued designation followed an intense stakeholder driven regional planning effort to adopt a CEDS for Cape Cod, an economic blueprint for the region.

The CEDS planning effort on Cape Cod is led by the Barnstable County Economic Development Council and staffed by the Cape Cod Commission. The planning process and plan are informed by a comprehensive analysis of the region's economy, its strengths, opportunities, weaknesses, and threats. The result is an action plan and an evaluation process specifically designed to address priority issues through achievable projects and programs. A number of projects and programs involve investments in transportation infrastructure consistent with the goals and objectives of the RTP.

"Future of Transportation in the Commonwealth" Report

With many changes facing the transportation system in the coming decades, the Cape Cod MPO looks to work with state and federal agencies to understand and plan for these changes. The Commonwealth of Massachusetts in a leader in transportation profession in terms of forward-thinking transportation planning and policy. The report, "Future of Transportation in the Commonwealth" Report, covers a number of key topics that are relevant to the Cape Cod region including:

- Climate and Resiliency
- Transportation Electrification
- Autonomous and Connected Vehicles
- Transit and Mobility Services
- Land Use and Demographics.

The Report identified the following 18 recommendations for how to best prepare Massachusetts' transportation network for the challenges and opportunities of 2040. A discussion from the Cape Cod MPO perspective is included as in Appendix A.

Chapter 5: Financial Plan

The Financial Plan sent forth in this chapter sets the regional priorities for surface transportation spending for the next 21 years.

LEGISLATIVE BACKGROUND

Federal legislation that contains requirements for transportation plans, programs and projects includes the current legislation: *Bipartisan Infrastructure Law (BIL)* as well as the *Clean Air Act Amendments of 1990*.

In January 2021, President Biden signed the *Infrastructure Investment and Jobs Act (IIJA)* also known as the *Bipartisan Infrastructure Law (BIL)* Act (Pub. L. No. 117-58) into law. The BIL is the largest long-term investment in our country's infrastructure and economy. The BIL authorizes $550 billion over fiscal years 2022 through 2026 for investments in infrastructure related to roads, bridges, public transit, water infrastructure, resilience and broadband.

The new Bipartisan Infrastructure Law includes Planning Emphasis Areas (PEAs), around which states and MPOs should orient their planning efforts. These emphasis areas are listed below. For all goals, the document notes that FHWA Division and FTA regional offices should work with State DOTs, MPOs, and other relevant parties.

- Tackling the Climate Crisis – Transitioning to a Clean Energy, Resilient Future: Ensure that our transportation plans and infrastructure investments help achieve the national greenhouse gas reduction goals of 50-52% below 2005 levels by 2030, and net-zero emissions by 2050.
- Equity and Justice40 in Transportation Planning: Advance racial equity and support for underserves and disadvantaged communities."
- Complete Streets: Review current policies, rules, and procedures to determine their impact on safety for all users. This effort should work to include provisions for safety in future transportation infrastructure, particularly those outside automobiles.
- Public Involvement: Increase meaningful public involvement in transportation planning by integrating Virtual Public Involvement (VPU) tools into the overall public involvement approach while ensuring continued public participation by individuals without access to computers and mobile devices.
- Strategic Highway Network (STRAHNET)/U.S. Department of Defense (DOD) Coordination: Coordinate with representatives from DOD in the transportation planning and project programming process on infrastructure and connectivity needs for STRAHNET routes and other public roads that connect to DOD facilities.

- Federal Land Management (FLMA) Coordination: Coordinate with FLMAs in the transportation planning and project programming process on infrastructure and connectivity needs related to access routes and other public roads and transportation services that connect to Federal lands.
- Planning and Environment Linkages (PEL): Implement PEL as part of the transportation planning and environmental review process. The use of PEL is a collaborative and integrated approach to transportation decision-making that considers environmental community, and economic goals early in the transportation planning process, and uses the information, analysis, and products developed during planning to inform the environmental review process.
- Data in Transportation Planning: Incorporate data sharing and consideration into the transportation planning process.

FUNDING SOURCES

The primary source of funding for implementation of the RTP projects and programs is from the federal Highway Trust Fund. Distribution of Highway Trust Fund revenues are appropriated by Congress for surface transportation purposes through the United States Department of Transportation (USDOT) Federal Highway Administration (FHWA) and the USDOT Federal Transit Administration (FTA) as dedicated through federal legislation. The current federal legislation, *Infrastructure Investment and Jobs Act* (the "Infrastructure Bill"S), was signed into law in 2021.

In addition to federal funds, the Commonwealth of Massachusetts provided significant funds to the region. Highway projects can either be funded by a combination of federal and state funds (typically 80-90% federal funding) or fully funded by the state. For transit projects typically the state amount may average at a higher percentage due to the state funding a large percent of operating cost.

Receipts for the federal Highway Trust Fund are collected primarily from the federal fuel tax. Funding for transportation in Massachusetts comes from a combination of the state fuel tax, toll revenue, transportation-related fees (i.e. motor vehicle registration), and a portion of the state sales tax.

With the passage of the federal Bipartisan Infrastructure Law (BIL), additional bond authorization was needed to fully utilize the additional funding provided to the Commonwealth. An Act Relative to Massachusetts's Transportation Resources and Climate (MassTRAC) was filed to ensure the Commonwealth could fully utilize the funding authorization provided under BIL. The Legislature passed the bill and the $11.4 billion MassTRAC bill signed into law in August 2022. MassTRAC provides MassDOT and the MBTA the necessary authorization to take advantage of the federal highway and transit funding under BIL.

Local funds also play a large role in the advancement of projects with towns paying for the design of most highway projects with their borders. A town may even pay for the design of an

improvement at a state-owned location if it sees the advancement of the project as a benefit to the town. Local funds are also occasionally used to cover items not covered by other sources such as landscaping above standard design or improvements to utilities. Transit services also have a local share in funding, with a portion of service operating costs assessed to the towns through the Cape Cod Regional Transit Authority.

ESTIMATED AVAILABLE FUNDS

Both the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), in partnership will MassDOT, provide funding to the region through a number of programs.

Federal Highway Administration Source Funds

MassDOT divides the federal highway funding that it receives between "regional target funding," which is allocated at the discretion of the MPOs for regional priority projects on the federal aid transportation system, and funding that is allocated at MassDOT's discretion for use principally on the state-owned transportation system.

Each MPO's regional target funding is composed of shares of Congestion Mitigation and Air Quality Improvement Program (CMAQ), Highway Safety Improvement Program (HSIP), Transportation Alternatives Program (TAP), and Surface Transportation Program (STP) funding. "Statewide" funding that is allocated at MassDOT's discretion includes funding from the federal highway sources detailed in Table 15.[42]

[42] https://www.mass.gov/service-details/funding-considerations

TABLE 15. FHWA Funding Programs

PROGRAM	DESCRIPTION
Congestion Mitigation and Air Quality Improvement (CMAQ)	A wide range of projects in air quality nonattainment and maintenance areas for ozone, carbon monoxide, and small particulate matter, which reduce transportation-related emissions.
Highway Safety Improvement Program (HSIP)	Implementation of infrastructure-related highway safety improvements
National Highway Performance Program (NHPP)	Improvements to interstate routes, major urban and rural arterials, connectors to major intermodal facilities, and the national defense network. Also includes replacing or rehabilitating any public bridge, and resurfacing, restoring, and rehabilitating routes on the Interstate Highway System.
Surface Transportation Block Grant (STBG)	A broad range of surface transportation capital needs, including roads; transit, sea, and airport access; and vanpool, bicycle, and pedestrian facilities.
Transportation Alternatives Program (TAP)	Construction of infrastructure-related projects (for example, sidewalk, crossing, and on-road bicycle facility improvements).
Bridge Replacement and Rehabilitation Program (BR)	Replacement or repair of bridges on or off the federal aid system.
Ferry Boat Program (FBP)	Project to construct ferry boats and ferry terminal facilities.
National Highway Freight Program (NHFP)	Projects that improve the efficient movement of freight on the National Highway Freight Network

In 2023, MassDOT provided estimated available funds for the Cape Cod region from Federal Highway Administration (FHWA) including the state matching funds as presented in Table 16.

TABLE 16. Federal Highway Administration Funding for Cape Cod with State Match

TIME FRAME	FUNDING AVAILABLE FOR MPO (REGIONAL DISCRETIONARY)	NON-INTERSTATE DOT PAVEMENT	REMAINING STATEWIDE PROGRAMS (EXCLUDING STATEWIDE BRIDGE PROGRAM)	NON-FEDERAL AID PRESERVATION (BRIDGES AND ROADWAYS)	TOTAL ESTIMATED AMOUNT
2024-2028	$74,436,354	$33,441,772	$41,192,297	$14,445,799	$163,516,222
2029-2033	$88,895,177	$36,271,241	$57,837,802	$20,022,906	$203,027,125
2034-2038	$95,890,227	$40,046,381	$62,575,225	$22,106,906	$220,618,738
2039-2043	$105,469,500	$44,214,440	$769,812,169	$24,407,810	$243,903,919
2044	$22,492,299	$9,380,465	$14,912,664	$5,178,322	$51,963,749
2024-2044 Totals	$387,183,556	$163,354,299	$246,330,156	$86,161,743	$883,029,754

Additionally, Table 17 lists the competitive FHWA discretionary grant programs which are authorized under the BIL. Although funding for these programs is awarded on a competitive basis, MassDOT is actively pursuing funding from these discretionary grant opportunities for several projects, including the Cape Cod Canal Bridge Program.

TABLE 17. FHWA Discretionary Grant Funding Programs

PROGRAM	DESCRIPTION
Safe Streets and Roads for All	Competitive grant program provides funding to local governments, MPOs and federally recognized tribes, to support efforts to advance comprehensive safety plans or "Vision Zero" plans to reduce crashes and fatalities.
Strengthening Mobility and Revolutionizing Transportation (SMART)	Strengthening Mobility and Revolutionizing Transportation (SMART) Program provides grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems in order to improve transportation efficiency and safety.
National Infrastructure Project Assistance (MEGA)	Program provides grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems in order to improve transportation efficiency and safety.
Bridge Formula Program	Competitive grant program supports multi-modal, multi-jurisdictional projects of regional or national significance.
Nationally Significant Multimodal Freight & Highway Projects (INFRA)	Competitive grant program for multimodal freight and highway projects of national or regional significance to improve safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas.
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	A discretionary grant program aimed to assist communities with projects with significant local or regional impact.
Promoting Resilient Operations for Transformative, Efficient and Cost-Saving Transportation (PROTECT)	Competitive grant program to increase the resiliency of the transportation system, including coastal resilience and evacuation routes.
Charging and Fueling Infrastructure Grants	Discretionary grant program will fund strategic deployment of publicly accessible electric vehicle charging infrastructure, as well as hydrogen, propane and natural gas fueling infrastructure, along designated alternative fuel corridors and in communities.
Rural Surface Transportation Grant	Competitive grant program to improve and expand surface transportation infrastructure in rural areas, increasing connectivity, improving safety and reliability of the movement of people and freight and generate regional economic growth.
Reconnecting Communities Pilot Program (RCP)	Competitive grant program to reconnect communities divided by transportation infrastructure.

Federal Transit Administration Source Funds

The Federal Transit Administration (FTA) provides financial assistance to develop new transit systems and improve, maintain, and operate existing systems. FTA oversees thousands of grants to state and local transit providers through the FTA regional offices. The grantees are responsible for managing their programs in accordance with federal requirements and FTA is responsible for ensuring that these grantees follow the mandates along with statutory and administrative requirements. FTA funding programs are summarized in Table 18. [43]

TABLE 18. FTA Funding Programs

PROGRAM	DESCRIPTION
Section 5307 – Urbanized Area Formula Grant Program	This program funds routine capital investments, including bus purchases, but for some smaller systems, a portion can be used to defray transit system operating expenses.
Section 5310 – Elderly Persons and Persons with Disabilities Formula Program	This program is intended to enhance mobility for seniors and persons with disabilities by providing funds for programs to serve the special needs of transit-dependent populations beyond traditional public transportation services and Americans with Disabilities Act (ADA) complementary paratransit services.
Section 5339 – Bus and Bus Facilities	This program seeks to provide capital funding to replace, rehabilitate, and purchase buses and related equipment and to construct bus-related facilities.

In early 2023, Cape Cod MPO staff estimated available funds for the Cape Cod region from Federal Transit Administration (FTA) including the state matching funds as presented in Table 19. The CCRTA is actively seeking additional funding through various FTA discretionary programs and any other sources that become available to better advance the goals of the RTP.

TABLE 19. Federal Transit Authority Funding for Cape Cod with State Match

TIME FRAME	SECTION 5307	SECTION 5310	SECTION 5339	TOTAL
2024-2028	$76,527,312	$26,138,211	$4,928,777	$107,594,300
2029-2033	$85,977,021	$27,602,229	$3,317,576	$116,896,826
2034-2038	$94,925,578	$30,475,091	$3,662,872	$129,063,541
2039-2043	$104,805,508	$33,646,963	$4,044,106	$142,496,577
2044	$22,235,368	$7,138,486	$857,991	$30,231,845
2024-2044 Totals	$348,470,787	$125,000,980	$16,811,322	$526,283,089

[43] https://www.massdot.state.ma.us/planning/Main/PlanningProcess/FundingConsiderations.aspx

UNIVERSE OF PROJECTS

The universe of projects identified for funding can be divided into one of four funding categories: Transportation Projects, Transportation Programs, Smart Solutions, and Transportation Studies.

A "**transportation project**" is specific in the location and nature of construction or other activity that is anticipated. Examples of potential transportation projects include Route 6 safety improvements and the construction of a new multi-use trail from the end of the existing Shining Sea Bikeway to the Cape Cod Canal Path. Any project over $20 Million in total cost must be included in the RTP to receive federal funding. Projects under $20 Million may be included in the RTP depending on the level to which the project has been developed.

Given that the RTP covers a 20-25-year time-span it beyond our ability to define every specific transportation project that will implemented. Therefore, "**transportation programs**" identifying categories of specific transportation projects that are anticipated to be implemented and identifying funds to pay for these bundles of transportation projects. Examples of potential transportation programs include roadway resurfacing, intersections improvements, and transit operating assistance and capital needs.

"**Smart solutions**" are initiatives that do not require major investments in capital or operations. Examples of potential smart solutions include coordination of Cape Cod Regional Transit Authority and ferry schedules with each other and the development of a Cape-wide bicycle route system.

Finally, "**transportation studies**," seek to solve problems through planning efforts that focus on analysis of alternatives and public participation. These transportation studies ultimately identify solutions to problems that may be in the form of future transportation projects, programs, and/or smart solutions.

See Appendix M for a complete listing of the Universe of Projects for the 2024 RTP. This list constitutes unmet need for the region.

As is demonstrated by the extensive program of projects, the anticipated system wide need for the region greatly exceeds the anticipated revenues. Strategic decisions will need to be made to determine where the limited funded will be spent and which project will have to be delayed.

PROJECT ANALYSIS

In order to determine the projects to be contained within the financial constraint of the document, analysis was conducted on the universe of projects. Analysis of projects was limited to projects $20 million or greater with the expectation that smaller projects could be programmed in the bundle of "other TIP projects" included in the financial constraint of this document. Some projects under $20 million were included if it was determined that the potential benefits were commensurate with these larger scale projects. Analysis was conducted with a subcommittee of the CCJTC where each project was considered for potential benefit, estimated cost, consistency with the objectives of the RTP, impact on performance targets, project score (where available), equity as it relates to minority,

low income, Limited English Proficiency (LEP) and other protected populations, and GHG reduction potential. Considering these factors and the anticipated available funding, a financially constrained program of projects was developed with the CCJTC subcommittee and reviewed and approved by the Cape Cod MPO.

TRANSIT IMPROVEMENT/EXPANSION PROJECTS

In September 2022, the CCRTA prepared a Ten-Year Strategic Plan and a Five-Year Supporting Capital Plan. These two plans provide a Cape-wide vision for managing and augmenting transit infrastructure and operations to continually enhance the customers travel experience. The following five focus areas have been identified by the CCRTA as part of their strategic planning:

- Increase ridership through funding outlays designed to improve the customers' transportation experience and restore the public's confidence that is it safe to travel on public transportation.
- Bolster critically needed transit assistance supporting the diverse needs of our customers, contribute to the improvement of our local economy, and assist local businesses through the provision of a broader umbrella of transit services.
- Improve the efficiency and cost-effective delivery of transit services through technology enhancements that employ a data driver decision approach to the implementation of transit improvements.
- Achieve a Zero Carbon Footprint Goal by 2030 through targeted capital investments in EV charging station infrastructure, incremental conversion from fossil fuel vehicles to electric and further investments in "green building" and solar technology.
- Reduce future budgetary costs and increase revenues through selective investments in operating and capital budget initiatives.

Over the next five years, the CCRTA has a regional approach to work with multimodal partners to promote and advance an "economy of scale" collaborative investments for the transition to electric vehicles and supporting infrastructure. It is expected that a significant portion of their capital funds will be dedicated to facility upgrades at the their Bus Maintenance/Operations Facility in Dennis to support the transition to a zero emissions fleet.

In addition to investments related to infrastructure and facility improvements, the CCRTA evaluates its routes and schedules on a regular basis in an effort to best meet the needs of the region. Where potential improvements or expansions are identified, funding is sought to support their implementation. Most often service expansions begin as demonstration projects and, when successful, long term-term funding is sought for their continued operation.

Two recent examples of demonstration projects are the Bourne Run and the Sandwich Line. After successful demonstration periods, their operation continues extending transit options to a larger portion of the Cape's population.

The CCRTA also continually reviews their existing routes to look for ways to improve the customer experience and system-wide efficiency. In consultation with a variety of community members, the CCRTA made such changes to their routes servicing Hyannis to improve access to pharmacies, grocery stores, the senior and youth centers, shopping areas, and a wide range of other locations. The CCRTA is working to improve late night service from Provincetown during the peak summer season.

Other service improvements or expansions that have been or are under considered include:

- Extending evening service hours on fixed routes
- Extending weekend service on fixed routes including Sunday service
- Providing fixed route service in underserved areas of the Mid-Cape
- Providing increased frequency on fixed routes in urban areas (i.e. Hyannis, Provincetown, Falmouth)
- Providing new seasonal services (i.e. Chatham Shuttle)

At this time there is not sufficient demand to sustain these services and/or the CCRTA does not anticipate sufficient funding for their operation. Based on current projections, the CCRTA anticipates that all of the levels of transit funding included in this document will maintain existing service, but not be sufficient to support significant expansions to the system.

Lastly, in addition to service improvements or expansions, the CCRTA considers investments in parking and in transit-oriented-development in the vicinity of the Hyannis Transportation Center as critical to the increase use of transit in the region. The CCRTA is also supportive of expansions to Cape Flyer rail service as it provides an important non-automobile option to Cape Cod that complements that transit services provided by the CCRTA.

As funding opportunities arise, the CCRTA will consider these and any other service improvement, expansion, or transit-supportive project that improves transit options for the region.

HIGHWAY PROGRAM OF PROJECTS

It is the responsibility of the Cape Cod MPO to select regional priority projects to be funded by the available highway regional target funds. With only $387 million anticipated in highway regional target funds available from 2024 through 2044, there is significantly more need than available funding.

Table 20 presents the Cape Cod MPO's recommended program of project for 2020 through 2040. This program of projects balances the need for large-scale regional projects that are specifically identified with smaller-scale projects included as a bundle of "Programs and Smart Solutions."

Project costs are shown with both 2024 estimated costs and, in order to account for inflation, year of expenditure (YOE) costs that include a 4 percent annual inflation rate.

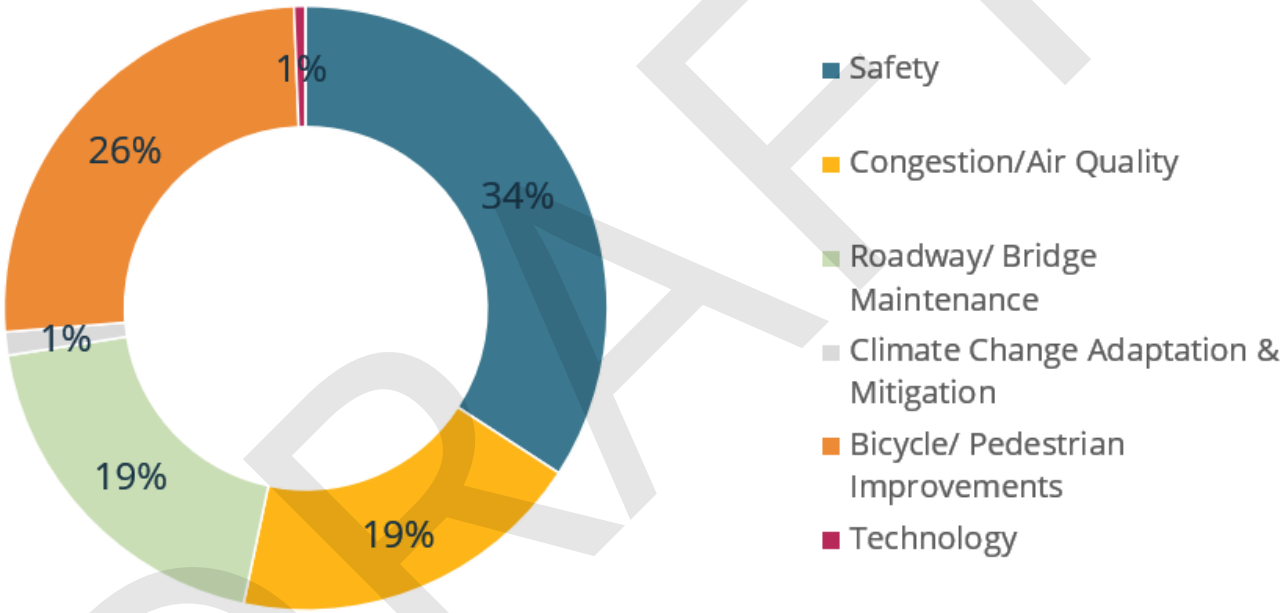
TABLE 20. Highway Regional Target Funding – Program of Projects

YEARS OF FUNDING	PROJECT / PROGRAM	2024 TOTAL ESTIMATED COST	TOTAL-YEAR OF EXPENDITURE (YOE) ESTIMATED COST
2024-2028	Mashpee 151 Improvements		$20,800,000
	Route 28 Multimodal Improvements		$40,200,000
	Provincetown, Shank Painter Road and Route 6 Improvements		$13,400,000
	Rail Trail Extensions (Mid- and Upper-Cape)[1]		[$16,500,000]
	Route 28 Bass River Bridge Replacment[1]		[$51,900,000]
	Cape Cod Canal Bridges Program[2]		
	Programs		$36,354
	Subtotal Funding		$74,436,354
2029-2033	Route 28 Multimodal Improvements	$20,000,000	$26,318,636
	Rail Trail Extensions (Upper and Mid Cape)	$15,000,000	$19,738,977
	Route 6 Safety & Multimodal Improvements (Outer Cape)	$15,000,000	$19,738,977
	Hyannis Area Improvements[3]	$10,000,000	$13,159,318
	Programs		$9,939,270
	Subtotal Funding		$88,895,177
2034-2038	Route 28 Multimodal Improvements	$20,000,000	$32,020,644
	Rail Trail Extensions (Upper and Mid Cape)	$20,000,000	$32,020,644
	Route 6 Safety & Multimodal Improvements (Outer Cape)	$15,000,000	$24,015,483
	Programs		$7,833,455
	Subtotal Funding		$95,890,227
2039-2043	Hyannis Area Improvements	$30,000,000	$58,437,015
	Rail Trail Extensions (Mid Cape)	$20,000,000	$38,958,010
	Programs		$8,074,475
	Subtotal Funding		$105,469,500
2044	Programs		$22,492,299
	Subtotal Funding		$22,492,299
2024 - 2044 Total			**$387,183,556**

[1] Projects funded in the *Federal Fiscal Year Cape Cod 2024-2028 Transportation Improvement Program* through a combination of state and federal sources outside of the regional target.
[2] See page 70 for discussion of the Cape Cod Canal Bridges Program. The Program is anticipated to be funded through a combination of state and federal sources outside of the regional target.
[3] Projects identified in the Hyannis Access Study and related projects being developed by MassDOT and the Town of Barnstable including improvements to Route 132

In allocating the available highway regional target funding, particularly for the bundled "Programs and Smart Solutions," it is important to keep a balance between different types of projects. Based on feedback from the budget challenge in the RTP survey, recommendations from the CCJTC project selection subcommittee, and, ultimately the recommendation of the Cape Cod MPO, Figure 37 represents the recommended distribution of funding across the range of programs. This recommended distribution will be used to inform TIP project selection through the development of revised TIP scoring criteria, as needed. Roadway maintenance, bridge maintenance, and transit are also often elements of these highway regional target projects but are addressed primarily through statewide funding streams. A discussion of the overall RTP funding distribution is presented in the next section.

Figure 37. Highway Regional Target Funding Distribution



Analysis of Highway Regional Target Projects

An analysis of potential impacts (positive or negative) on low income, minority, and LEP populations was conducted on regional target projects and is presented in Table 21. Of the approximately $387 million in highway regional target funding, approximately $339 million is programmed for specific regional target projects while the remainder will go to "Programs and Smart Solutions." Analysis was limited to the specific projects, with existing TIP analysis procedures ensuring that the "Programs and Smart Solutions" will be programmed in an equitable way.[44]

TABLE 21. Highway Regional Target Projects – Income, Minority, and LEP Population Impacts

PROJECT	LOW INCOME [I], MINORITY [M], OR LIMITED ENGLISH PROFICIENCY [LEP] POPULATION AREA PROXIMATE	NATURE OF IMPACT ON LOW INCOME, MINORITY, OR LEP AREA
Mashpee: Route 151	M	Improved bicycle/ pedestrian access, safety, traffic flow
Route 28 Multimodal Improvements: Various Locations	TBD	Improved bicycle/ pedestrian access, safety
Provincetown, Shank Painter Road and Route 6 Improvements	I	Improved bicycle/ pedestrian access, safety
Rail Trail Extensions (Mid- and Upper-Cape)	I, M, LEP	Improved bicycle/ pedestrian access, safety
Route 6 Safety Improvements (Outer Cape)	I	Improved bicycle/ pedestrian access, safety, traffic flow
Rail Trail Extensions (Upper and Outer Cape)	I	Improved bicycle/ pedestrian access, safety
Hyannis Area Improvements	I, M, LEP	Improved bicycle/ pedestrian access, safety, traffic flow
Route 6 Safety Improvements (Interchanges and Shoulders)	I, M, LEP	Improved safety, traffic flow
Route 28 Bass River Bridge Replacement[1]	I, M	Improved bicycle/ pedestrian access, safety
Cape Cod Canal Bridges Program[1]	I, M	Improved bicycle/ pedestrian access, safety, traffic flow

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

[44] The most recent slate of highway projects programmed in the 2024-2028 Cape Cod TIP indicated that approximately 98% of funding is allocated on projects within and proximate to low income, minority, and LEP populations. This represents an investment in transportation infrastructure serving these areas that is proportionally higher than other areas on Cape Cod.

Of the approximately $387 million programmed for specific regional target projects, approximately 75% was on projects within and proximate to minority populations, 92% was on projects within and proximate to low income populations, and 80%, was on projects within and proximate to LEP populations. Given the regional nature of these projects, even projects that are not proximate to these identified population are likely to positively impact these identified populations as they travel through these locations to access regional services. This represents an investment in transportation infrastructure serving these areas proportionally higher than other areas on Cape Cod. In summary, the areas with higher proportions of low income and minority populations see more transportation dollars spent than other areas on Cape Cod. Further analysis of highway regional target projects is presented in Appendix M.

An analysis of regional target projects was also analyzed in relation to greenhouse gas (GHG) emissions. As presented in Table 22, it is anticipated that most of the projects will result in nominal decreases in emissions for sidewalk and/or bicycle infrastructure or other improvements. It is anticipated that other projects will result in a quantifiable decrease in emissions that will need to be verified by statewide modeling efforts.

TABLE 22. Highway Regional Target Projects – Anticipated GHG Impacts

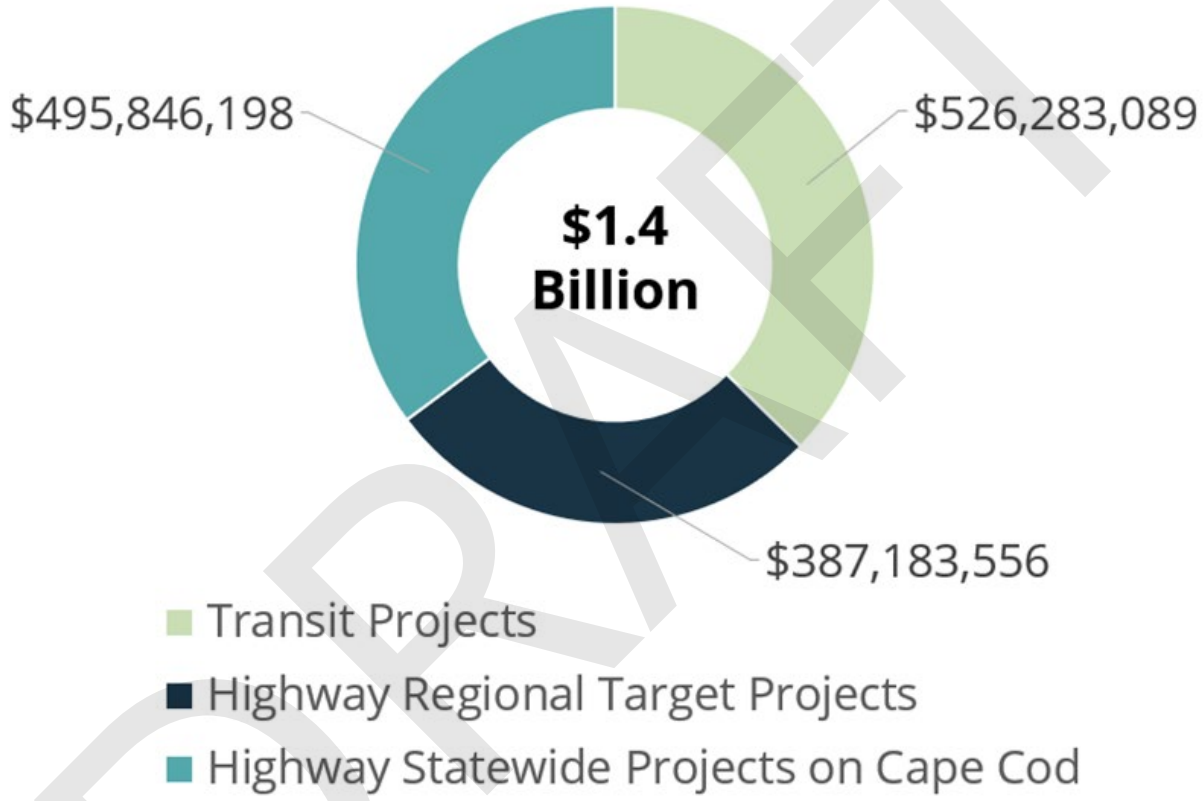
PROJECT	ANTICIPATED GHG IMPACT
Mashpee: Route 151	Quantified Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Route 28 Multimodal Improvements: Various Locations	Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Provincetown, Shank Painter Road and Route 6 Improvements	Quantified Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Rail Trail Extensions (Mid- and Upper-Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Route 6 Safety Improvements (Outer Cape)	Assumed Nominal Decrease in Emissions from Sidewalk, and Bicycle Infrastructure
Rail Trail Extensions (Upper and Outer Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Hyannis Area Improvements	Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Route 6 Safety Improvements (Interchanges and Shoulders)	Assumed Nominal Decrease in Emissions from Roadway Infrastructure
Rail Trail Extensions (Mid-Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Route 28 Bass River Bridge Replacement[1]	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure
Cape Cod Canal Bridges Program[1]	Project included MassDOT modeling used to develop the "Evaluation and Reporting of Statewide Greenhouse Gas Reductions in Transportation" presented in Appendix N

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

CONCLUSION

The spending on highway regional target projects, highway statewide projects on Cape Cod, and the transit service and projects, summarized in Figure 38, all contribute to the development of a transportation system that will serve the region for years to come.

Figure 38. Summary of Anticipated Funding



The RTP vision, goals, and objectives set a framework for the spending of surface transportation funds in the region. Based on the overall program established in this report, the anticipated $1.4 billion is allocated to overall spending categories as summarized in Figure 39.

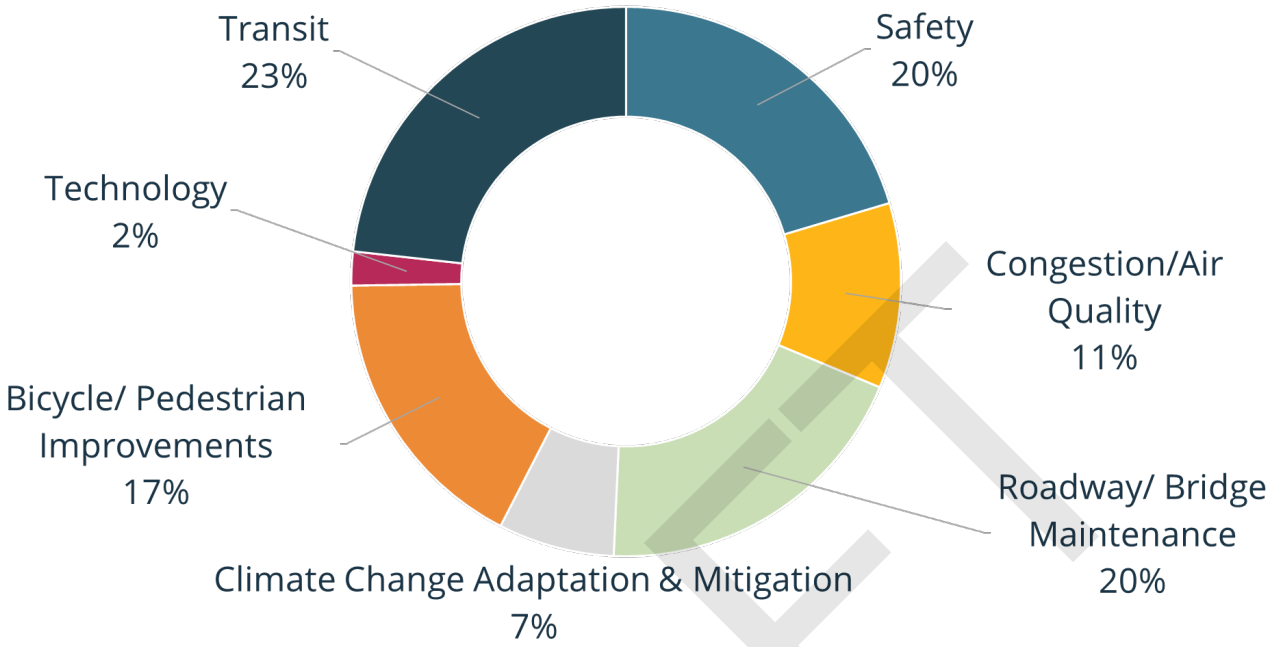


Figure 39. Summary of Recommended RTP Spending Distribution

While there is still significant unmet need for the region, see Appendix M, the $1.4 billion of anticipated surface transportation funding available over the next 21 years represents a significant investment in the region.

List of Abbreviations

ADA	Americans with Disabilities Act
BIL	Bipartisan Infrastructure Law
BMP	Best Management Practices
CCC	Cape Cod Commission
CCJTC	Cape Cod Joint Transportation Committee
CCRTA	Cape Cod Regional Transit Authority
CEDS	Comprehensive Economic Development Strategy
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CMP	Congestion Management Process/Plan
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FAST	Fixing America's Surface Transportation Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FFY	Federal Fiscal Year
FY	Fiscal Year
GHG	Greenhouse Gas
GIS	Geographic Information System
GWSA	Global Warming Solutions Act
IIJA	Infrastructure Investment and Jobs Act
ITS	Intelligent Transportation System(s)
LEP	Limited English Proficiency
LID	Low-impact Development
MAP-21	Moving Ahead for Progress in the 21st Century
MassDER	Massachusetts Division of Ecological Restoration
MassDOT	Massachusetts Department of Transportation
MPO	Metropolitan Planning Organization
NHPP	National Highway Performance Program
NHS	National Highway System
PPP	Public Participation Plan
RPP	Regional Policy Plan
RTA	Regional Transit Authority
RTP	Regional Transportation Plan
STIP	Statewide Transportation Improvement Program
STP	Surface Transportation Program
TAP	Transportation Alternatives Program
TCI	Transportation & Climate Initiative
TDM	Transportation Demand Management
TMA	Transportation Management Area
TIP	Transportation Improvement Program

Title VI	Title VI of the Civil Rights Act of 1964
UPWP	Unified Planning Work Program
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled
YOE	Year of Expenditure

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2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix A: Historical Context and the Future of Transportation

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Technical Appendix A: Historical Context

Cape Cod and its transportation system is a story of a continually evolving community with ever-changing transportation needs. This appendix will touch on how the region arrived where it is today, what today's transportation landscape looks like, and what are the challenges and opportunities that lie ahead is maintaining the region's connection to the past while looking toward the future.

Additional information on the region's development and land use patterns over time has been compiled by the Cape Cod Commission and is available in an online Chronology Viewer. The Cape Cod Commission Chronology Viewer is available at:

www.capecodcommission.org/chronology/

The Chronology Viewer explores how the population is changed over time, where and when houses where constructed, and when key infrastructure was developed.

RESOURCE DEPLETION, TECHNOLOGICAL CHANGE, AND GOVERNMENT POLICY

Cape Cod's development and economy have been heavily influenced by three factors:

- Resource depletion,
- Technological change, and
- Government policy.

The Cape has seen many ways of making a living come and go as a result of these three factors. These include agriculture, fin fishing, shell fishing, whaling, salt, limited clothing and shoe manufacturing, and glass manufacturing. The Cape's current economy is dominated by tourism.

The Mashpee Wampanoag Tribe were stewards of these lands and resources for thousands of years. At the time the Cape was settled by Europeans in the colonial period it was rich in natural resources including hardwood forests, fertile soil, and waters teaming with marine life. By the end of the Colonial period the region has been clear cut and the soils exhausted.

The overcutting of woodlands and excessive farming had reduced soil fertility, resulting in lower than average crop yields. The lack of ground cover, combined with the effects of wind and water, resulted in

topsoil being eroded away, to one-third or one-half their 17th-century depths. This erosion may have been in part responsible for the silting in of numerous harbors and for the death of oyster beds.

Historical & Archaeological Resources of Cape Cod & the Islands, Massachusetts Historical Commission, 1986

The region had to import wood to heat homes and cook. Whaling on the Cape started with salvaging dead or stranded whales off the beach; by the end of that industry ships were sailing all the way to the South Pacific to find whales. Fishing peaked in 1851, employing over 3,200 in the industry. Like whaling, fishing was initially a near shore activity but gradually moved farther off shore as stocks were depleted. Today we face the near if not complete collapse of the cod fishery for which the peninsula is named. Even tourism is now threatened by environmental damage due to over development. Ponds and estuaries that were once pristine are clouded, mucky, and in some cases, devoid of marine life. Shell fishing beds are gone and swimming is no longer desirable in some places. Time will tell the fate of the tourism industry on Cape Cod.

Changes in technology have had a major impact on the economic and social history of the Cape. Technology has changed the scale of commercial activity everywhere by increasing both productivity and distribution. Advances in productivity, have in some cases accelerated the resource depletion discussed above.

By the early 1890s, Barnstable, Brewster, Wellfleet, Truro, and Province town had all built large numbers of these traps and weirs to supply both fish for market as well as bait for fishing vessels. Extensive trapping, however, had a severe effect on fish populations. When the mackerel disappeared from New England waters in the mid-1880s, many blamed the use of these traps.

Historical & Archaeological Resources of Cape Cod & the Islands, Massachusetts Historical Commission, 1986

The discovery of new resources elsewhere also had a great impact on major regional industries. For example, the opening of the first commercial oil well in Pennsylvania in 1859 significantly reduced the demand for whale oil for lighting. But transportation technology has possibly the greatest impact on the way of life, economy, and level of development on Cape Cod. The railroads brought the first significant influx of tourist, particularly summer residents, to the Cape as early as 1870.

None, however, were more prominent in their resort success than the Woods Hole Branch, opening in 1872. Although organized initially to serve the guano works at Woods Hole, the line quickly became instrumental in the development of Bourne, Falmouth, and, through the ferry terminal at Woods Hole, Martha's Vineyard and Nantucket. Small villages from Buzzards Bay to Woods Hole sprouted hotels and resort communities almost overnight.

Historical & Archaeological Resources of Cape Cod & the Islands, Massachusetts Historical Commission, 1986

The salt industry is perhaps the best example of how government action impacts the economy. The industry was made viable by a tariff placed on imported salt by the US government along with a subsidy to domestic manufacturers. Combine with improvements to the evaporation process, this led to a thriving salt industry on the Cape from the late 1700's to 1840's. At its peak, every town except for Mashpee and Bourne had multiple saltworks lining their beaches. But the industry virtually collapsed when the subsidy was removed and the US reduced the tariff on imports of salt.

Probably the chief reason for the decline in production, however, was the lowering of the duty on imported salt. Ever since 1790 there had been a duty of at least ten cents a bushel... In 1842, the duty on imported salt fell to 8¢ a bushel, and in 1846 it was changed to a 20% ad valorem scale, greatly to the advantage of foreign sources.

Historical & Archaeological Resources of Cape Cod & the Islands, Massachusetts Historical Commission, 1986

Another example of the government's role in the Cape's economy is its investment in roads, particularly interstates, in the 1950's. This changed the nature of tourism on Cape Cod as well as the development patterns which to date had been fairly concentrated in villages accessible by rail. This coincided with a stronger middle class with disposable income and a reduction in the cost of construction. Sprawling auto-oriented development has dominated since that time and been reinforced by zoning rules.

TRANSPORTATION INFRASTRUCTURE DEVELOPMENT

Cape Cod's transportation system has both shaped and been shaped by development patterns of the region. As our regional economy has evolved so too has our transportation infrastructure. From a reliance on ports and marine transport, to a steady growth by rail, and explosion of change fueled by the automobile – our region has undergone dramatic changes.

Early Trail and Road Network

EARLY TRAILS

Before European settlers landed on Cod Cape, Native Americans, including the Mashpee Wampanoag Tribe, had established a network of trails throughout the region. Linking up key geographic locations and important natural resources, many of these trails evolved into roadway connections we are familiar with today.

CONTACT (1500 - 1620) AND PLANTATION (1620 - 1692) PERIODS

By the time the Pilgrims arrived, there was an extensive trail network stretching from one end of the region to the other as shown in Contact Period map in Figure 1. Even this far back, we can see connections that would eventually become the road network of Cape Cod. As Native Americans and Europeans used the network more extensively, trails were upgraded to cartpaths or roadways. As shown in Figure 1 portions of present-day Route 6A took shape as County Road.[1]

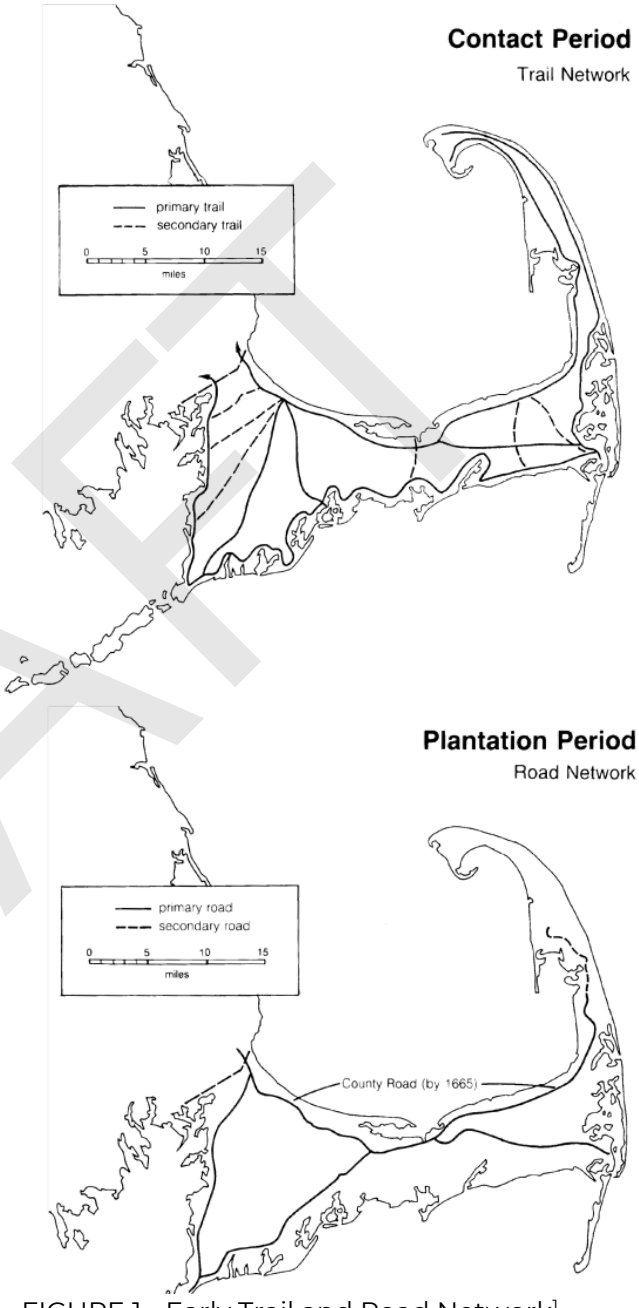

FIGURE 1. Early Trail and Road Network[1]

[1] Historic & Archeological Resources of Cape Cod & the Islands. Massachusetts Historical Commission. Originally published August 1986. PDF reprint version, 2007.

Expansion of Water Routes

COLONIAL (1692 - 1775) AND FEDERAL (1775-1830) PERIODS

As local transportation and commerce increased, water routes were the life blood of the region. Land routes were improved, widened, and expanded to support connection to the ports. Figure 2 shows the expansion of the road network and connection to water routes in these periods.[1]

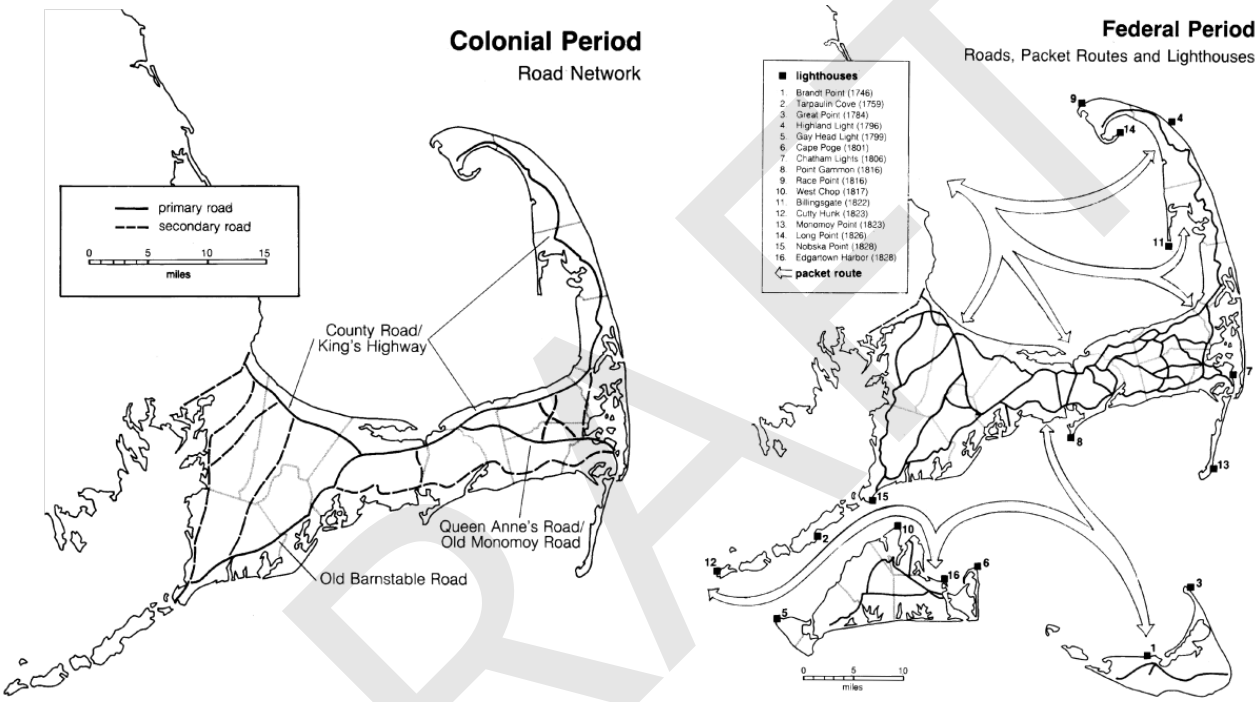

FIGURE 2. Expansion of Water Routes and Land Connections[1]

Expansion of Railroads

EARLY AND LATE INDUSTRIAL PERIODS (1830-1915)

The industrial period saw the development and expansion of railroads across the region. Still tied to major ports, as shown in Figure 3, rail served both freight-needs as well as the emerging tourism market.

This period saw multiple expansions of the rail network ultimately including connections to almost every town on Cape Cod. As the rail network expanded, development grew up around the train depot. These pockets of development thrived while rail transportation dominated the region. As the predominance of rail waned, some of these developments evolved to meet new needs while others did not.[1]

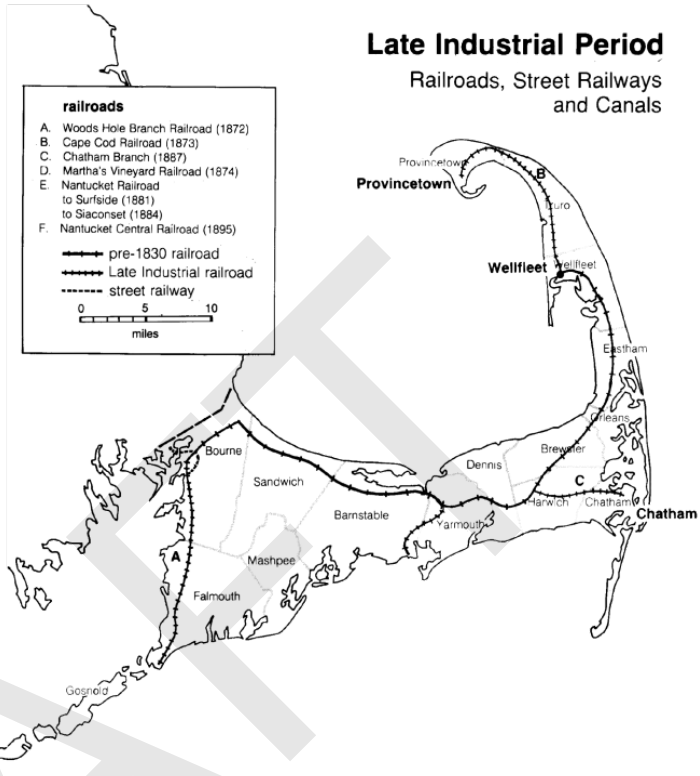

FIGURE 3. Rail Expansion[1]

Age of the Automobile

MODERN PERIOD TO PRESENT DAY (1915-)

The emergence of the automobile and tourism industry on Cape Cod forever changed the transportation network of the region. Construction of the Cape Cod Canal redefined the transportation landscape of the region. Expanding from the Cape Cod Canal, the transportation system was significantly expanded and modernized during the 20th century. As shown in the Table 1, some of greatest expansions occurred in the 1950's.

TABLE 1. Industrial Period Rail Expansion

YEAR	MILESTONE
1935	Bourne, Sagamore, and Railroad bridges over the Cape Cod Canal
1950	Rt. 6: Sagamore Bridge to Hyannis (exit 6) – 2 lanes
1954	Rt. 6: Sagamore Bridge to Hyannis (exit 6) – 4 lanes
1955	Rt. 6: Hyannis (exit 6) to Dennis (exit 9) – 2 lanes
1956	Rt. 6: Dennis (exit 9) to Harwich/Brewster (exit 11) – 2 lanes
1958	Rt. 6: Harwich/Brewster (exit 11) to Orleans (exit 12) – 2 lanes
1959	Rt. 6: Orleans (exit 12) to Orleans/Eastham Rotary – 2 lanes
1967	Rt. 6: Hyannis (exit 6) to Yarmouth (exit 7) – 4 lanes
1971	Rt. 6: Yarmouth (exit 7) to Dennis (exit 9) – 4 lanes
1987	Route 25: East Wareham (I-195) to Bourne Bridge – 6 lanes

Sixty-five years after that great expansion, the region is struggling to face tomorrow's challenges with an aging transportation network. Most notably with the impending replacement of the Bourne and Sagamore Canal Bridges at the forefront. While there is debate over whether we are still in the age of the automobile, it is clear that investments in all modes are required to meet the region's future transportation needs.

HISTORIC PRESERVATION TOOLS

Cape Cod towns utilize a wide variety of tools to protect their historic resources. The most commonly used are local historic districts and demolition delay bylaws, though many towns have also adopted more specialized regulations. Some historic resource protections are initiated by town historical commissions, while others are spurred by planning boards, nonprofit historic societies, and neighborhood groups. Key information about tools such as historic inventories and districts is available at the Massachusetts Historical Commission (MHC)[2].

While these preservation tools are primarily applied to the demolition or modification of structures, a number of the tools apply to roadway work as well.

[2] http://www.sec.state.ma.us/mhc/mhcidx.htm

Inventories

Inventory is an important first step toward protecting a community's historic resources. Historic inventories can be used to teach people about their community's history and to guide town boards in future land use decisions. The MHC provides standardized inventory forms for different types of historic resources. The forms are typically filled out by local historical commission members, volunteers, or private consultants, and many Cape towns have sought grants to support this work. Completed forms are kept both in the town and at MHC, which provides online access through its MACRIS database.[3]

Local Historic Districts

Local Historic Districts require review by a historic district commission for any exterior alteration to buildings and structures visible from a public way.

On Cape Cod, local historic districts in the towns of Barnstable, Dennis, Eastham, Harwich, and Provincetown were created under Chapter 40C (the Historic Districts Act) of Massachusetts General Law. The towns of Chatham and Falmouth have established local historic districts under special legislation. The Old Kings Highway Regional Historic District, covering portions of Sandwich, Barnstable, Yarmouth, Dennis, Brewster and Orleans, was also created by a special act of legislation. (See Figure 4)

National Register Buildings and Districts

The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources.[4]

National Register of Historic Places offers special protection for individual historic

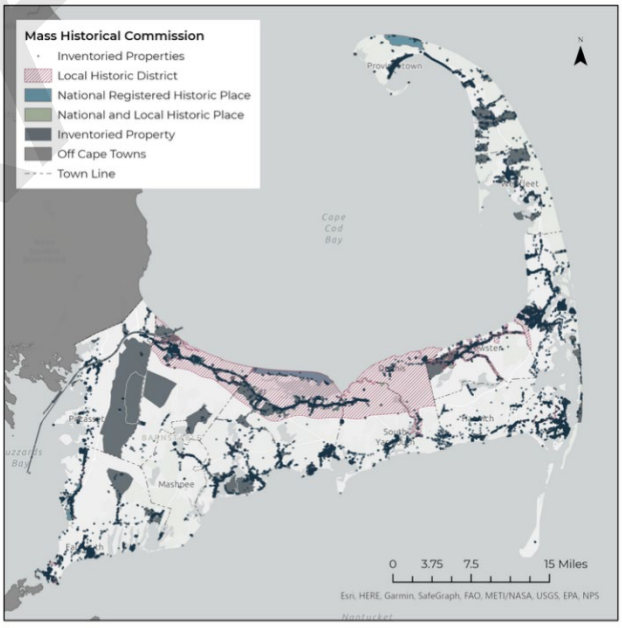

FIGURE 4. State Registered Historic Districts and Places

[3] http://mhc-macris.net/

[4] http://www.nps.gov/nr/

buildings and properties in historic districts on Cape Cod. As shown in Figure 4, historic properties are spread across Cape Cod In addition to protections under local historic districts; the Cape Cod Commission Act[5] provides additional protections. Under the Cape Cod Commission Act, demolition or substantial alteration of National Register properties, whether individually listed or part of a National Register Historic District, are subject to review by the Cape Cod Commission if there is no other historic district protection in place. In addition, there are hundreds of other historic locations across Cape Cod that have not yet been inventoried by the National Register of Historic Places.

Preservation Bylaws

- **Demolition Delay Bylaws** create time to explore alternatives to demolition of historically significant buildings. Any demolition permit request is reviewed by the Historical Commission to determine if a building is "preferably preserved" and if a delay period should be imposed. On Cape Cod, delay periods range from 6 to 18 months. See the Cape Cod Commission's Demolition Delay Network[6].
- **Overlay Districts** create special zoning regulations for unique areas. Brewster's Corridor Overlay Protection District limits the scale and massing of commercial buildings along historic Route 6A. The Village Commercial Overlay District in Harwichport allows smaller setbacks and mixed uses consistent with historic development patterns. The Cape Cod Commission's Village Development Model Bylaw[7] guides small-scale, mixed-use development in village centers. It can be established as an overlay district or as a stand-alone zoning district.
- **Archaeological Resource Districts** aim to protect archaeological sites by limiting ground disturbance in sensitive areas. The towns of Barnstable and Brewster protect historic values in their Wetland Protection Bylaws, using Massachusetts Historical Commission review to help determine if an area is likely to have archaeological significance.
- **Scenic Road Bylaws** protect trees, stone walls, and features that fall within the right-of-way of designated roads. A planning board hearing is required prior to repair, maintenance, reconstruction, or paving work if it would involve removal or cutting of trees, or destruction of stone walls within the road right-of-way. It does not address trees or walls on adjacent private property. Barnstable, Falmouth, and Sandwich coordinate their scenic road reviews with the Planning Board, Department of Public Works, Tree Warden, and Historical Commission.

[5] http://www.capecodcommission.org/aboutccc/act

[6] http://www.capecodcommission.org/resources/regulatory/HistoricPreservation_CCCActandNationalRegister.pdf

[7] http://www.capecodcommission.org/resources/bylaws/village.doc

- **Districts of Critical Planning Concern** are a tool created by the Cape Cod Commission Act to protect special resource areas. Towns nominate an area to the Cape Cod Commission and work with Commission staff to craft regulations that protect the district. The Designated DCPCs page[8] describes the Centerville Village, Craigville Beach, and Sandwich Three Ponds DCPC regulations to protect cultural and scenic resources.

Preservation Restrictions

Preservation Restrictions and Conservation Restrictions are legal agreements used to protect historic buildings and lands from change. The restrictions are drawn up by the property owner and a nonprofit preservation group or a government entity that is in charge of their enforcement. Restrictions can be placed on buildings or on land, and may also be used to protect archaeological resources hidden beneath the surface of the land.

The Massachusetts Historical Commission holds Preservation Restrictions on numerous Cape properties that have received preservation grant monies. Preservation Restrictions are required for some projects that use Community Preservation Act (CPA) funding, and many of these restrictions are held by conservation trusts and local historical commissions.

"FUTURE OF TRANSPORTATION IN THE COMMONWEALTH" REPORT

With many changes facing the transportation system in the coming decades, the Cape Cod MPO looks to work with state and federal agencies to understand and plan for these changes. The Commonwealth of Massachusetts in a leader in transportation profession in terms of forward-thinking transportation planning and policy. The report, "Future of Transportation in the Commonwealth" Report, covers a number of key topics that are relevant to the Cape Cod region.

In January of 2018 Governor Baker established the Commission on the Future of Transportation to investigate the following topics as they affect transportation during the 2020-2040 time span:

- Climate and Resiliency
- Transportation Electrification
- Autonomous and Connected Vehicles
- Transit and Mobility Services
- Land Use and Demographics.

[8] http://www.capecodcommission.org/departments/planning/DCPC/designated

The Governor's commission identified the following 18 recommendations for how to best prepare Massachusetts' transportation network for the challenges and opportunities of 2040. A discussion from the Cape Cod MPO perspective is included following each recommendation and is shown in *italics*.

1. PRIORITIZE INVESTMENT IN PUBLIC TRANSIT

The Commonwealth must continue to focus on modernizing its existing public transit assets, including vehicles, to prepare the current system to perform better long before 20440. The public transit agencies of Massachusetts need to reinvent transit operations to offer better, more responsive, and more customer-focused service, in concert with new mobility. *As an MPO partner, the Cape Cod Regional Transit Authority (CCRTA) continues to innovate and expand its services. For example, the CCRTA has been integrating support for bicyclists with transit service and adopting ride sharing services as part of its network*.

2. TRANSFORM ROADWAYS AND TRAVEL CORRIDORS

MassDOT, municipalities, and other roadway owners should redesign them to prioritize person-throughput rather than vehicle-throughput, so that limited corridor capacity is allocated to moving as many people as possible, while accommodating mobility alternatives. *Several communities in Barnstable County have already expressed interest in MassDOT's "Complete Streets" program; the Town of Sandwich has received funding through the program; the Cape Cod Commission has completed a prioritization plans in a number of Cape Cod towns as detailed at www.capecodcommission.org/CompleteStreets. Applying Complete Street's principles has and will continue to improve state and local roads to accommodate all users. In addition, accommodating transit service can lead to increased use of intercity buses thereby shifting travelers away from personal automobiles.*

3. BETTER MANAGE TRAFFIC CONGESTION

The Commonwealth must consider a full set of options to address roadway congestion, including improvements to public transit, better systems operations, and the consideration of congestion pricing. The Commonwealth should prioritize and target investments in public transit and other high-capacity transportation modes to make these more efficient, attractive, and reliable to reduce single occupancy vehicle (SOV) use, particularly on our most congested roads in the urban core. *The Cape Cod MPO's Regional Transportation Plan has and will continue to support comprehensive strategies to address traffic congestion. Cape Cod is fortunate to have pleasant weather during its busiest season – making bicycling and walking attractive options for shorter trips; additionally, the CCRTA deploys expanded services during the busy season. Intersection operations can be improved through deployment of signal preemption – allowing Opticom-equipped CCRTA buses to improve travel times. The use of Congestion Pricing could be effective both as a traffic management strategy as well has a funding mechanism to support transportation alternatives.*

4. ESTABLISH A COMMONWEALTH TRANSPORTATION TECHNOLOGY TRANSFORMATION INITIATIVE

The Governor's commission believes that we are in the early stages of a transportation revolution as impactful as any that has come before it. In order to harness the talent of our workforce, academia, and innovators to take full advantage of this opportunity, the Commission calls for the establishment of the Commonwealth Transportation Technology Transformation Initiative (T3I) to partner public and private resources with innovators to tackle some of the Commonwealth's most difficult transportation issues. *Cape Cod MPO staff will continue to monitor developments in this area and participate in MassDOT efforts such as training and workshops*.

5. SUPPORT AND ACCELERATE EFFORTS TO CONSUME TRANSPORTATION DIFFERENTLY

MassDOT should lead the development of policies related to changes in mobility practices, including ride-sharing, vehicle-sharing, Mobility as a Service (MaaS), on-demand mobility (ODM), and micro-mobility. The Commonwealth should continue to be an innovation proving ground for shared mobility initiatives. *Cape Cod MPO staff will continue to participate with MassDOT's efforts in this area. One area of emphasis will be to explore deployment of bikeshare, dockless bicycles and/or scooters in some of the Cape's higher-density villages*.

6. PROMOTE A STATEWIDE TELECOMMUNICATIONS INFRASTRUCTURE

The Commonwealth should promote full statewide communications infrastructure (5G, Wi-Fi, and their future counterparts) that can support and enable new transportation technologies and services, from connected and autonomous vehicles (C/AVs), to real-time traffic and asset management systems, to telecommuting opportunities. Since the siting of infrastructure to support new technologies includes municipal approval, MassDOT and other state agencies will need to expedite their review and approval processes while better coordinating them with local communities. *Improving the Cape's wireless communications systems continues to be a priority of the Cape Cod Commission and stakeholders such as OpenCape. Cape Cod MPO staff will continue to work with MassDOT and Cape Cod communities to deploy an improved system*.

7. DEVELOP A STRATEGY TO SUPPORT CONNECTED AND AUTONOMOUS VEHICLES

MassDOT should dedicate resources to the management of an interagency Connected and Autonomous Vehicle (C/AV) Committee, to understand how the Commonwealth can prepare for and maximize the positive impacts of C/AVs. To continue Massachusetts' leadership position, the Governor should consider proposing legislation to establish statutory and regulatory structures that enable the safe and reliable deployment of C/AVs. *C/AVs can be expected to have a significant impact on mobility and traffic operations. Positive impacts include improved safety and efficiency. It is uncertain what effect C/AVs would have on parking demand since the vehicles could operate independently and avoid the need to park (and may circulate on the road network). Another concern is that since the arduous task of driving a car would be eliminated, more people may be attracted to travel*

by automobile since they could spend the time working or relaxing. Cape Cod MPO staff will work with MassDOT help prepare the County's transportation system to maximize the benefits and minimize the detriments of C/AV deployment.

8. ENABLE AND PROMOTE A UBIQUITOUS ELECTRIC CHARGING (AND/OR ALTERNATIVE FUEL) INFRASTRUCTURE

The Commonwealth should continue to facilitate the establishment of a statewide electric charging network –and/or the infrastructure needed for other alternative fuels –that is fast, equitable, robust, and resilient in order to support a growing fleet of zero emission vehicles (ZEVs). The Commonwealth should develop standards or incentives for vehicle (driven by humans or driverless) to be electric, to charge during off-peak hours, and to be available to deliver energy back to the grid at peak times. *Cape Cod MPO staff will work with MassDOT to identify strategic locations for deployment of charging infrastructure. Through the County's Regional Policy Plan, the Cape Cod Commission encourages land development projects to include appropriate charging equipment*.

9. ESTABLISH A GOAL THAT ALL NEW CARS, LIGHT DUTY TRUCKS, AND BUSES SOLD IN MASSACHUSETTS WILL BE ELECTRIC BY 2040

Achieving the Commonwealth's 2050 Global Warming Solutions Act (GWSA) mandate will require the near-complete transition of our vehicle fleet (cars, trucks and buses) to electric vehicles or other zero-emission vehicle (ZEV) technology. Because vehicle fleets turn over slowly, for vehicles on the road to be electric by 2050, the Commonwealth should establish the goal for vehicle sales to be electric by no later than 2040 (perhaps sooner in some vehicle classes). *The Cape Cod MPO supports this policy*. *A comprehensive analysis of a path towards addressing our regional support for these statewide goals are detailed in the Cape Cod Climate Action Plan and the Cape Cod Regional Policy Plan.*

10. ESTABLISH A REGIONAL, MARKET-BASED PROGRAM TO REDUCE TRANSPORTATION SECTOR GREENHOUSE GAS (GHG) EMISSIONS

The Commonwealth should publicly support the prompt development and implementation of a regional program that uses market mechanisms and public investment as a means to limit GHG emissions from the transportation sector. The Commission also recommends exploring the adoption of a regional Low Carbon Fuel Standard. The Massachusetts EOEA has produced a policy statement for a Transportation Climate Initiative (TCI). A goal of this initiative is to "design a regional low-carbon transportation policy proposal that would cap and reduce carbon emissions from the combustion of transportation fuels… and allow each TCI jurisdiction to invest proceeds from the program into low-carbon and more resilient transportation infrastructure." *The Cape Cod MPO staff will work with MassDOT to explore these strategies.*

11. MAKE TRANSPORTATION INFRASTRUCTURE RESILIENT TO A CHANGING CLIMATE

The Commonwealth should develop vulnerability assessments for all publicly-owned or funded transportation infrastructure in Massachusetts across all agencies, the outcomes of which can then

inform capital planning. MassDOT should develop and disseminate resiliency-oriented statewide design standards for transportation infrastructure, including infrastructure owned by the MBTA and the RTAs; by 2020, no transportation-related project should be built that does not conform to those standards. *Cape Cod MPO staff continue to work with member towns to develop plans for strategic improvement of critical transportation infrastructure. This of particular concern to Cape Cod as each of the 15 towns in Barnstable County are of varying degree susceptible to damage from flooding and other hazards associated with climate change*.

12. ENSURE SUFFICIENT ELECTRIC CAPACITY

As electric vehicle penetration accelerates, Massachusetts should work in close coordination with ISO New England (ISO-NE) and other states to ensure that sufficient electricity continues to be available to provide reliable, clean, and competitively priced power supplies for all electricity users in the Commonwealth. *The Cape Cod MPO supports state and local efforts to provide these services.*

13. ADOPT DENSE, MIXED-USE, AND TRANSIT-ORIENTED LAND USE POLICIES

Municipalities should accelerate the adoption of land use regulations that promote density and the use of shared vehicles and active and shared transportation modes. The Commonwealth should consider accelerating local progress in this area through incentives and regulations. *The Cape Cod Commission, through the Cape Cod Regional Policy Plan, works with member communities and developers through regulation and local comprehensive plans to locate development in Activity Centers. These centers are intended to create the density necessary for public transit, bicycling, and walking to succeed as transportation options*.

14. ENABLE GATEWAY CITIES AND THE REGIONS THEY ANCHOR TO COMPETE FOR RESIDENTS AND JOBS

The Commonwealth's transportation providers –including MassDOT, MBTA, and the RTAs –should support opportunities for housing and economic development in Gateway Cities and other regional hubs that have the potential to act as economic anchors within their respective regions. *Cape Cod MPO staff will work with MassDOT to explore this strategy. Part of this effort will be coordinated with the Cape Cod Regional Policy Plan's strategies to guide development.*

15. COORDINATE THE PLANNED REINVENTION OF THE MBTA COMMUTER RAIL SYSTEM WITH LOCAL, REGIONAL, AND STATE LAND USE AND ECONOMIC DEVELOPMENT STRATEGIES

MBTA should work with stakeholders to compile a menu of new service options for the commuter rail network by the end of 2019 and then develop detailed information on the costs (both capital and operating) and benefits of each of the service models. Regional planning officials and local elected officials in commuter rail-served communities should continue to develop plans to support near-term increases in ridership and the transition to broader, interconnected service models, as laid out in the 2019 MBTA Rail Vision Report.. *Cape Cod MPO staff will work with MassDOT to explore extending passenger rail service to Cape Cod communities such as Buzzards Bay and Hyannis. Service to*

these areas has been identified as a priority of several updates of the Regional Transportation Plan and is detailed in the Cape Rail Study[9].

16. PROVIDE BETTER MOBILITY OPTIONS IN RURAL COMMUNITIES

MassDOT, working with MPOs and local municipalities, should develop strategies for providing rural Massachusetts with viable transportation options to supplement privately-owned vehicles. The Commonwealth should designate appropriate state agencies to work with the private sector to ensure that necessary infrastructure is available to support deployment of C/AV and TNC technologies throughout the state, including in rural areas. Many of Cape Cod's communities share rural limitations such as remoteness from activity centers and lower densities that make transit less viable. Challenges are particularly acute for residents of the Outer Cape towns who must travel great distances for many critical services such as healthcare; this has a direction impact on community health. The trip from Provincetown to the nearest hospital (Cape Cod Hospital in Hyannis) is the longest among all communities across the Commonwealth. *Cape Cod MPO staff will work with MassDOT, the Cape Cod Regional Transit Authority, municipalities, and local transportation, health and community organizations to explore strategies and implement solutions that improve mobility options for the rural communities on Cape Cod.*

17. PREPARE MASSDOT AND OTHER TRANSPORTATION-RELATED ENTITIES TO EFFECTIVELY OVERSEE A CHANGING TRANSPORTATION SYSTEM

To prepare the Commonwealth's transportation system for the inevitable changes of tomorrow, the Governor should consider specific organizational changes to MassDOT and other agencies that allow better focus, alignment, and results, including the continuation of a dedicated MBTA Board, a new paradigm for MassDOT, MBTA, and Regional Transit Authorities, and plans for data-sharing to enable improved services and options for the transportation system. *The Cape Cod MPO supports this effort.*

18. DEVELOP A FISCALLY SOUND AND RESPONSIBLE TRANSPORTATION RESOURCE PLAN

Among the most significant contributions that today's decision makers could make to the public for the year 2040 is to commit to providing sufficient resources for the proper maintenance, operation, and upgrades to the state's transportation network. The Governors' commission concludes its report with this recommendation, not because it is the least important, but because the promise found in our earlier recommendations can only be achieved through a long-term commitment to providing the resources necessary to operate and maintain the Commonwealth's evolving transportation system. This begins with a commitment to eliminate the longstanding backlog of today's identified priority deferred MBTA and MassDOT maintenance projects to achieve safe,

[9] Cape Rail Study is available at www.capecodcommission.org/CapeRailStudy

efficient services and asset conditions by 2030. Only then will the Commonwealth be able to fully turn its attention to effectuating the Commission's vision for 2040. *The Cape Cod MPO supports this effort*.

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CAPE COD COMMISSION

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix B: Existing Conditions

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Technical Appendix B: Existing Conditions

VEHICLE INFRASTRUCTURE

Roads

Travel by vehicle in Barnstable County is the primary method of transportation and can often be unique and picturesque for visitors and residents. The style of the roads and the buildings that line them are internationally recognized as Cape Cod. In certain parts of the county the historical district or town by-laws dictate the style of the road and the buildings along that road to preserve the culture of the town or city. The residents on Cape Cod have a long standing connection to the preservation of infrastructure character and natural open space. It is well known that the largest attractions in Barnstable County are the beaches; however it is the style of roadway that enhances the experience of traveling to destinations while living or visiting the region.

ROADWAY FUNCTIONAL CLASSIFICATION

Cape Cod's three major routes, Route 6, Route 28, and Route 6A, comprise only less than 6% of Cape Cod's roads by mileage. The majority (80%) of Cape Cod roads are designated as Functional Class "0/null," or local roads. 6% of roads are classified as minor or major "Collector" roadways. This means that just over two-tenths of Cape Cod's roadways are used as primary routes, while the remaining nearly eight-tenths are used to access residential and other private areas. There are no interstate highways on Cape Cod. Cape Cod's roadway functional classes are presented in the following figure.

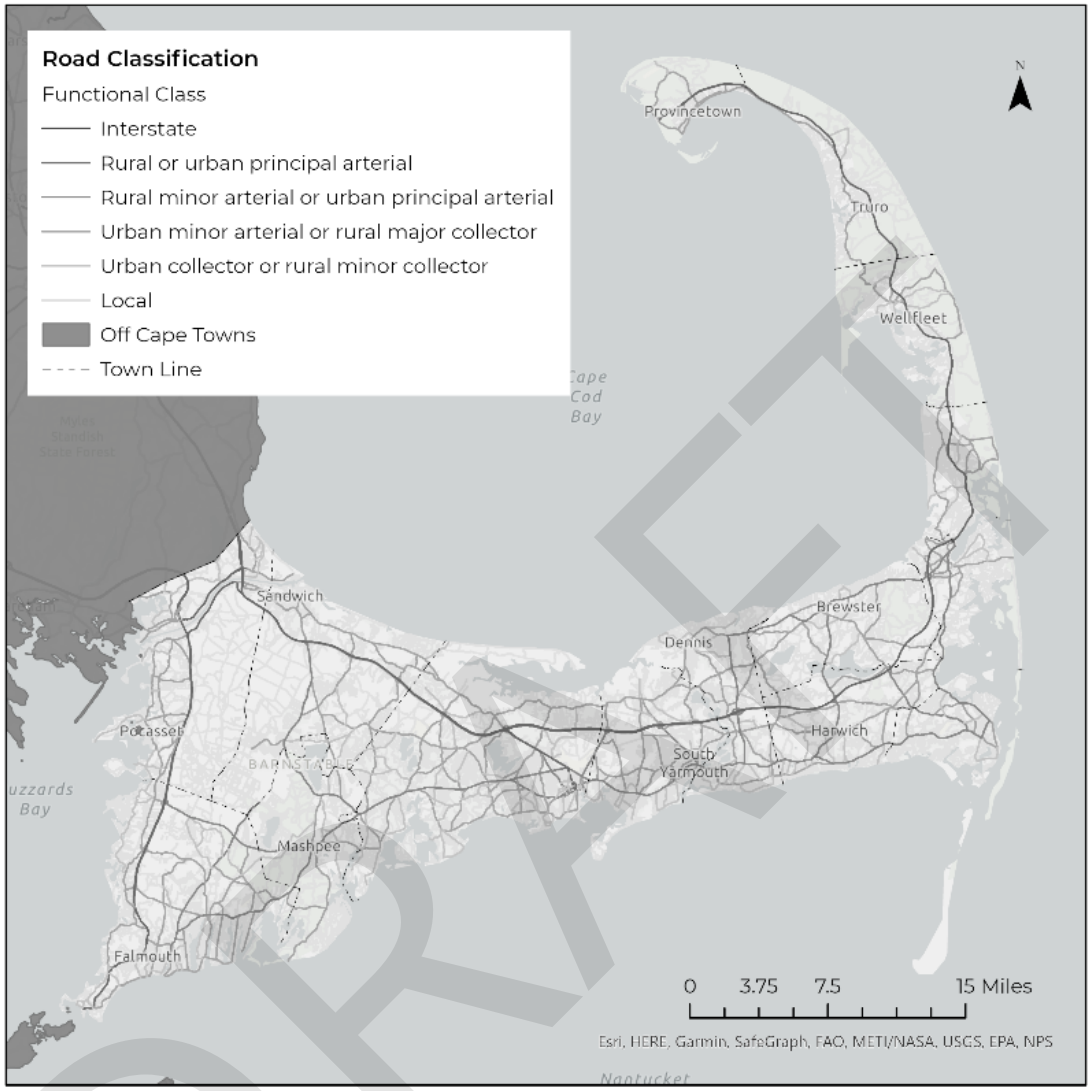


FIGURE 1. Roadway Classification

LIMITED ACCESS ROADS

Limited-access highways south/east of the Cape Cod Canal bridges are portions of either Route 6 or Route 28 and are shown in the figure below. The only limited-access portions of Route 28 are located in Bourne and Falmouth. Most of Route 28 (MacArthur Boulevard) in Bourne is partial-access control with sporadic opportunities to change direction in U-turn lanes. The majority of Cape Cod's roads do not have access control. The lack of availability of limited access routes, especially on the Outer Cape area can create congestion.

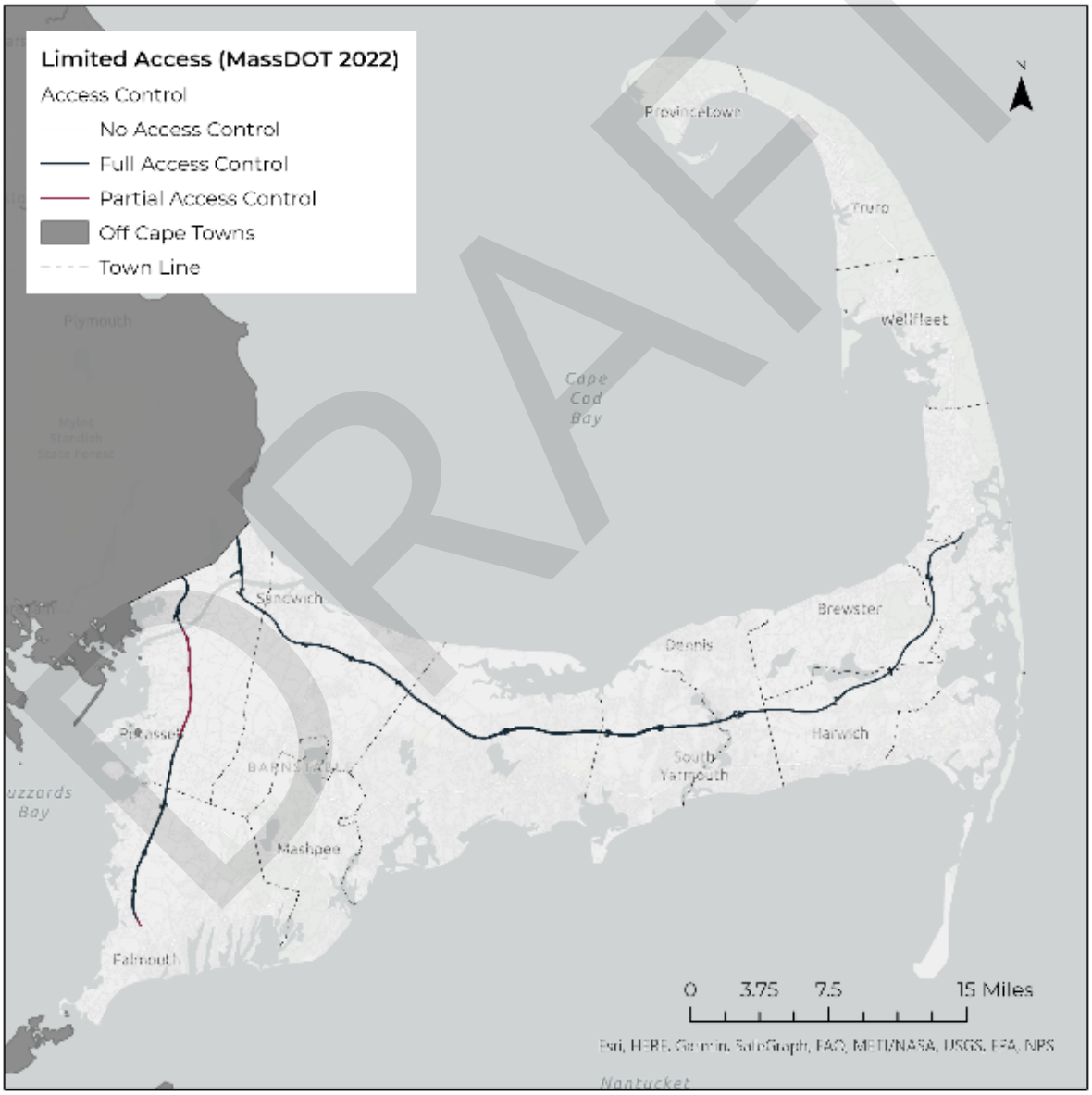


FIGURE 2. Limited Access Roads

SPEED LIMITS

The maximum legal speed limit on most Cape Cod highways is 55 mph. Exceptions include Route 3 (60 mph) and Route 25 (65 mph) in Bourne. The majority of roads that are not recognized as highways have posted speed limits below 50 mph. Exceptions include portions of Route 28 in Falmouth, Mashpee and Barnstable and Route 151 in Falmouth and Mashpee.

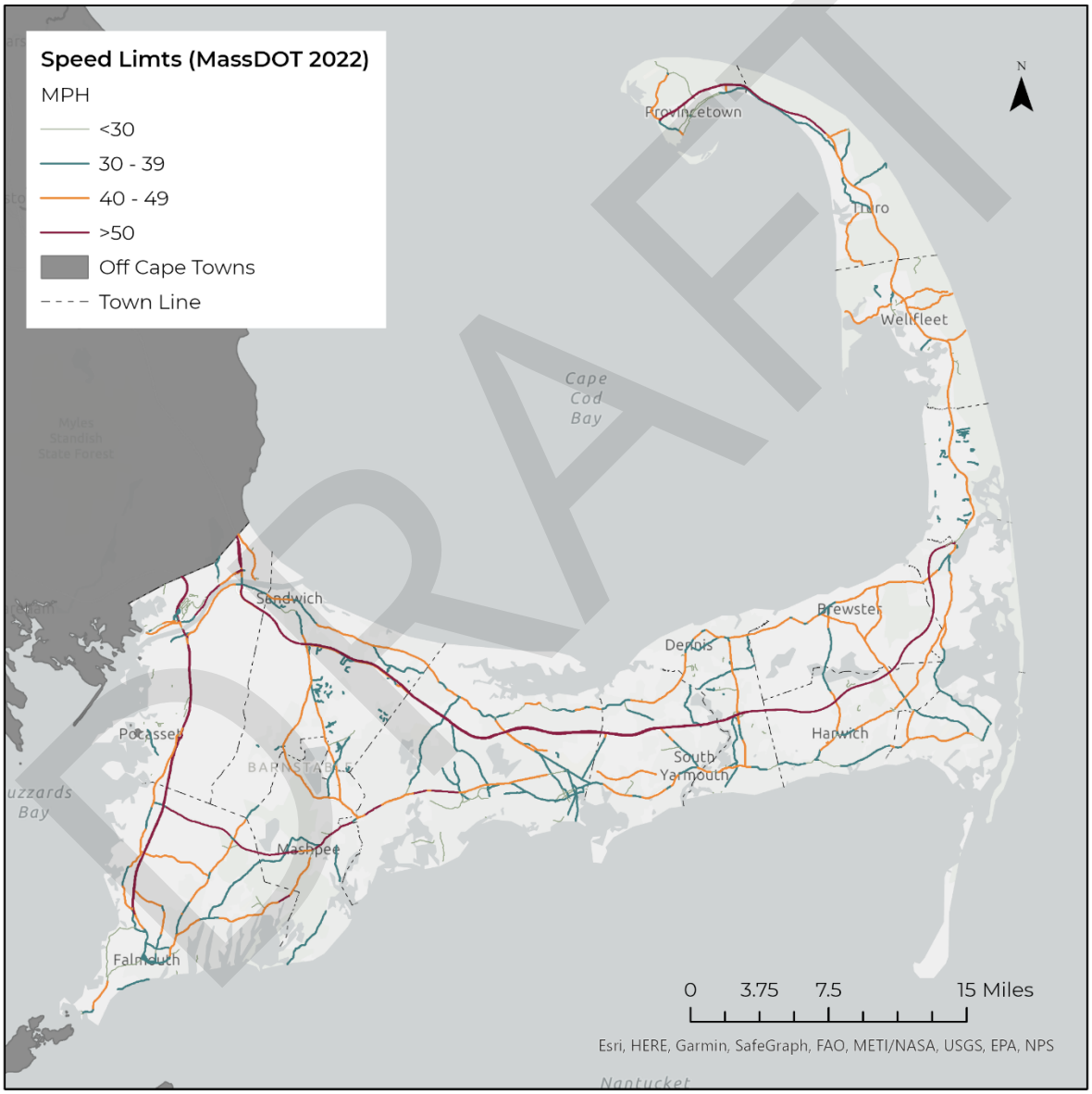


FIGURE 3. Speed Limits

INTERSECTIONS

There are thousands of roadway intersections across Cape Cod. Of these intersections, 135 are signalized and 30 are circular. Circular intersections refer to rotaries and roundabouts. Rotaries tend to be larger in diameter, and their interior travel speed is often faster than a modern roundabout. Roundabouts are identified by smaller diameters and approaches that enter at a greater angle than rotaries – encouraging slower speeds. Barnstable has five circular intersections, the most of any Cape Cod town.

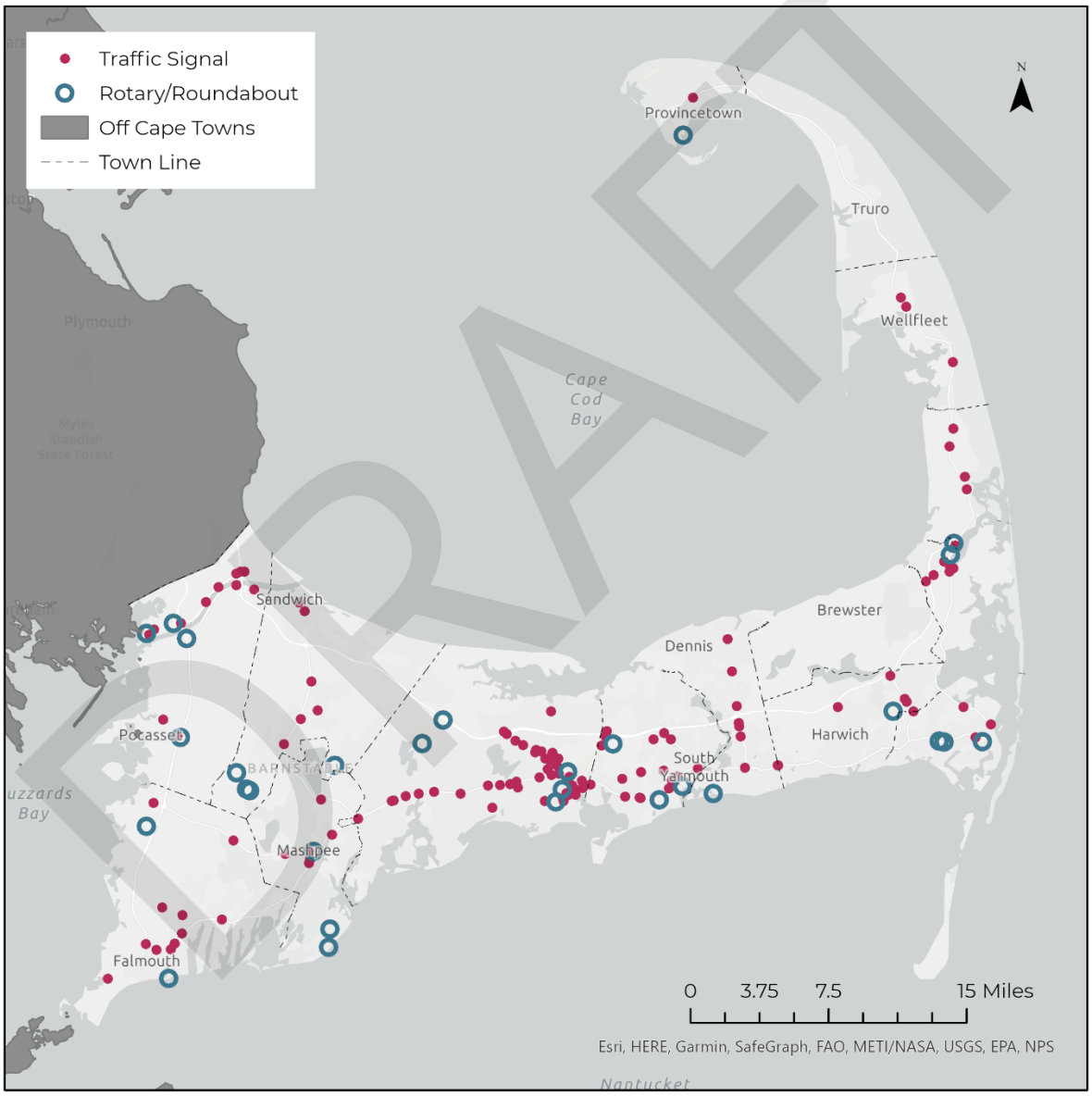


FIGURE 4. Intersections

AVERAGE ANNUAL DAILY TRAFFIC

The following figure shows year-round average daily traffic volumes on major Cape Cod roads. Heaviest travel occurs on the Cape Cod Canal road and canal bridges and the Mid-Cape Highway. High volumes of traffic are found on the roads leading to and within the Hyannis area (an area that receives/sends goods to/from many businesses, institutions such as Cape Cod Hospital and multimodal facilities such as the ferry ports). In comparison, downtown Falmouth also experiences high levels of congestion.

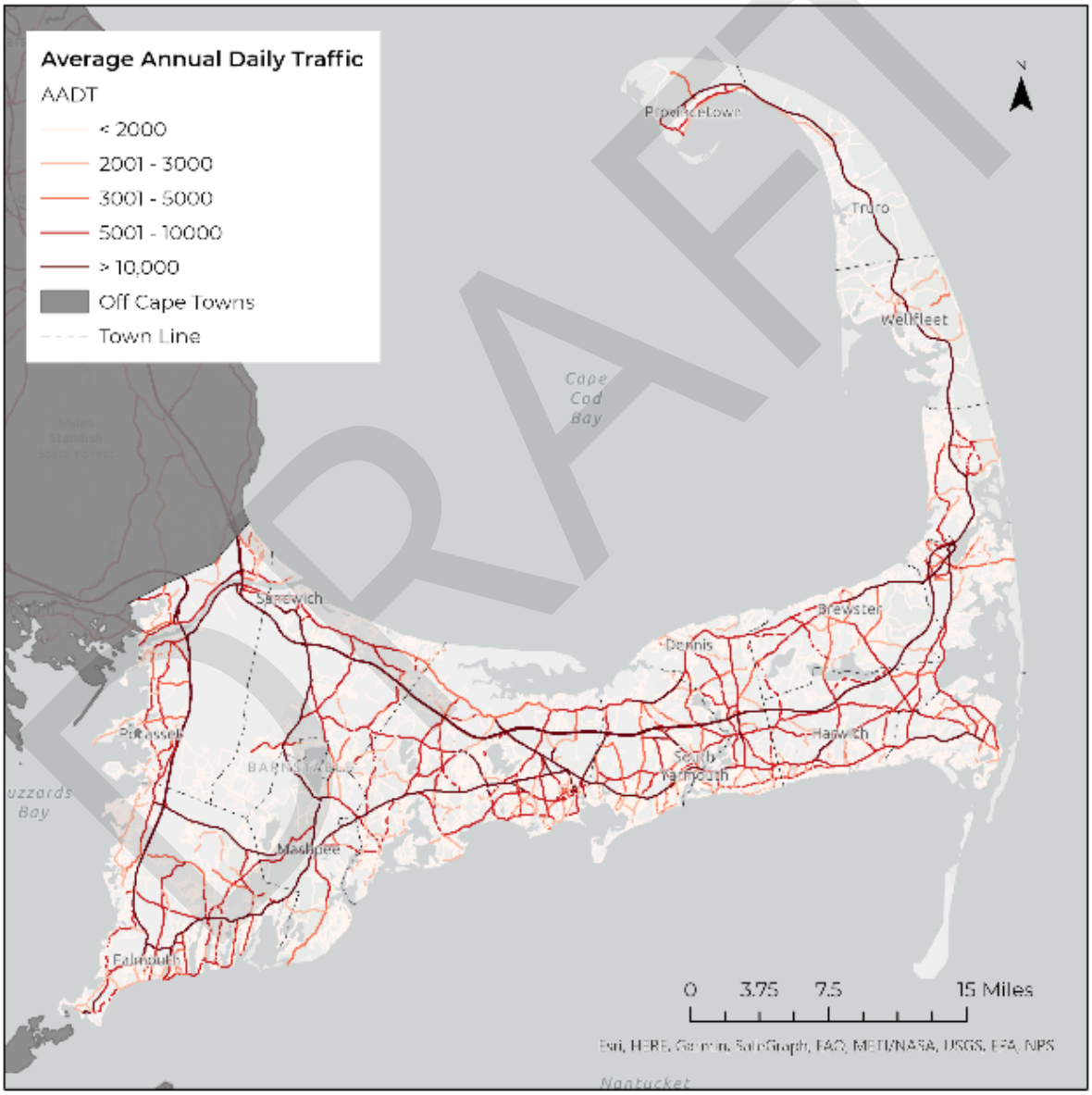


FIGURE 5. Average Annual Daily Traffic

U.S. ROUTE 6

U.S. Route 6 runs from Provincetown, Massachusetts all the way to Bishop, California, and is the longest continuous route in the United States. On Cape Cod, Route 6 is the major transportation corridor, particularly for those traveling long distances. From where it enters Barnstable County in Buzzards Bay until its end in Provincetown, it provides a primarily limited-access high-speed means of traveling along the spine of the Cape for commercial traffic. The Route 6 corridor in the Outer Cape does not have limited access. This portion of Route 6 also contains segments of the Claire Saltonstall Bikeway, or State Bicycle Route 1. During peak travel periods in the summer it is not unusual for westbound traffic to be stopped for several miles east of the Sagamore Bridge or in Wellfleet or in Dennis.

Buzzards Bay to Sagamore Bridge

From where it enters the county in Buzzards Bay to where it crosses the Cape Cod Canal at the Sagamore Bridge Route 6 is a two- to four-lane road with curb cuts on both sides. The Sagamore Rotary, located north of the Sagamore Bridge, was eliminated by 2006. This grade separated intersection provides for a direct connection between Route 3 and the Sagamore Bridge.

Sagamore Bridge to Exit 9, Dennis

From the Sagamore Bridge to just after Exit 9 in Dennis, Route 6 is a four-lane limited-access highway with a grass shoulder and rest areas.

Exit 9, Dennis to Orleans Rotary

From Dennis to the Orleans/Eastham rotary the road narrows to two lanes but remains limited-access, with a raised median and yellow reflective post delineators to reduce crossovers from one direction of traffic to the other.

Orleans Rotary to Provincetown

Route 6 in the Outer Cape area is generally a consolidation of existing roadways over time since the 1930s. Short sections of the original Route 6 have been retained for local access for road straightening projects. In northern Truro and Provincetown, the original Route 6 became Route 6A – several sections of which have been realigned.

Finally, from the Orleans Rotary until the road's end in Provincetown the road is once again a two- to four- lane road with curb cuts on both sides, although a grassed median limits crossovers on sections of Route 6 in Provincetown.

STATE ROUTE 28

State Route 28 begins at the New Hampshire border and joins Route 6 as it enters Barnstable County at Cohasset Narrows on the border of Bourne/Wareham. Route 28 runs for almost sixty-five miles after crossing the Cape Cod Canal and passing through villages adjacent to Buzzards Bay/Nantucket Sound/the Atlantic Ocean from Bourne to Orleans Center. Route 28 is a regional roadway but it does not provide direct inter-regional travel options in most cases. The cross section

of Route 28 varies greatly throughout the Cape. However, there are three primary sections to Route 28, which are identifiable by their roadways characteristics.

Traffic flow along the corridor is generally heavy during the summer, with gridlock occurring in many locations. However, the level of traffic varies greatly along the corridor. Much of the Route 28 corridor is congested during summer peak hours. Some sections, such as in Hyannis and Falmouth, can experience congestion year-round.

Buzzards Bay to Bourne Rotary

Route 28 consists of four lanes from the county line across the Bourne Bridge to the Bourne Rotary.

Bourne Rotary to Palmer Avenue, Falmouth

Route 28 consists of four lanes, divided by a grassy median, from the Bourne Rotary to Saconesset Hills in Falmouth. The western side of Route 28 in Bourne from the Bourne Rotary to the Otis Rotary (MacArthur Boulevard) allows property access. Vehicles can reverse direction via a number of U-turn areas in the median.

Palmer Avenue, Falmouth to Orleans Rotary

From Palmer Avenue in Falmouth, Route 28 is predominately two lanes to the intersection of Old Stage Road in Barnstable. Route 28 then transitions to four Lanes from Old Stage Road to Phinney's Lane in Barnstable and then predominately is two lanes from Phinney's Lane to the Orleans/Eastham Rotary. Portions of this route are more developed than others. The most developed and subject to congestion are in Hyannis. Congestion in this area is experienced year-round.

ROUTE 6A

Route 6A on Cape Cod is one of the oldest travel corridors in the country. Originally a path used by Native Americans, it was later adopted by colonists for travel from Plymouth out to Eastham. Later it served as state Route 6 until the construction of the current Route 6 in the 1950s. Today it serves much of the Old Kings Highway Historic District and is designated as a state Scenic Byway.

Route 6A is a narrow and windy two lane road with little or no shoulder. One exception to this is the four-lane cross section in Orleans (which is not included in the Old Kings Highway Historic District). Because of the narrow shoulders, passing zones are limited and biking can be difficult. There are not any rest areas located on this corridor. Traffic congestion along the corridor is generally heavy during the summer however; the level of traffic varies greatly along the corridor.

Much of the Route 6A corridor is congested during summer peak hours. Recommendations from the Route 6A Corridor Management Plan (Cape Cod Commission, 2010) include the reduction of

speed limits to 35 MPH and accommodation of alternate mode users such as pedestrians, bicyclists and public transportation users.

Bridges

CAPE COD CANAL BRIDGES

The largest bottlenecks on Cape Cod occur at the canal bridges during the summer season. Cape Cod's bridges serve many important functions, one of which is to permit travel over waterways by automobile and along waterways by boat or barge, between Buzzards Bay and Cape Cod Bay. The Bourne Bridge and Sagamore Bridge permit vehicular travel over the Cape Cod Canal. If not for the canal bridges, vehicles would have to use a ferry to reach Cape Cod. Summertime delays at the canal bridges can sometimes be measured in hours.

FIGURE 6. Congestion at the Bourne Bridge

The Bourne Bridge and Sagamore Bridge are both under the jurisdiction of the Army Corp of Engineers (ACOE). One or the other of the two highway bridges may have restrictions on lanes and heavy vehicles during several weeks of the year to accommodate painting and structural maintenance activities. While avoiding the heavy summer traffic season, these lane closures have been observed to result in traffic backups of several hours.

The Bourne and Sagamore bridges provide the only crossings of the Cape Cod Canal for motorists, pedestrians and cyclists. Maintained by the U.S. Army Corps of Engineers, the geometric design of each bridge includes a roadway width of 40 feet (four 10-foot-wide lanes) flanked by a 6-foot-wide sidewalk on one side and a 2-foot wide safety curb on the other. The roadways are separated from the sidewalks and safety curbs by 16-inch-high vertical granite curbing.

The bridges first opened to traffic in 1935. Historic records indicate a general upward trend in the annual bridge crossings and this traffic is currently over 100,000 vehicles per average day. Over the decades, the bridges have been exposed to deicing salts, the effects of which include progressive

deterioration of the concrete deck and some steel members of the bridges. These effects are compounded by the fact that the bridges are located near salt water. An additional maintenance activity is the periodic painting of the exposed steel portions of the bridges.

For certain maintenance activities, including repairs to the concrete deck, the worksite requires the closures of two lanes. For a bridge undergoing maintenance, the four lanes are reduced to two. Depending on the duration of the closure and the seasonal demand, significant delays and backups may occur. The ACOE is committed to minimizing these conditions by avoiding daytime lane reductions during the summer months and limiting work to one bridge at a time.

At the time of adoption of this plan, MassDOT, in partnership with the Federal Highway Administration (FHWA) and the New England District of the USACE, is advancing the Cape Cod Bridges Program (Program) in the town of Bourne, Barnstable County, Massachusetts. The Program proposes replacement of the Bourne and Sagamore highway bridges and reconfiguration of the highway approach networks north and south of the Cape Cod Canal to align with the replacement highway bridges. The replacement bridges, and their interchange approaches will accommodate shared use pedestrian and bicycle paths that connect to the local roadway network on both sides of Cape Cod Canal in the town of Bourne. This Program is a continuation of previous studies conducted by the MassDOT and the USACE to evaluate the current condition and recommend improvements to the Cape Cod Canal bridges and roadways.

Bridge condition information, provided by MassDOT is presented in Appendix P: Statewide Tables.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) is an emerging aspect of infrastructure that has surfaced on Cape Cod. Along Route 6, permeant message boards display travel time to exits on the roadway. This information calculated using Bluetooth technology to calculate drive times. This information has been effective at reducing distraction and driver confusion by presenting valuable information to automobile drivers outside of content received by cellphones or GPS devices. The project began in 2012 with signage installed on Route 3 approaching Cape Cod and was statewide in 2015.

FIGURE 7. Travel Time ITS

A second source of Intelligent Transportation Systems on Cape Cod is the use of remote counting stations. Currently there are seven stations maintained by MassDOT including Sagamore Bridge, Bourne Bridge, Route 6 East of Exit 5 in Barnstable, Route 3 at the Bourne/Plymouth Town Line, Route 28 East of Higgins Crowell Road in Yarmouth, Route 28 West of Old Post Road in Barnstable, and Route 28 north of the Otis Rotary in Bourne. A counter at Route 28 East of Main Street Cotuit in Barnstable was maintained by MassDOT but was discontinued several years ago. In addition to the MassDOT devices, the Cape Cod Commission Maintains three permanent counters at Route 137 at Route 39 in Harwich, Route 124 at Queen Anne Road in Harwich, and Route 28 at Lumbert Mill Road in Barnstable. Each of these counting stations count vehicles using detectors installed in the pavement. Similar technologies use cameras to count cars, but this is not practiced on Cape Cod. This information is useful to planners in reflecting traffic patterns throughout the year and could redefine seasonal factors used in design, improve signal optimization or affect the priority of regional projects.

Other technologies that are emerging or integrated include assisted driving cars or signal priority for emergency vehicles. As new technologies their acceptance into infrastructure is changing the way people travel. Intelligent transportation systems in development or in practice nationally that have not been integrated on Cape Cod include infrastructure to support driverless cars, pavement that is responsive to weather changes, and signal priority for transit.

BUS INFRASTRUCTURE

Intermodal Facilities

HYANNIS TRANSPORTATION CENTER

The Hyannis Transportation Center was built in 2002 as a hub for Cape Cod's transportation needs. The property has entrances from Route 28, Center Street, and Ridgewood Avenue. The facility includes a bus terminal and a connection to the Cape Cod Central Railroad terminal. Additionally,

there is parking space available for 220 cars on an eight-acre lot and over two dozen electric vehicle chargers.

FIGURE 8. Hyannis Transportation Center

The building itself is owned and operated by the Cape Cod Regional Transit Authority (CCRTA). The Hyannis Transportation is open 7 days a week, excepting holidays, from early morning to 8:30pm. Inside, travelers are offered several amenities, such as Wi-Fi internet, vending machines, an ATM, and restrooms. Electronic route maps are posted throughout the facility and announcements of arrivals and departures are made over the loudspeaker system. Additional travel information is available at the information desk which is open year-round from 7am to 5 pm.

The Hyannis Transportation Center brings together local and interregional bus services, rail facilities, and connections to air and ferry service. Plymouth and Brockton (P&B) and Peter Pan lines all make daily use of the bus terminal facilities. Four RTA bus lines make stops at the Hyannis Transportation Center, as well as two RTA shuttles. These transit lines provide connections to ferry service in Hyannis as well as to air service and rental car service at Barnstable Municipal Airport. Plymouth and Brockton service from Boston and Provincetown, and Peter Pan service from Providence and New York make stops at the Hyannis Transportation Center. There is also an area designated for Taxi service pick-up and drop-off. Nearby, ferry service to Martha's Vineyard and Nantucket is accessible by local transit. Given the variety of transportation options available, the Hyannis Transportation Center is sometimes also referred to as the Hyannis Intermodal Center.

In addition to the Hyannis Transportation Center, several other locations serve as bus terminals and stops throughout Cape Cod.

MACMILLAN PIER AND BUS DEPOT

MacMillan Pier in Provincetown is located at the intersection of Commercial Street and Ryder Street. The facility is open Monday through Saturday from 9am to 6pm and is closed on Sundays and holidays. MacMillan Pier includes a bus depot, ferry terminal, and a parking facility open seven days a week. The bus depot serves as a terminal for Plymouth and Brockton and Peter Pan bus

service from Hyannis and Boston. The Cape Cod Regional Transportation Authority's (CCRTA) seasonal Provincetown Shuttle makes scheduled stops at the facility on its way to Race Point, Provincetown Municipal Airport and North Truro. Ferry service to Plymouth and Boston is also available seasonally.

FIGURE 9. Macmillan Pier

MacMillan Pier is in the heart of downtown Provincetown, with access to restaurants, hotels and shopping.

FALMOUTH BUS DEPOT

The Falmouth Bus Depot is located on Depot Avenue in Falmouth. The building itself used to be a railway station. After rail service to Woods Hole was suspended, the building was converted into a bus terminal. The facility is generally open 7 days a week, excepting holidays, from 8am to 4pm. Limited parking is available. The Falmouth Bus Depot serves as a destination for local transit and interregional bus service as well as provides connections to various ferry terminals. Peter Pan service from Boston to Woods Hole stops at the Falmouth Bus Depot. Additionally, the CCRTA's Hyannis-Falmouth Sealine service and the seasonal WHOOSH Trolley will make stops at the Bus Depot. These transit services provide connections to the ferry terminals at Woods Hole and Falmouth Marina. Beyond the available transit services, the Shining Sea Bike Path is located next to the depot along the former rail right-of-way. Given its proximity to downtown, the Falmouth Bus Depot also provides access to restaurants, hotels and shopping.

FIGURE 10. Falmouth Bus Depot/Park and Ride

WOODS HOLE STEAMSHIP AUTHORITY PIERS

The Steamship Authority piers in Woods Hole are also used as a bus terminal. Across from the ferry terminal is a small Peter Pan ticket facility and place for buses to pick-up and drop-off. Peter Pan buses continue from the Steamship Authority Piers to Boston. Due to the demand for ferry service, parking for the bus terminal is extremely limited. Travelers using the bus terminal can make use of amenities at the ferry terminal including restrooms, and food services. Additionally, the Shining Sea Bikeway terminates at the Steamship Authority Pier, providing bicycle access to downtown Falmouth and points north. Nearby Wood Hole offers restaurants, hotels and shopping.

FIGURE 11. Woods Hole Steamship Authority Piers

CAPE SIDE CONVENIENCE IN BOURNE

Cape Side Convenience on Trowbridge Road in Bourne also serves as a stop for interregional bus service. The location was selected due to its proximity to the Bourne Bridge and Route 25. Peter Pan makes stops here on its route from Boston to Woods Hole and on its route from Providence to Hyannis. Tickets can be purchased online or via the Peter Pan mobile app and a portion of their parking lot is available for commuters.

SAGAMORE PARK-AND-RIDE LOT

The Sagamore Park-and-Ride Lot is owned by MassDOT located by Interchange 1a in Bourne, near Routes 3 and 6. In early 2009, the lot was expanded to a total of 396. Sagamore Park-and-Ride Lot is accessed by Plymouth and Brockton on its Boston to Hyannis route. In this way it serves as a commuter stop for those traveling to work in Boston, Logan International Airport and other points north.

FIGURE 12. Sagamore Park-and-Ride Lot

BARNSTABLE PARK-AND-RIDE LOT

The Barnstable Park-and-Ride Lot is a MassDOT owned facility located off Exit 68 of Route 6 in Barnstable. The lot was expanded to 365 parking spaces in August 2001. As part of the expansion, two new shelters were installed and currently appear to be in good condition. This lot has a ramp directly onto Route 6 westbound, making it convenient for motorists and buses. The Exit 68 facility is adjacent to amenities such as restrooms, food service, a convenience store, ATMs, fuel, and a seating area. The Barnstable Mobil Mart located inside is open 24 hours and sells tickets for interregional bus service. The Barnstable Park-and-Ride Lot is used as a stop for the Plymouth and Brockton route from Hyannis to Boston and for the Peter Pan route from Hyannis to Providence. The CCRTA's Barnstable Villager service provides local bus service to the Route 132 entrance to the Park-and-Ride lot, with connections to Barnstable Village, Route 132, and Hyannis.

FIGURE 13. Barnstable Park-And-Ride Lot

HARWICH PARK-AND-RIDE LOT

The Harwich Park-and-Ride Lot is a MassDOT owned facility located off Exit 82 of Route 6 on Route 124. The lot has 75 parking spaces. The lot is available as a stop (on-demand) for the CCRTA's Flex Service.

HYANNIS PARK-AND-RIDE LOT

The Hyannis Park-and-Ride Lot is located at the Hyannis Transportation Center. There is room for 225 vehicles. Long-term parking (over 30 minutes) is officially available on a pay-basis. The lot has access to all the bus services and user amenities at the Hyannis Transportation Center.

PARK-AND-RIDE LOT USAGE

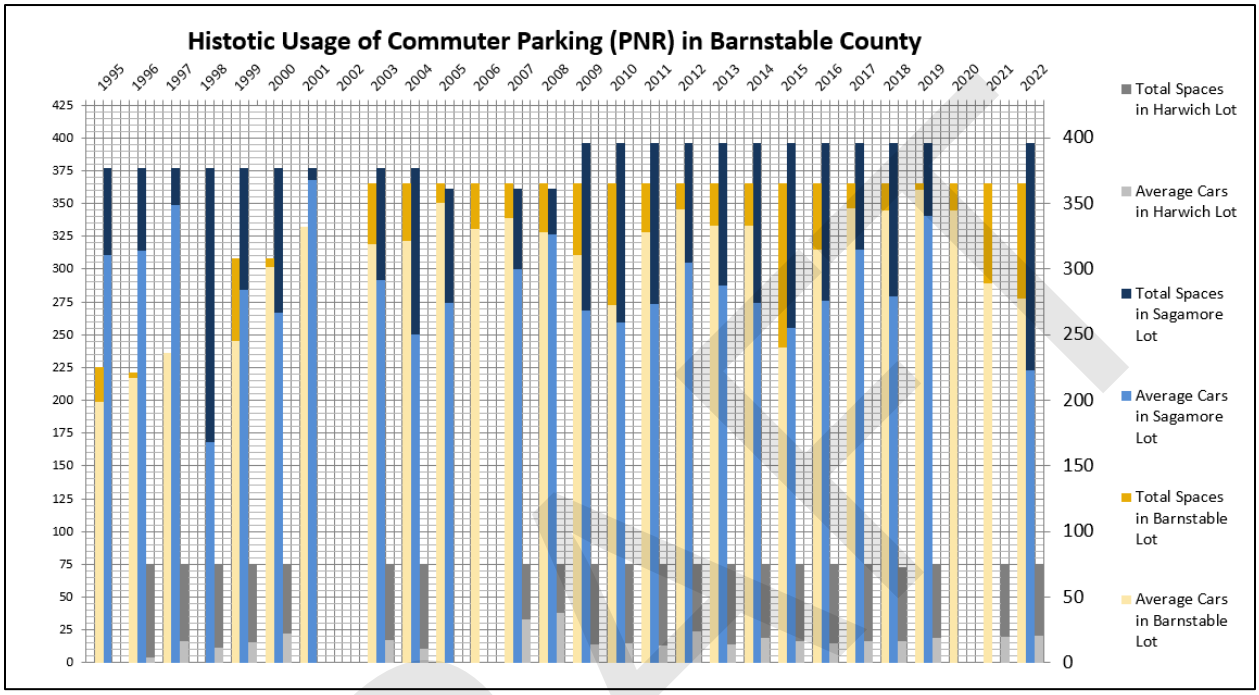
Data collected at Park-and-Ride locations are organized in the figure below to show the capacity, average occupancy, and maximum occupancy for each of the lots from 1995-2013. The dark shaded bar graphs represent the capacity of each lot. The capacity has historically changed at the Barnstable and Sagamore Locations due to construction. The Barnstable location has grown from 225 spaces to 365 spaces from 1995-2013. The Sagamore Lot was reduced in 2005 due to the reconstruction of bridge access and then expanded in 2009 to accommodate 396 vehicles.

The average occupancy for each lot is shown by the lighter color on the bars. These data were collected in various samples during the summer months and shows inconsistent trends when comparing the data. The average occupancy does show that the Harwich lot averages fewer than 50 percent capacity for each year despite the removal of commuter bus service.

The maximum occupancy is shown by the red line located on or above the bar. A line located on the bar indicates that observations did not find a lot exceeding the capacity. A line located above the bar indicates that the lot did on occasion exceed capacity. Exceeding capacity would result in illegally parked cars. It can be noted that the Barnstable lot exceeded capacity 2011 and 2013,

2012 was observed at maximum capacity but not exceeding. The Sagamore Lot has not been observed to exceed capacity in the last ten years.

FIGURE 14. Historic Park-and-Ride Usage Data



Interregional Bus Service

Interregional bus service transports travelers to and from Cape Cod. Some examples are bus service from Hyannis to New York City, or Boston to Provincetown. Users of interregional bus service include commuters who work in Boston, Logan Airport users, and those traveling or vacationing. Two bus companies currently serve Cape Cod's interregional service needs. Interregional bus service has been provided throughout the years by different companies including the former Bonanza Bus Lines. Currently, interregional bus service is provided by Plymouth and Brockton Street Railway Company and Peter Pan Bus Lines.

PLYMOUTH AND BROCKTON STREET RAILWAY COMPANY

The Plymouth and Brockton Street Railway (P&B) was established in 1888, as a local service provider for the area. According to P&B, electric trolley cars carried passengers to and from work, and on weekend "joy rides." Following World War I, street railway tracks were abandoned and replaced by motor coaches throughout the South Shore. Plymouth and Brockton's final electric trolley run was made on June 28, 1928 between Jabez Corner and Kingston. The company was purchased by the Anzuoni family in 1948, who continue to operate and manage the Plymouth and Brockton Street Railway to this day. P&B serves 25 cities and towns from Boston to Cape Cod and is

partially subsidized by the Massachusetts Bay Transportation Authority (MBTA), MassPort, and the Cape Cod Regional Transit Authority (CCRTA).

Current Plymouth and Brockton service stretches from Logan International Airport to Provincetown. There are three primary routes. The first route is between Hyannis and Provincetown. The bus makes several stops along the Outer Cape route as shown in the table below.

TABLE 1. Plymouth and Brockton Outer Cape Bus Stops

STOP NAME	LOCATIONS
Hyannis	Hyannis Transportation Center
Hyannis	Cape Cod Hospital
Harwich	Harwich Park-and-Ride Lot
Orleans	CVS @ Main St. & Route 6A
Eastham	Eastham Town Hall/Superette, Rt 6
North Eastham	Village Green @ Rt. 6 and Brackett Rd.
South Wellfleet	Marconi Wireless Station Site
Wellfleet	Outer Cape Health Services
Truro	Jam's Market Route 6A
North Truro	Salty/Dutra's Market, Route 6A
Provincetown	MacMillian Pier

The second route is between Hyannis and points in Boston. Stops in Boston include Logan International Airport, and South Station Transportation Center. In addition, several stops are made along the way both on and off Cape (See Table below). Buses terminate in Boston at Logan Airport, and most frequently South Station. Total operations are reduced during the fall and winter to reflect the lower demand for travel.

TABLE 2. Plymouth and Brockton Commuter Bus Stops

STOP NAME	LOCATIONS
Hyannis	Hyannis Transportation Center
Barnstable	Barnstable Park-and-Ride Lot
Sagamore	Sagamore Park-and-Ride Lot
Plymouth	Rt. 3 Exit 13 Info Center Park-and-Ride Lot
Rockland	Rt. 3 & Rt. 228 Park-and-Ride Lot
Boston	South Station Transportation Center
Boston	Park Square & 200 Stuart Street
Boston	Logan International Airport

The third Plymouth and Brockton route is between Woods Hole and points in Boston as shown below.

TABLE 3. Plymouth and Brockton - Woods Hole to Boston

STOP NAME	LOCATIONS
Woods Hole	Steamship Authority Piers
Falmouth	Falmouth Bus Depot, Depot Ave.
Boston	South Station Transportation Center
Boston	Logan Airport

PETER PAN BUS LINES

Pan Bus Lines provides daily express service between Cape Cod and Boston with stops at both Logan Airport and South Station. Daily service is also provided between Cape Cod and Providence, Rhode Island to Cape Cod. The three major terminals on Cape Cod are Woods Hole, Hyannis and Provincetown. Peter Pan Bus Lines provide connecting service to Steamship Authority ports in Hyannis and Woods Hole to provide connecting service to Nantucket and Martha's Vineyard.

FIGURE 15. Peter Pan and Plymouth & Brockton Buses at Hyannis Transportation Center

There are two routes connecting service between Boston and Cape Cod. The first route is service between Woods Hole and Boston and the second route is from Hyannis to Boston. Service may be reduced in the winter to reflect reduced demand.

TABLE 4. Peter Pan Woods Hole to Boston

STOP NAME	LOCATIONS
Woods Hole	Steamship Authority Piers
Falmouth	Falmouth Bus Depot, Depot Ave.
Bourne	Cape Side Convenience Store, Trowbridge Rd.
Boston	South Station Transportation Center
Boston	Logan Airport

TABLE 5. Peter Pan Hyannis to Boston

STOP NAME	LOCATIONS
Hyannis	Hyannis Transportation Center
Hyannis	Barnstable Municipal Airport
Barnstable	Barnstable Park-and-Ride Lot
Sagamore	Sagamore Park-and-Ride Lot
Boston	South Station
Boston	Logan Airport

Similarly, there are two routes connecting service between Providence, RI and Cape Cod. The first route is service between Woods Hole and Providence and the second route is from Hyannis to Providence. Service may be reduced in the winter to reflect reduced demand. Connections can be made at a number of stops along each route.

TABLE 6. Peter Pan Woods Hole to Providence

STOP NAME	LOCATIONS
Woods Hole	Steamship Authority Piers
Falmouth	Falmouth Bus Depot, Depot Ave.
Bourne	Cape Side Convenience Store, Trowbridge Rd.
New Bedford	SRTA Terminal, Elm Street
Fall River	SRTA Terminal, Fourth Street
Providence	Bus Terminal
Providence	Kennedy Plaza

TABLE 7. Peter Pan Hyannis to Providence

STOP NAME	LOCATIONS
Hyannis	Hyannis Transportation Center
Bourne	Cape Side Convenience Store, Trowbridge Rd.
New Bedford	SRTA Terminal, Elm Street
Fall River	SRTA Terminal, Fourth Street
Providence	Bus Terminal
Providence	Kennedy Plaza

In 2019, Peter Pan Bus Lines extended regular daily service to the Outer Cape with a terminal in

Provincetown. Connections can be made to additional regional service to Boston and Providence, RI via the Hyannis Transportation Center. The route is similar to service provided by Plymouth and Brockton.

TABLE 8. Peter Pan Outer Cape Bus Stops

STOP NAME	LOCATIONS
Hyannis	Hyannis Transportation Center
Harwich	Harwich Park-and-Ride Lot
Orleans	CVS @ Main St. & Route 6A
Eastham	Eastham Town Hall/Superette, Rt. 6
North Eastham	Seamen's Bank, Rt 6
South Wellfleet	Southfleet Motor Inn, Rt. 6
Wellfleet	Outer Cape Health Services
Truro	Jam's Store, Route 6A
North Truro	Salty Market, Route 6A

Cape Cod Regional Transit Authority

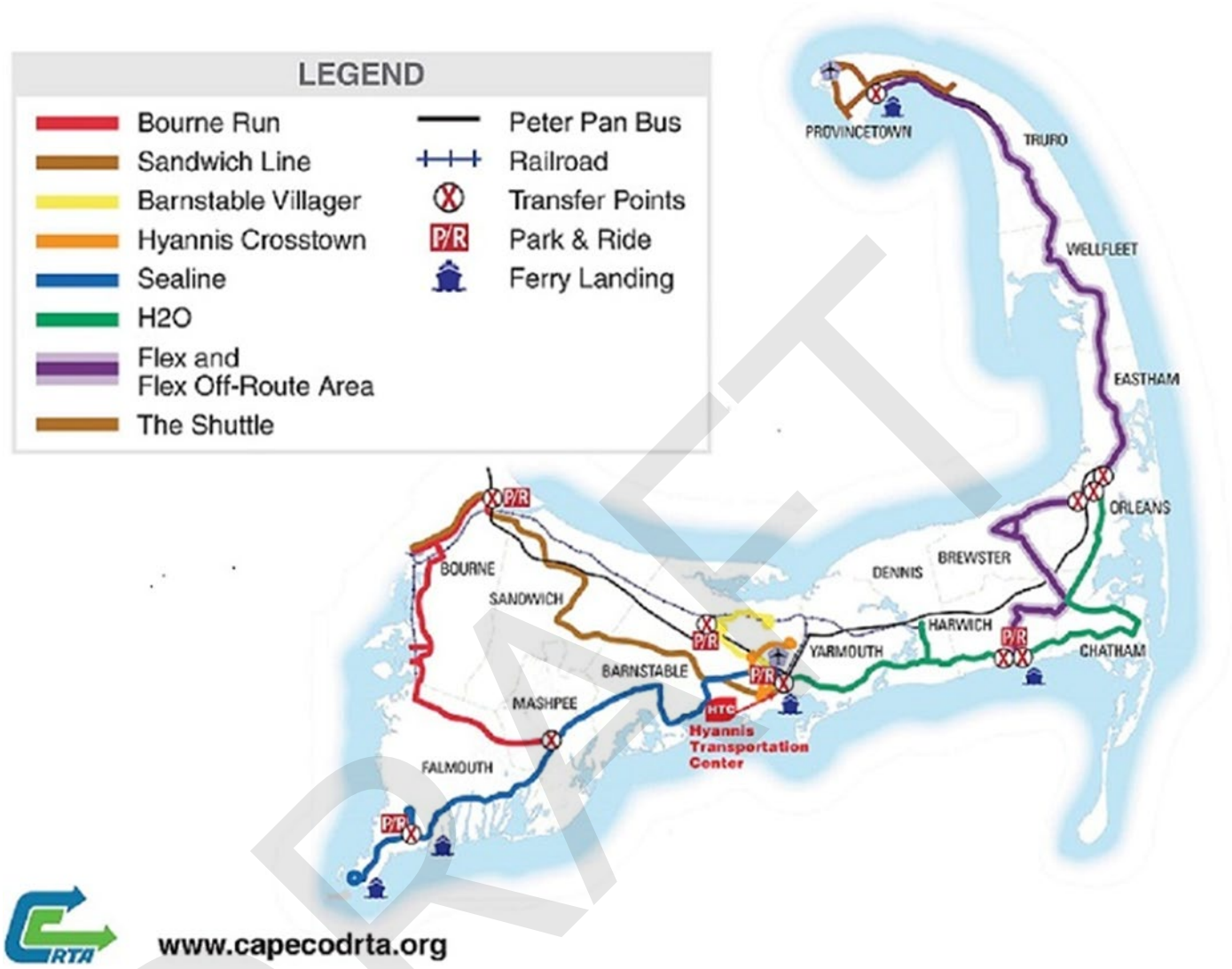
The Cape Cod Regional Transit Authority (CCRTA) is the agency in charge of operating and maintaining public transit services on Cape Cod. The CCRTA is an independent public agency, governed by a board of directors. The 15 Cape Cod towns each appoint one board member to represent their interests in the CCRTA. The CCRTA offers several types of services, including Fixed Route service, Flexible Route service, and Demand Response or Paratransit service. Some Paratransit and Demand Response services are not operated directly by the CCRTA, but are contracted.

FIXED ROUTE BUS SERVICE

Fixed Route bus service is the traditional form of transit. Vehicles follow specific routes and stop at designated areas. Fixed Route service on Cape Cod is slightly different, in that CCRTA buses (with the exception of the Flex) stop anywhere along their route when flagged. All CCRTA fixed route buses have bicycle racks, designed to carry two bicycles. In addition, all fixed route buses are wheelchair accessible and equipped with low floors, ramps or lifts. Service animals are the only animals allowed to board the buses.

FIGURE 16. Cape Cod Regional Transit Authority System Map

Source: Cape Cod Regional Transit Authority



Hyannis-Falmouth Service: "Sealine"

The Hyannis-Falmouth service known as the Sealine runs from the Hyannis Transportation Center to Woods Hole mostly on Route 28. Passengers can board the bus at any of the 20 designated stops, or flag the driver anywhere along the route to stop. The Sealine operates round trips beginning at 5:30am and ending at 9:30 pm. Some of the round trips feature stops that others do not and the number of trips are increased in the summer. Buses are scheduled to run every 60 minutes, with a complete one-way trip taking 1 ½ hour. During the summer months service operates 7 days per week. Outside of the summer months service operates Monday through Saturdays. Service may be reduced during the winter in order to reflect lower demand. The Sealine

connects to the WHOOSH Trolley in Woods Hole and to most other lines at the Hyannis Transportation Center.

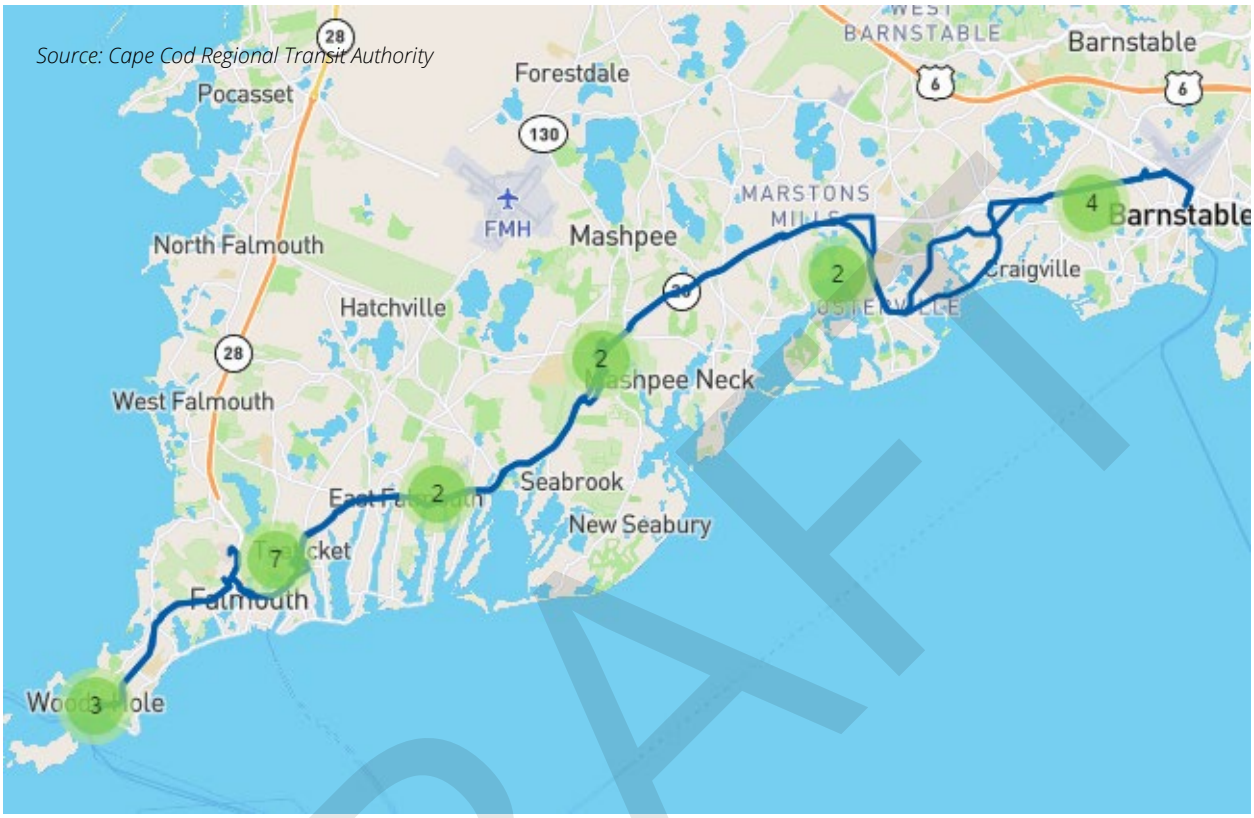
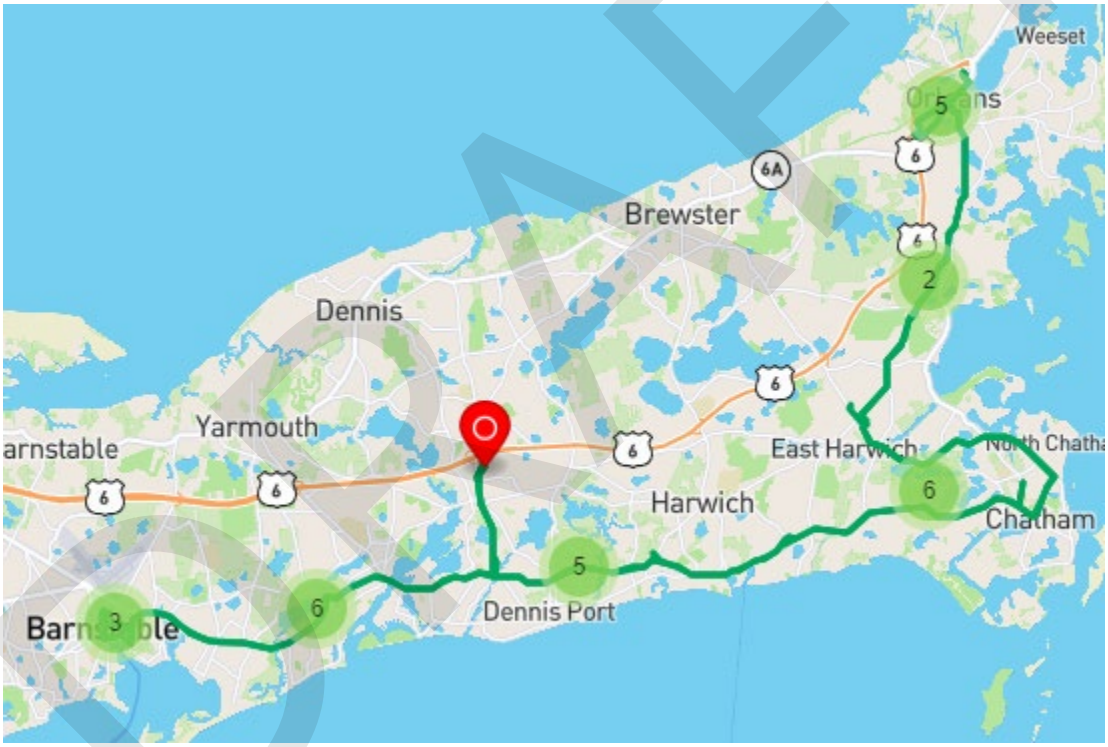


FIGURE 17. CCRTA Sealine Map

Hyannis-Orleans Service: "H2O"

The Hyannis-Orleans service, also known as the H2O Line, runs from the Hyannis Transportation Center to the Stop and Shop on Routes 28/6A in Orleans. Passengers can board the bus at any of the 28 designated stops, or flag the driver anywhere along the route to stop. The H2O operates round trips beginning at 5:30 am and ending at 9:20 pm. Buses are scheduled to run about every hour, with the complete one-way trip taking 1 hour and 30 minutes. During the summer months the H2O operates seven days per week including holidays. Outside of the summer months the H2O operates Monday through Saturday. Service may be reduced during the winter in order to reflect lower demand. Passengers riding the H2O can transfer to the Flex at four locations indicated by a red X on the map above in Harwichport and Orleans, and to most other lines at the Hyannis Transportation Center.

FIGURE 18. CCRTA H2O Line Map

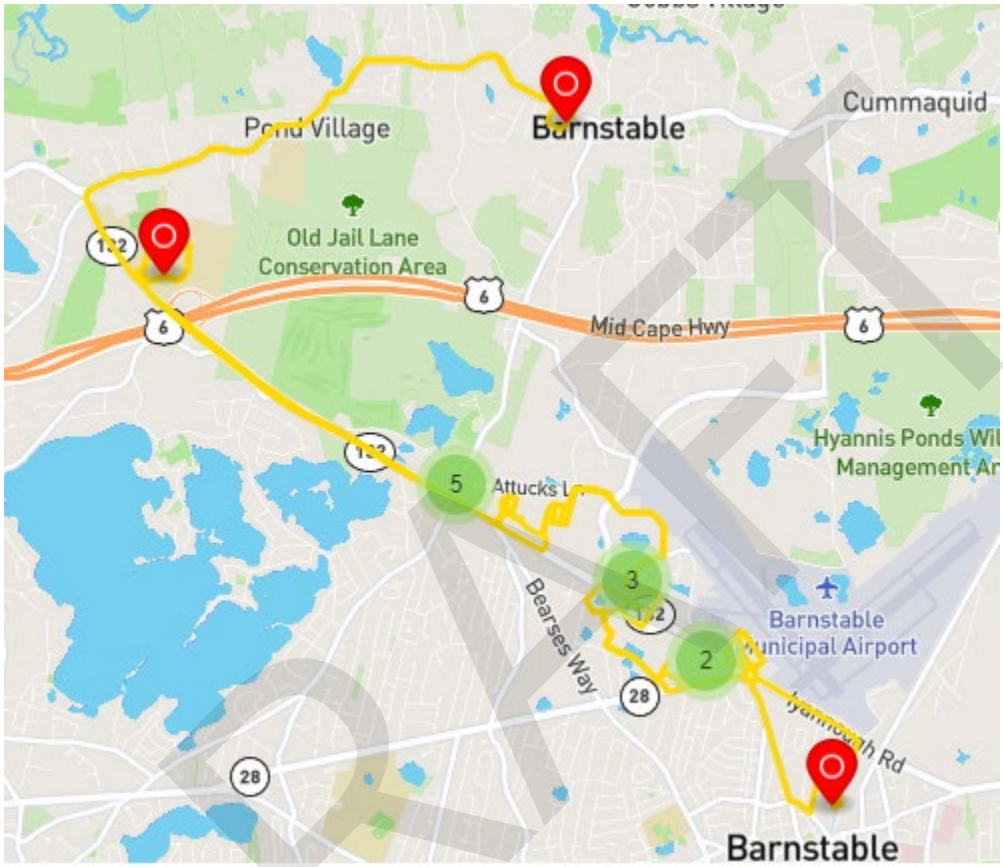


Barnstable Villager

The Barnstable Villager service runs from the Hyannis Transportation Center to the Barnstable County Complex on Route 6A and Barnstable Harbor. Passengers can board the bus at any of the designated stops, or flag the driver anywhere along the route to stop. The Barnstable Villager makes round trips, beginning at 8:30am and ending at 6:35pm. Buses are scheduled to run every hour, with the complete one-way trip scheduled to take 1 hour. During the summer months the Villager operates seven days per week. Outside of the summer months service is offered Monday

through Saturday. Service may be reduced during the winter in order to accommodate lower demand. Passengers riding the Villager can transfer to most other lines at the Hyannis Transportation Center.

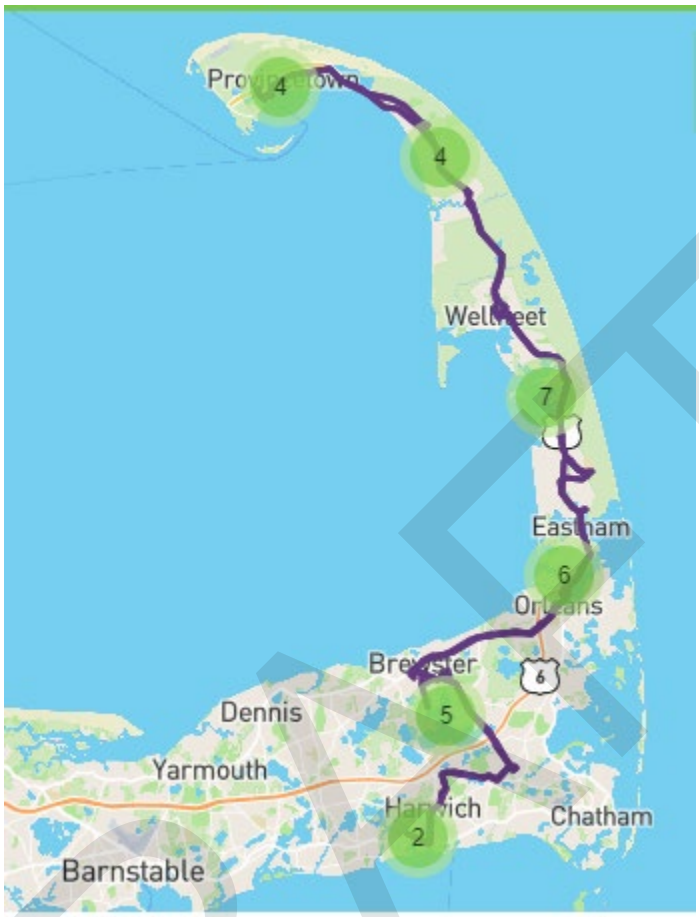
FIGURE 19. CCRTA Barnstable Villager Map



Flexible Route Bus Service: "the Flex"

The Flex stretches from Harwichport to Provincetown. Along this route, the Flex picks up passengers at any of the designated stops. Of the designated stops, some are "Main Stops." This means that the Flex bus always makes a stop, usually within five minutes of schedule. The remaining stops are "In-Between Stops," and the Flex only stops when a passenger is waiting, or to drop off a passenger by request. The time of these stops vary. In addition to the "Main Stops" and "In-Between Stops" passengers may flag the bus down along the main route, with the exception of portions along Route 6.

FIGURE 20. CCRTA Flex Map



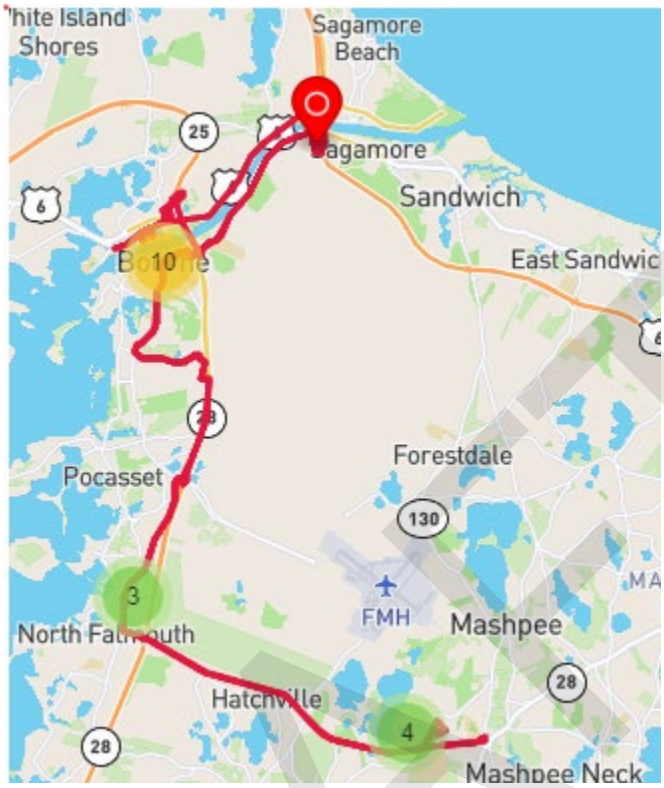
The bus can also "flex" off its route up to ¾ of a mile to pick up passengers who cannot reach a regular stop. Users must call the RTA at least two hours in advance in order to schedule a Flex bus pick up or drop off.

The Flex makes round trips, beginning at 4:45am and ending at 9:15pm. Buses are scheduled to run generally every two hours, with additional service in the summer. A one-way trip takes about 2 hours and 15 minutes. Service is available Monday through Saturdays. Service may be reduced during the winter in order to reflect lower demand.

Bourne Run

The Bourne Run operates from the Mashpee Commons to Buzzards Bay. Passengers can board the bus at any of the designated stops or flag the driver anywhere along the route to stop. Buses are scheduled to run about every hour and a half, with the complete one-way trip taking 1 hour and 15 minutes. The Bourne Run operates Monday through Friday. Service may be reduced during the winter in order to reflect lower demand. Passengers riding the Bourne Run can transfer to the Sealine at the location indicated by a red X on the map above in Mashpee, and to the Sandwich Line in Buzzards Bay.

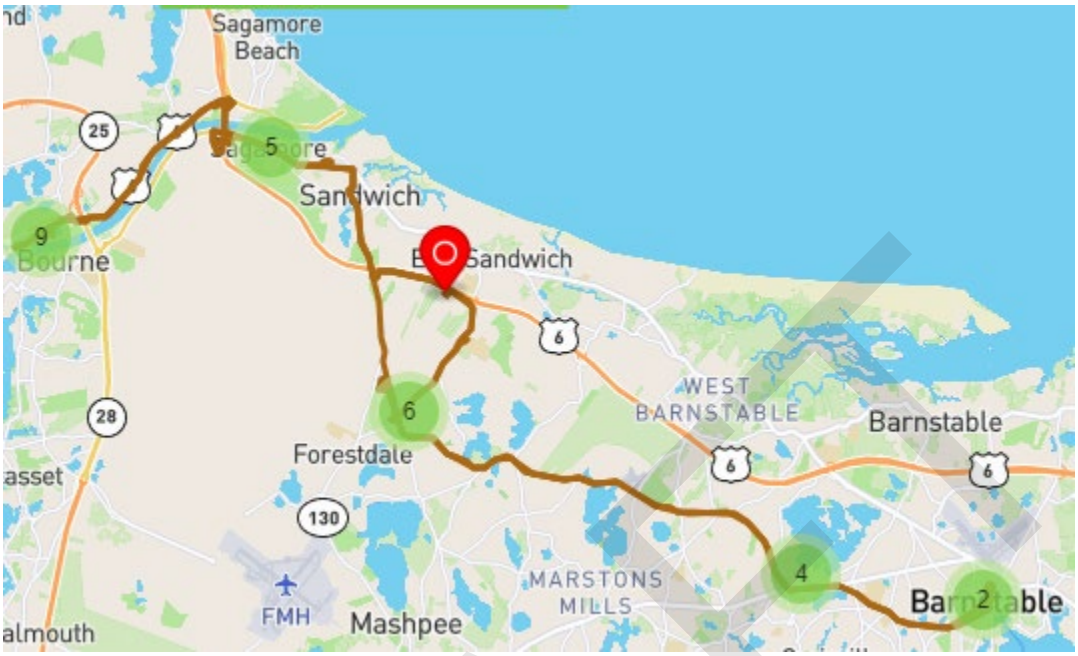
FIGURE 21. CCRTA Bourne Run Map



Sandwich Line

The Sandwich Line operates from the Hyannis Transportation Center to the Buzzards Bay Train Station with the majority of stops occurring in Sandwich. Passengers can board the bus at any of the designated stops, or flag the driver anywhere along the route to stop. Buses are scheduled to run about seven times a day in each direction with more service during the summer. A complete one-way trip takes about 1 hour and 25 minutes. The Sandwich Line operates Monday through Friday. Service may be reduced during the winter in order to reflect lower demand. Passengers riding the Sandwich Line can transfer to other CCRTA routes and intercity buses at the Hyannis Transportation Center or in Buzzards Bay.

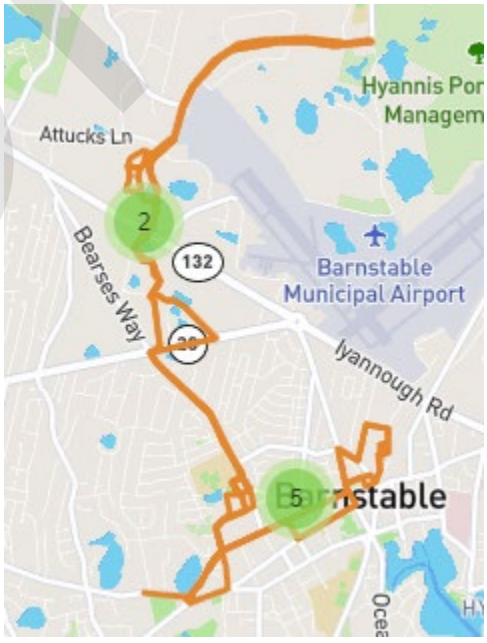
FIGURE 22. CCRTA Sandwich Line Map



Hyannis Crosstown

The Hyannis Crosstown operates Monday-Saturday from at 8am to 5:50 pm. The Hyannis Crosstown connects at the Hyannis Transportation Center with several other services. Service travels in both directions hourly and each round trip takes about 50 minutes. Passengers can board the bus at any of the designated stops or flag the driver anywhere along the route to stop.

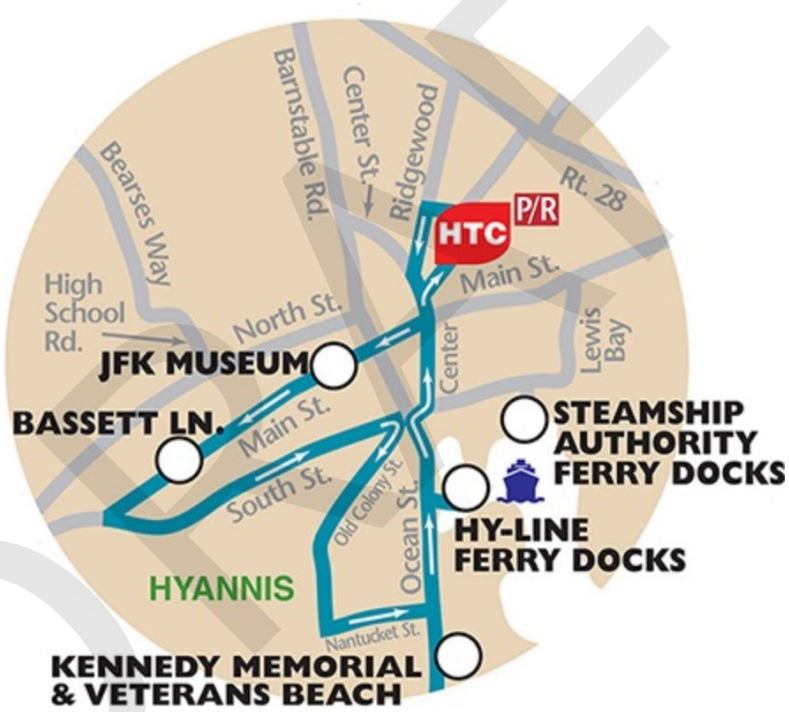
FIGURE 23. Hyannis Crosstown Map



SEASONAL SERVICES

Hyannis Trolley

The Hyannis Shuttle is the summer service from the Hyannis Transportation Center to several beaches in the Hyannis area. Passengers can board the bus at any of the designated stops or flag the driver anywhere along the route to stop. The Hyannis Shuttle makes round trips, beginning at 10:30am and ending at 9:15pm on a 45 minute schedule continuously throughout the day. Buses operate 7 days per week including holidays starting late June and continuing through Labor Day. Passengers riding the Hyannis Shuttle can transfer to most other lines at the Hyannis Transportation Center.



Source: Cape Cod Regional Transit Authority

Provincetown/Truro Shuttle

The Shuttle serves MacMillian Pier, Province Lands Visitor Center, Provincetown Inn, Provincetown Airport, Race Point Beach, Herring Cove Beach, Beech Forest and North Truro. The Shuttle operates on a reduced schedule from 7:00am to 12:30am Friday, Saturday, Sunday in the shoulder season of late May to mid June with service running every 60 minutes. Extended service in the peak summer season is provided. Passengers riding the Shuttle may board at designated stops or flag the bus down at any location along its route. Passengers also can transfer to the Flex bus for free at Dutra's Market in North Truro.

FIGURE 24. CCRTA Provincetown/Truro Shuttle

Source: Cape Cod Regional Transit Authority

The WHOOSH Trolley

During summer months, the WHOOSH Trolley, or the Woods Hole Trolley, runs from the Falmouth Mall to the Steamship Authority Docks in Woods Hole. Passengers can board the bus at any of the designated stops or flag the driver anywhere along the route to stop. During the summer, the WHOOSH Trolley operates between 9:45am and 8:05pm seven days a week with extended service on Friday and Saturday. Transfers are available to the Sealine at the Falmouth Mall.

FIGURE 25. CCRTA Woosh Trolley

Source: Cape Cod Regional Transit Authority

DEMAND RESPONSE BUS SERVICE

Demand response bus service addresses the needs of passengers who cannot use standard transit services. Demand response buses do not use a route system, but instead pick up passengers at scheduled locations and times, often at their homes or offices, as requested.

Dial-A-Ride Transportation (DART)

The DART service is a demand response service that operates year-round across all 15 Cape towns, six days a week from 8am to 5pm. In order to use the service, passengers must call the RTA at least one day in advance during normal business hours to schedule a pickup and drop off. If multiple passengers are being picked up or dropped off in the same location their trips will be grouped. For this reason, users must be flexible with their pickup and drop off times. If passengers do not show for a requested trip, they are considered a "No-Show" and are subject to restrictions when scheduling their next trip. Repeat "No-Shows" could result in the loss of riding privileges.

The standard fare to ride the DART is $3.00. This rate is reduced for seniors and individuals with disabilities, and monthly passes are available. Many passengers use the DART to get to work or school, shopping trips and medical appointments.

SmartDART

A new service provided by CCRTA, is an app based, on demand service that is called SmartDART. SmartDART is a door-to-door, ride hail service using the SmartDART app similar to Uber and Lyft. This service is currently only available in Yarmouth, Barnstable and East Falmouth. The service is intended to assist connecting to fixed route CCRTA service. SmartDART operates seven days a week from 8:00am to 7:00pm in East Falmouth and Monday through Friday in Yarmouth and Barnstabale from 7:00am to 6:30pm. The fee costs $3. CCRTA will continue to expand this service over time.

Boston Hospital Service

CCRTA provides medical transportation services on Monday through Thursday by reservation from Cape Cod to all major hospitals in the Boston area. This service has stops located in Wellfleet, Eastham, Orleans, Harwich, Barnstable and Sagamore and generally leaves between 7am and 8am. Medical appointments should be scheduled between 10am and 2pm. The bus leaves Boston by 3pm. Fares cost $15/one way and should be reserved ahead of time.

ADA Paratransit Service

The Americans with Disabilities Act (ADA) is a federal law passed in 1990, which states that individuals with disabilities are entitled to a comparable level of public transportation service as individuals without disabilities. In order to comply with the ADA, the CCRTA offers a demand response, or paratransit specifically for individuals with disabilities. This paratransit service operates within ¾ mile of existing routes and runs during the same hours as existing bus services. Trips may be requested during normal business hours on the day prior to the desired service.

ADA Paratransit Service is available to people with physical, mental, cognitive, and visual impairments that prevent them from boarding or disembarking fixed route services, from recognizing destinations, from understanding bus transfers, or from distinguishing between different buses in different routes. Residents who think they may qualify are encouraged to contact the CCRTA to request an application.

Fully Funded and Councils on Aging

The CCRTA also helps transport passengers through contracting or funding bus service for other agencies. The buses are not operated by CCRTA staff but were obtained through contract.

Greater Attleboro-Taunton Regional Transit Authority

The Greater Attleboro-Taunton Regional Transit Authority (GATRA) is the agency in charge of operating and maintaining public transit services for 17 member communities in Southeastern Massachusetts. GATRA serves Cape Cod via Link 2 with stops in Bourne.

Link 2 connects Route 6/28 in Wareham Center, Onset Village to Buzzards Bay in Bourne and every hour from 7:55am to 5:15pm Monday-Friday with six trips on Saturday. Passengers can board at any point on the route by waving down the driver. Fares are $1.50 for a one-way trip, with discounts for the elderly, disabled, students, and children. Monthly passes are also available. Connections to

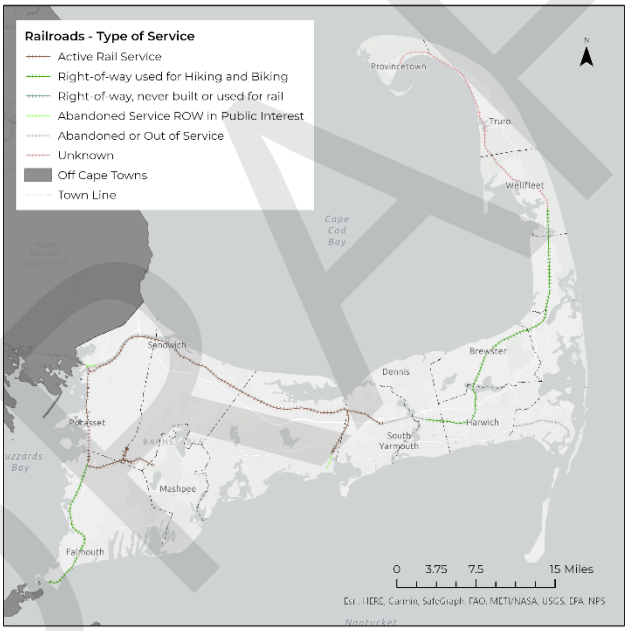
RAIL INFRASTRUCTURE

Rails

Cape Cod has a single rail line, the Cape Cod Line, with three branches. Together, they form a network of rail infrastructure which serves the freight and recreational needs of Cape Cod residents and visitor.

Rail infrastructure extended the entire length of Cape Cod, from Bourne to Provincetown, in the first half of the 1900s. Service was also available along the west coast, extending from Bourne to Woods Hole in Falmouth, and to Chatham. Today the expanse and usage of rail is reduced. Active rail still exists starting in Bourne and ending in three locations, Joint Base Cape Cod, Hyannis, and Yarmouth.

FIGURE 26. Cape Cod Rail Infrastructure



The portion of track that formally connected Dennis to Provincetown was dismantled. From Route 134 in Dennis to LeCount Hollow Road in Wellfleet the former tracks were turned into the Cape Cod Rail Trail bicycle facility. From LeCount Hollow Road north the rail track right of way had various conversions including sale to private owners. An extension of the Rail Trail is planned to connect into Barnstable, using rail right-of-way from Route 134 in Dennis to an area to the east of Higgins Crowell Road in Yarmouth. Rail track in Falmouth, from Old County south to Woods Hole have also been converted to a bike path called the Shining Sea Bikeway in 1976.

The rail tracks that have remained in place have varied levels of usage. Figure 35 shows the location of existing rails and Table 6 details the mileage and percent of total. This data was obtained from the MassDOT roadway inventory file.

TABLE 9. Cape Cod Rail Mileage by Category

		TOTAL MILES	PERCENT OF TOTAL
	Cape Cod Total	53.8	
By Rail Line	Cape Cod Line	32.0	59.5%
	Hyannis Branch	4.4	8.2%
	Otis Branch	10.4	19.3%
	Woods Hole Branch	7.0	13.0%
By Owner	Federally Owned	9.8	18.2%
	Army Corps of Engineers	0.2	0.3%
	MassDOT	43.8	81.4%
By Town	Barnstable	11.2	20.8%
	Bourne	14.4	26.8%
	Dennis	1.2	2.2%
	Falmouth	4.0	7.4%
	Mashpee	0.4	0.8%
	Sandwich	14.8	27.5%
	Yarmouth	7.8	14.5%

CAPE COD LINE

The Cape Cod Line begins in Buzzards Bay, Bourne after it crosses over the Cohasset Narrows Bridge. The tracks pass the former train station in Buzzards Bay. This building is currently used by the Canal Area Chamber of Commerce, is a stop on the CapeFLYER summer service and the parking lot has varied users including inter-city bus passengers. There are currently two rail platforms at this location. CapeFLYER passengers use the short, raised platform, and the longer ground level platform is considered obsolete because it is not handicap accessible.

FIGURE 27. Cape Cod Canal Rail Bridge

Immediately after passing the Buzzards Bay train station the train must cross the Cape Cod Canal over the Cape Cod Canal Railroad Bridge. The Cape Cod Canal Railroad Bridge was first built in 1910 during the construction of the Cape Cod Canal. When the canal was reconstructed in 1933, a new railroad bridge was built over the widened waterway. Since the railroad grade could not be easily raised, the Army Corps of Engineers constructed a vertical lift railroad bridge. The new bridge was completed in December of 1935 and was the longest bridge of its kind at the time. Recently, the Cape Cod Railroad Bridge underwent a major rehabilitation effort, in large part through $25 million in Federal funds. Normally the bridge remains in the "up" position, allowing marine traffic access through the canal, and is lowered for rail service as needed. Marine traffic has statutory right-of-way over rail traffic but can be managed to accommodate scheduled train service such as the Cape Flyer. The bridge is 806 feet long, 297 feet high and has a high-water clearance of 136 feet.

FIGURE 28. Former Rail Station in Buzzards Bay

FIGURE 29. Rail Tracks West of the Sagamore Bridge

After Crossing the Cape Cod Canal, the track splits between the Cape Cod Branch and Woods Hole Branch. The Cape Cod Branch follows the Cape Cod Canal and then runs alongside Route 6A through Sandwich and Barnstable. Out of service sidetracks and former stations can be seen in West Barnstable and Sandwich. A CapeFLYER platform was built under the Bourne Bridge and allows passengers on the south side of the canal to disembark. Transit connections are provided from the Cape Flyer to the Steamship ferries in Woods Hole. The Cape Cod Line continues to the Yarmouth "wye" (triangular junction) at Willow Street in Yarmouth. Here, the Hyannis Branch turns south, while the Cape Cod Line continues to the east.

East of Willow Street, the Cape Cod Line continues towards Yarmouth on its third segment. This is the easternmost section of railroad still in use on Cape Cod. It extends from Willow Street in Yarmouth to the Yarmouth Waste Management Facility just west of Station Avenue. The connection to the Waste Management Facility can be made from the mainline in either direction. Mass Coastal Railroad operates its "Energy Train" from this facility, usually one or two trips a day exporting solid waste to a waste-to-energy facility in Rochester, Mass. In total, the segment contains 3.38 miles of track, the grade separated crossing of Route 6, and 23 total roadway crossings.

FIGURE 30. Rail Crossing at Willow Street in Yarmouth

In sum, the Cape Cod Line is the backbone of rail service on Cape Cod. The Cape Cod Line forms the majority of regional rail infrastructure. It serves as the only access to Cape Cod by rail and is used by both Massachusetts Coastal freight services and Cape Cod Central Railroad for scenic excursion trains and the CapeFLYER for weekend passenger service.

HYANNIS BRANCH

The Hyannis Branch begins at the Yarmouth "wye" (triangular junction) at Willow Street in Yarmouth and travels south. The historic Hyannis Roundhouse, located between Route 28 and Main Street in Barnstable, has been converted into a nightclub and warehouses. The rail yard is now used for the Hyannis Transportation Center and as a rail yard for Cape Cod Central Railroad. A restaurant and a retail store now occupy part of the site. The terminus of the Hyannis Branch is a station for the Cape Cod Central. Originally, the Hyannis Branch continued from the rail yard south to a port facility in the Outer Harbor of Hyannis Harbor. The port and rail connection were dismantled however, and the right of way converted into Old Colony Road. This segment has also been rated for 30 MPH travel. In total, the Hyannis Branch contains 4.39 miles of track, 2 grade separated crossings under Route 6, and 6 total roadway crossings. Currently the Hyannis Branch only serves passengers.

FIGURE 31. Rail Platform at the Hyannis Transportation Center

WOODS HOLE BRANCH

The Woods Hole Branch begins at the Canal Junction, splitting off from the Cape Cod Line and traveling south through Bourne and Falmouth. Three depot stations along the route, in Monument Beach, Pocasset, and Cataumet, have been converted to other uses. The tracks continue south to the Otis Junction just south of County Road in Falmouth. The track from Otis Junction to Joint Base Cape Cod is currently owned by Mass Coastal Railroad but currently not in use by train. An out of service sidetrack runs from Old Main Road to the Otis Junction. This portion of the Woods Hole Branch has been rated for 30 MPH travel. In total, the segment contains 8.43 miles of track, 2 bridges over waterways, 5 grade separated roadway crossings, and 17 total road crossings.

The final segment of the Woods Hole Branch runs from the Otis Junction to the overpass at the southern crossing of Palmer Avenue. Vegetation encroached upon the rail tracks and crossing signals have been left in disrepair, and road crossings have been paved. This section has been converted to an extension of the Shining Sea Bike Path. In total, the segment contains 5.82 miles of track, a bog sluiceway north of Fox Lane, 4 grade separated roadway crossings, and 14 road crossings.

FIGURE 32. Rail Tracks North of County Road in Falmouth

Originally, the Woods Hole Line continued south with stations at Depot Street and the current Steamship Authority port at Woods Hole. Originally built in 1872, this section of the Woods Hole line has been dismantled. The station at Depot Street now serves as a bus terminal, while the right-of-way has been converted into the Shining Sea Bike path.

OTIS BRANCH

From the Otis Junction, the Otis Branch runs east into Joint Base Cape Cod. Inside the base, the track splits into several terminals, with one track running as far east as Mashpee. In total, the segment contains 10.51 miles of track, 3 grade separated roadway crossings, and 15 total roadway crossings

FIGURE 33. Rail Tracks at the Otis Junction

Road Crossings

Exclusive rights-of-way can limit the interaction of rail and other modes, making rail transportation safer and faster. However, crossing at roadways can pose problems if the intersection is not properly signed and designed. Currently on Cape Cod, there are 66 at-grade roadway intersections along active rail lines. Some, such as the railroad crossing at Route 28 in Barnstable, can interfere with roadway traffic and cause congestion and delays. Of those, 21 are not gated, signalized or signed. Although most of these are minor roadways, they do represent a potential for mishap. Moreover, there are 18 grade separated roadway crossings, as well as 5 bridges over waterways along active rail lines. These bridges and overpasses must be maintained in order to ensure continued use. If rail service on Cape Cod is to be increased, further study of railroad crossings may be necessary to ensure safety and prevent interruptions to roadway traffic.

TABLE 10. Railroad Crossing by Type

		TOTAL	GRADE SEPARATED	GATED	SIGNALIZED	SIGNED	OTHER\ NONE
	Cape Cod Total	102	22	4	26	19	31
By Rail Line	Cape Cod Line	62	10	3	20	11	18
	Hyannis Branch	6	2	1	-	1	2
	Otis Branch	15	3	-	-	2	10
	Woods Hole Branch	19	7	-	6	5	1
By Owner	Federally Owned	13	4	-	5	3	1
	Army Corps of Engineers	15	3	-	2	-	10
	MassDOT	73	15	4	27	13	14
By Town	Barnstable	18	1	3	8	4	2
	Bourne	27	11	-	6	5	5
	Dennis	3	-	-	-	-	3
	Falmouth	6	4	-	1	-	1
	Mashpee	33	2	1	11	3	16
	Sandwich	15	4	-	1	6	4
	Yarmouth	7.8	14.5%				

Source: www.masscoastal.com/train-energy.php

AVIATION INFRASTRUCTURE

For Cape Cod travelers, air transportation provides an important link from Cape Cod to Boston, New York, and the islands of Martha's Vineyard and Nantucket. Six airfields and airports serve Cape Cod as a base for air transportation.

TABLE 11. Airports and Airfields of Cape Cod

NAME	FAA IDENTIFIER	FACILITY TYPE
Barnstable Municipal Airport	HYA	Scheduled Air Carrier Service
Provincetown Municipal Airport	PVC	Scheduled Air Carrier Service
Chatham Municipal Airport	CQX	General Aviation
Falmouth Airpark	5B6	General Aviation
Cape Cod Airfield	2B1	General Aviation
Cape Cod Coast Guard Air Station	FMH	Military

The commercial service airports, Barnstable Municipal Airport and Provincetown Municipal Airport, supply data on total enplanements to the Federal Aviation Administration (FAA). In 2021, Barnstable Municipal Airport reported 19,520 enplanements and Provincetown Municipal Airport reported 7,707 enplanements.[1]

Barnstable Municipal Airport

The largest airport on Cape Cod is Barnstable Municipal Airport, Boardman-Polando Field located in Hyannis. It is one of two airports on Cape Cod to provide scheduled air carrier service.

[1] 2022 Air Carrier Activity Information System data

FIGURE 34. Barnstable Municipal Airport Terminal

The history of the airport goes back to 1928, when Charles Ayling and his son Robertson formed the Hyannis Airport Corporation. During World War II, the Works Progress Administration funded the construction of three paved 4,000-foot runways, while the Army and then the Navy assumed control of the airport. After the war ended, the navy turned over control of the Hyannis Airport to the Town of Barnstable. The advent of larger planes and increased passenger service required the construction of a larger, 5,400-foot runway in the mid-1950s, new terminals in 1957, and a control tower in 1961. In 1981, the airport was renamed the Barnstable Municipal Airport, Boardman-Polando Field. Russell Boardman and John Polando were two Bay State pioneers who flew a record nonstop distance of 5,011 miles from the United States to Istanbul in 1931.

Recent improvements to the airport include a new 35,000 sq. ft. passenger terminal, a new 85 ft. air traffic control tower, and a new vehicle access road—all opened at the end of 2011— extensive parking facilities, new aircraft ramps and taxiways, a rescue and maintenance building and an aircraft fuel farm.

FIGURE 35. Barnstable Municipal Airport

Barnstable Municipal Airport the airport is home to Cape Air, JetBlue and Atlantic Aviation along with other charter, corporate and general aviation aircraft operators. JetBlue operates daily service to New York in season.[2]

A 2014 state study found that the airport has a direct economic impact of $119.2 million a year on the Cape Cod community. The analysis, by the Aeronautics Division of the Massachusetts Department of Transportation, calculated the value of jobs, payroll and business generated by the airport and its tenants, along with visitor spending.

The study found there is a measurable multiplier of an additional $88.7 million a year produced by the recirculation of money spent locally by airport businesses and the people employed there. Overall, the study determined that Barnstable Municipal Airport generates 2,135 jobs, an $85.3 million payroll and $208 million a year in direct and indirect benefits.[3]

Provincetown Municipal Airport

The Provincetown Municipal Airport also has scheduled air carrier service. The Airport provides passenger service to Logan Airport in Boston. The airport is located at the end of Race Point Road and is one of two airports in the country located in National Park territory. Cape Air and Jet Blue Airways operate passenger services.

FIGURE 36. Provincetown Municipal Airport

[2] http://www.town.barnstable.ma.us/airport/aboutairport/aboutairport.asp

[3] http://www.town.barnstable.ma.us/airport/aboutairport/aboutairport.asp

Cape Cod Coast Guard Air Station

U.S. Coast Guard Air Station Cape Cod (ASCC), with its MH-60T Jayhawk helicopters and HC-144A Ocean Sentry fixed-wing aircraft, is the only Coast Guard Aviation facility in the northeast. As such, ASCC is responsible for the waters from New Jersey to the Canadian border. Centrally located at Joint Base Cape Cod, ASCC maintains the ability to launch a helicopter and/or fixed-wing aircraft within 30 minutes of a call, 365 days-a-year, 24 hours-a-day, and in nearly all-weather conditions.[4]

Other General Aviation Airports

Several other airports are open to the public and offer general aviation service. Chatham Municipal Airport, located on George Ryder Road, offers a variety of tours around Monomoy Island and the Outer Cape. One asphalt runway provides service for the 31 aircraft based on the field.

Another general aviation airport is the Falmouth Airpark, located near Route 28 and Fresh Pond Road. The airpark has a single asphalt runway, which serves 53 aircraft. A nearby "Fly-In Community," with aircraft access from the homes to the runway, offers shares of the Falmouth Airpark with residence.

Lastly, the Cape Cod Airfield on Route 149 and Race Lane in Marstons Mills provides tours and glider rides from three turf runways. The length of the runways, the height of the nearby trees and the absence of a fence restrict the type of airplanes that can use the airfield. It opened as the Cape Cod Airport on July 4, 1929 with an air circus, stunt flights, parachute jumps, and other spectacles. Currently, the airfield is operated by Cape Cod Flying Service and serves as a base for 14 aircraft.

Air Service Accessibility and Mobility

Barnstable Municipal Airport is accessible by various means. According to the Cape Cod Transit Task Force Report, the vast majority airport users arrive by automobile. Rental car service is provided by over a dozen rental car agencies, with taxi service available as well. Moreover, the Villager Line of the Cape Cod Regional Transit Authority provides local bus service to the airport upon request, carrying passengers to the Hyannis Transportation Center and Barnstable Park-and-Ride lot. Paratransit service to the airport can also be arranged.

The roadways surrounding the Barnstable Municipal Airport have always provided a challenge in providing safe and convenient access for passengers. While the airport is near many regional roadways (i.e., Route 132 and Route 28), getting from the regional roadways to the airport is not always straightforward. While recent signage improvements and resources online have assisted motorists, long-term improvements are needed. Such access improvements, particularly at the

[4] http://www.uscg.mil/d1/airstacapecod/

Airport Rotary, have been included in preliminary designs that were part of the Hyannis Access Study[5]. As funding decisions are made, it is critical to the regional air service that these improvements be seen as a priority for the region.

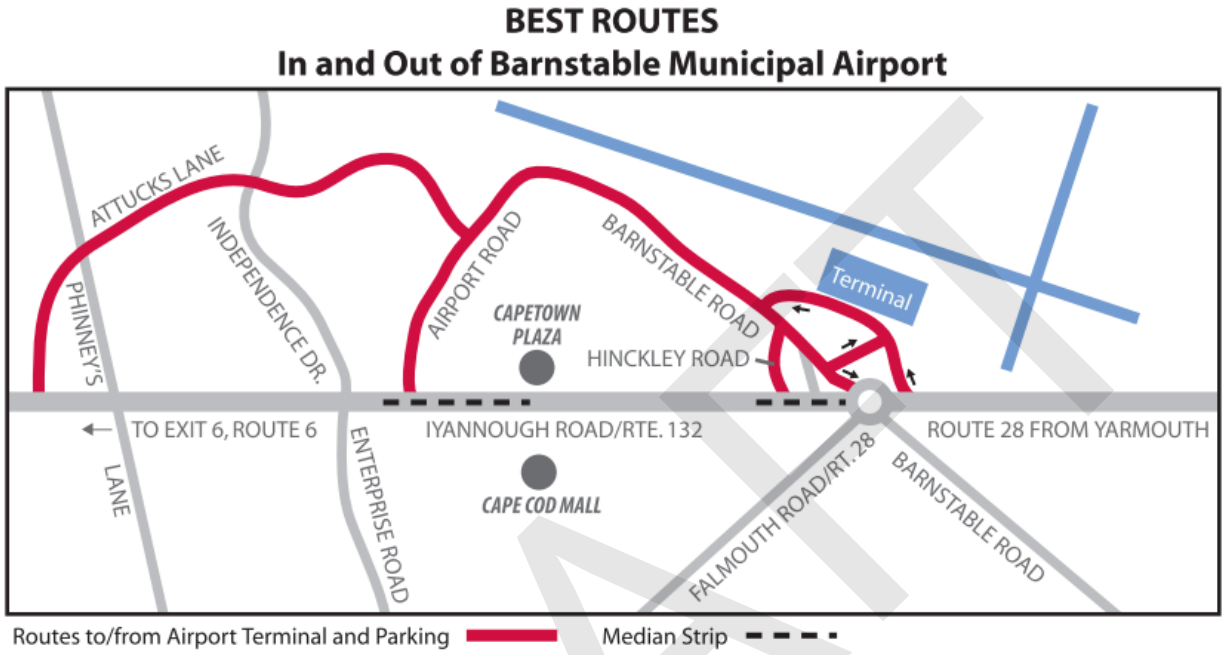


FIGURE 37. Barnstable Municipal Airport Access

Provincetown Municipal Airport is primarily accessible by road. The Provincetown Shuttle service makes a stop at the airport and connects air service passengers with interregional bus service and ferry service in downtown Provincetown. Provincetown Municipal Airport is also located along a bicycle path, which serves users that are traveling light. However, many users access the Provincetown Municipal Airport via automobile, including taxi.

Interregional bus service also links travelers on Cape Cod to air service in Boston. Plymouth and Brockton Street Railway Company and Peter Pan Bus Lines each run daily service from the Hyannis Transportation Center to the terminals at Logan International Airports. This routes includes stops at the Barnstable and Sagamore Park-and-Ride lots. By providing direct service to Logan International Airport, these transit connections provide travelers with increased access to domestic and international air services. Additionally, opportunities to connect to T.F. Green Airport in Rhode

5 http://www.capecodcommission.org/resources/transportation/hyannisaccess/HASI_2013_final_report06282013.pdf

Island exist via service from Cape Cod on Peter Pan Bus Lines to Providence, RI. Commuter rail service is then available from Providence, RI to T.F. Green Airport from the train station.

Air service on Cape Cod offers users the potential of global mobility. With service to major air transportation hubs such as New York City, Boston, and Providence, a user can transfer to domestic and international flights. Ironically, however, no scheduled flights exist between Cape Cod airports. Thus, there is a great deal of air service mobility between on-Cape and off-Cape sites, but no intraregional mobility.

MARITIME INFRASTRUCTURE

Cape Cod has approximately 586 miles of tidal coastline, with many inlets and bays that provide marine access to the land. Seaports have been constructed along several of these bays and inlets to facilitate the transfer of people and goods.

Cape Cod Channels

CAPE COD CANAL

The Cape Cod Canal connects Buzzards Bay to Cape Cod Bay through the towns of Bourne and Sandwich. The channel itself stretches 17.4 miles in length, extending from the outer end of the northerly breakwater in Cape Cod Bay to a point in Buzzards Bay near Cleveland Ledge about 5 miles southwest of the Wings Neck Light. It provides a shorter route for vessels traveling along the Atlantic Coast, reducing trip length by 65-150 miles depending on origin and destination. Additionally, the route is a safer path, allowing vessels to avoid the shoals and shipwrecks scattered along the Outer Cape route.

A canal was envisioned as early as 1623 by Myles Standish of the Plymouth Colony. Studies and surveys were produced over the next 250 years recommending the construction of a canal, until a charter was finally granted to the Cape Cod Canal Company in 1880. Finally, in 1907, August Belmont purchased the charter to build the canal. Work began in June of 1909, and was completed in 1914 at 100 feet wide and 25 feet deep. The new toll seaway opened with great celebration, however small dimensions and low toll revenues dogged operations in the upcoming years.

In 1918, the U.S. Government assumed control of the canal after a German U-boat attacked five vessels just three miles off Cape Cod. Control was returned to Belmont's company after World War I in 1920. The Cape Cod Canal was sold to the federal government for $11.5 million in 1921. Responsibility for the Cape Cod Canal was passed to the Army Corps of Engineers, who subsequently set out to improve it. The Corps began construction on an expanded canal in 1935 and completed the work by 1940. The existing canal is the result of this work.

The current Cape Cod Canal has a width of 480 feet and a 32-foot-deep channel, allowing two-way travel. At that size, the Cape Cod Canal is the world's widest sea-level canal. The old canal drawbridges were replaced in 1935 by the Bourne, Sagamore, and Railroad bridges. The architect

Ralph Adams Cram designed the Sagamore and Bourne bridges. Built simultaneously with Work Progress Administration funds, construction provided about 700 jobs. The existing bridges have larger spans of 616 feet each and provide an overhead clearance of 135 feet. A 32-foot-deep approach channel was also constructed to facilitate movement of ships from Buzzards Bay into the canal. The channel is 700 feet wide from Cleveland Ledge to Wings Neck and 500 feet from Wings Neck to the canal entrance. Other improvements to the canal include two mooring basins, two basins for small boats, an improved lighting system, a 600-foot and a 3,000-foot stone jetty at the entrance to canal from Cape Cod Bay, and a dike between Hog Island and Rocky Point in Bourne. Support for the navigation mission at the Canal includes a state-of-the-art Marine Traffic Control System, Marine Traffic Patrol by Corps vessels, and maintenance and improvement of the Canal channel and mooring basins.

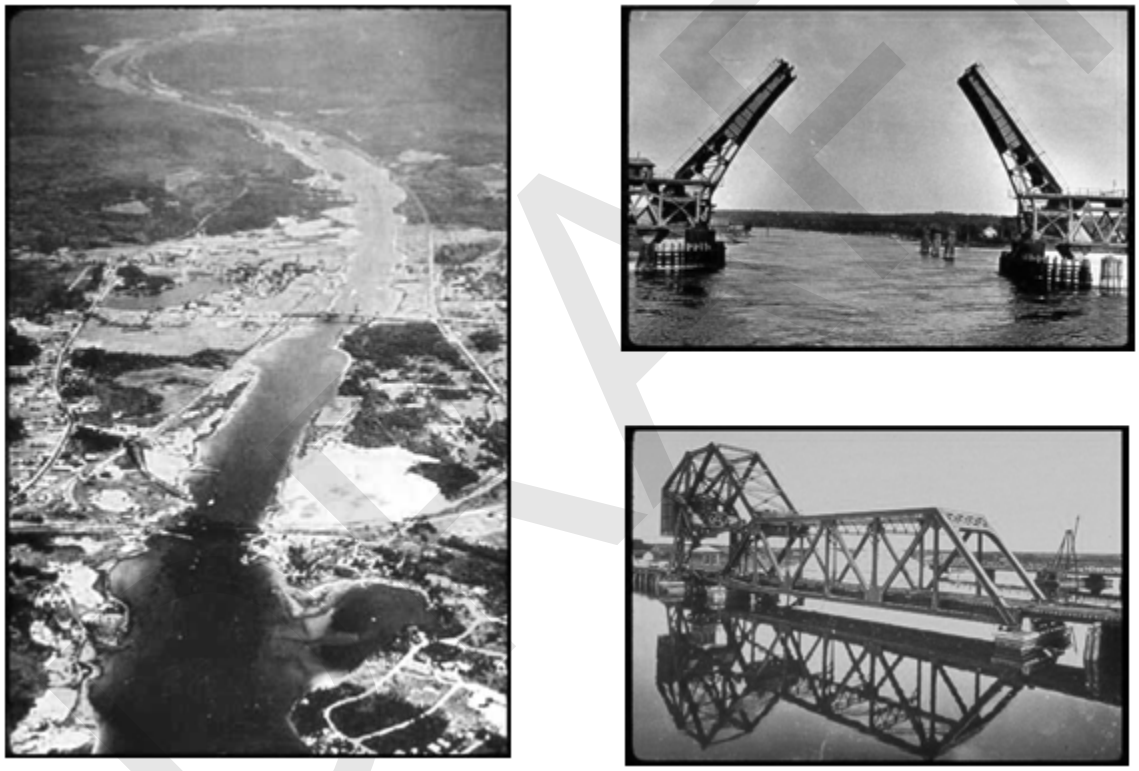


FIGURE 38. Historic Cape Cod Canal Pictures

Source: U.S. Army Corps of Engineers

The Army Corps of Engineers continues to operate and maintain the Canal and its bridges today. The highway bridges now carry over 34 million vehicles to and from the isthmus of Cape Cod annually. Over six thousand ships, tug and barge combinations and other large commercial vessels pass through the canal annually. Marine traffic is monitored and regulated 24 hours a day, 365 days a year. Moreover, Corps patrol boats stand by to assist vessels in distress. As a result, the Cape Cod Canal is a safe shortcut for marine traffic from Cape Cod Bay to Buzzards Bay.

Recreational boaters take advantage of this fact as well with over seven thousand small boat canal transits each year.

WOODS HOLE CHANNEL

Woods Hole Channel connects ports and ferry terminals in Woods Hole Harbor to seaports in Buzzards Bay and Vineyard Sound and is the most heavily traveled Cape Cod waterway. It is located between Penzance Point on the mainland and the northernmost of the Elizabeth Islands. The channel connects Buzzards Bay with Great Harbor in Woods Hole.

The Army Corps of Engineers has performed work on the Woods Hole Channel since 1870. Major works include the dredging of the channel and the removal of dangerous shoals and boulders from the main channel. By 1913, the Corps completed the current dimensions of the channel.

The Woods Hole Channel is comprised of a main channel and two branches (see following figure). The main channel, referred to as "The Strait," is 2,500 feet long, 13 feet deep and 300 feet wide. It connects an inlet of Buzzards Bay to Woods Hole between Grassy Island and Red Ledge. The larger branch, called "Broadway," separates from the Strait at Middle Ledge and travels south of Red Ledge to Vineyard Sound. Broadway is 1,300 feet long, 13 feet deep and 300 feet wide. The final branch simply provides a route into Buzzards Bay that is aimed towards the north. The smaller branch is also 13 feet deep and 300 feet wide.

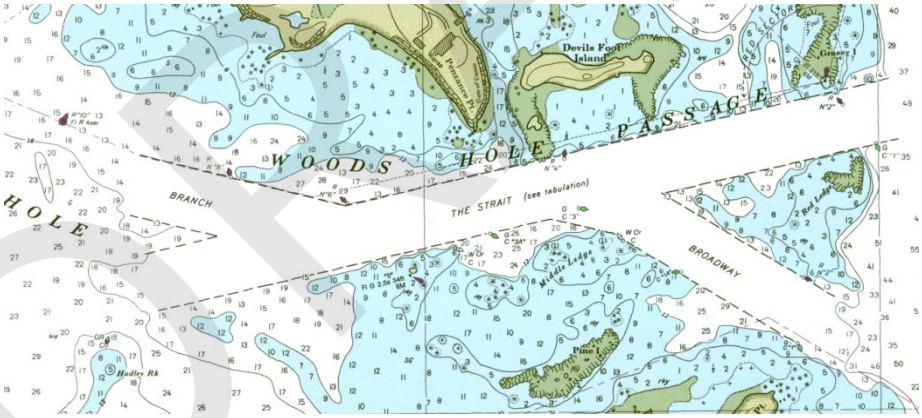


FIGURE 39. Woods Hole Channel

NANTUCKET SOUND CHANNELS

Nantucket Sound also contains several channels that serve Cape Cod's water traffic. The Cross Rip Shoals mark the point, about 14 miles south of Hyannis Harbor, where several of these channels meet. From this point, vessels can travel to Buzzards Bay, Martha's Vineyard, Nantucket, Cape Cod, and the Atlantic Ocean. The channel at the Cross Rip Shoals was created by the Army Corps of Engineers and is 30 feet deep, 4,000 feet wide, and 1.7 miles long (see following table). The Pollack Rip Shoals are located about three miles to the east of Monomoy Island. The Army Corps of

Engineers constructed a channel extending six miles through the Pollack Rip Shoals in 1925. The Pollack Rip Channel is 30 feet deep and 2,000 feet wide. It serves as the entrance to Nantucket Sound from the Atlantic Ocean. Taken together, the Wood Hole Channel, Cross Rip Channel, the Pollack Rip Channel, and the Main Channel create a thoroughfare for water traffic within Nantucket Sound (see following figure).

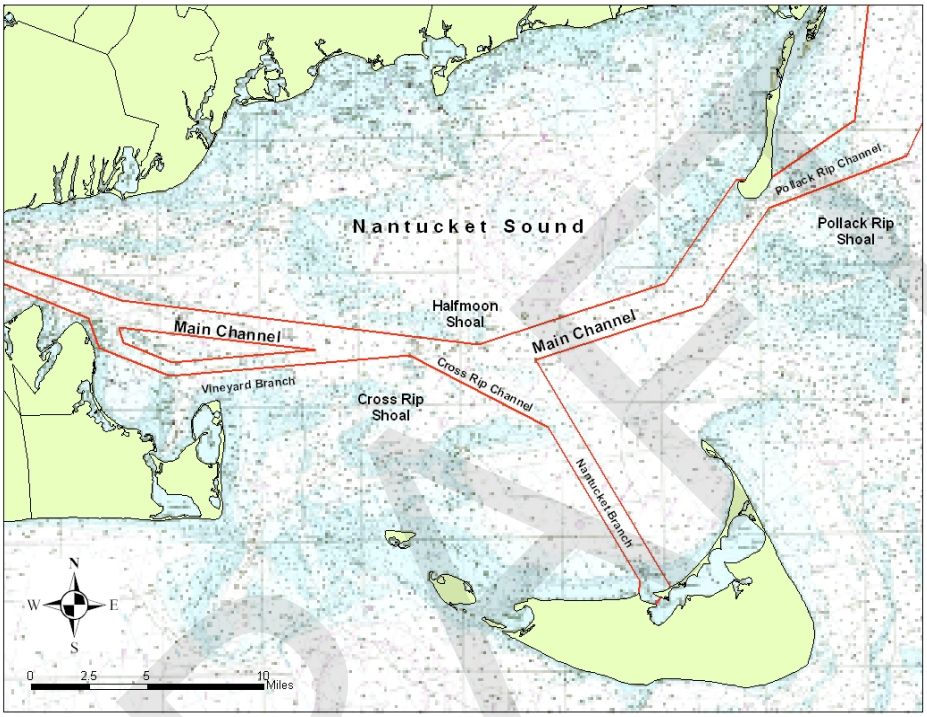


FIGURE 40. Nantucket Sound Channels

Water Transportation Infrastructure

A lighthouse is a structure, such as a tower, that gives a continuous or intermittent light signal to navigators. Cape Cod is famous for its many lighthouses and their unique towers. However, in addition to being aesthetically pleasing, these lights serve a vital purpose. Along with other navigational lights and aids, they form the infrastructure that keeps water traffic on course and out of danger. There are ten active lighthouses on Cape Cod, as listed in the table below. Most of the active lighthouses are in the Outer Cape region. Additionally, there are six inactive lighthouse structures still in their original locations. Navigational lights and fog signals (bells, whistles, gongs, and horns) are generally located along the perimeter of channels and at dangerous areas. Due to its shoals and other hazards, the majority of Cape Cod's navigational aids are located in Nantucket Sound. Cape Cod has 43 fog signals and 72 navigational lights in total.

FIGURE 41. Navigational Aids

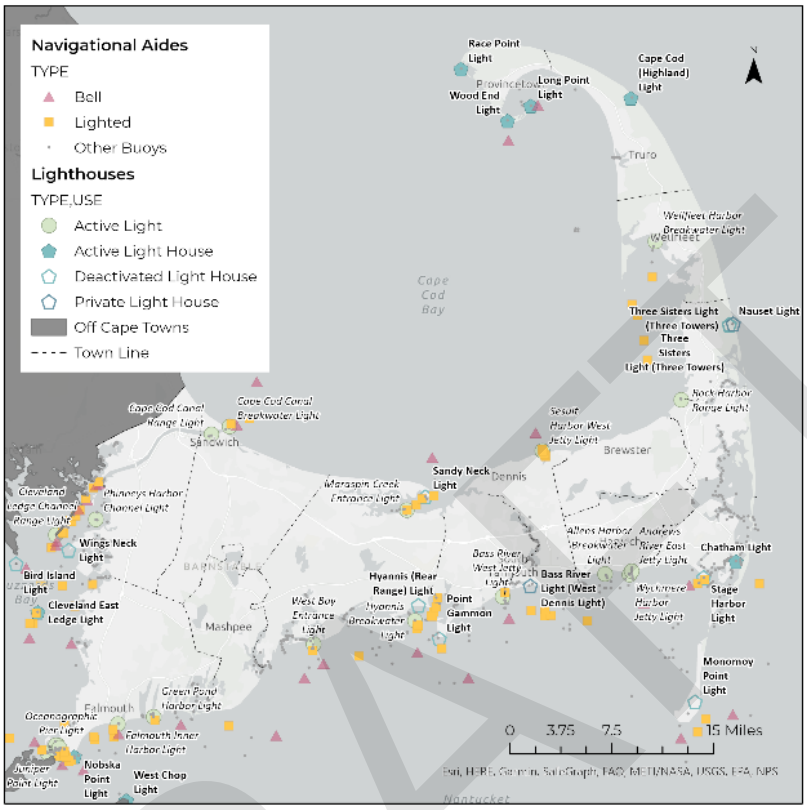


TABLE 12. Active Lighthouses

LIGHTHOUSE NAME	TOWN
Nobska Light	Falmouth
Cleveland Ledge Light	In Buzzards Bay
Lewis Bay Light	Barnstable
West Dennis Light	Dennis
Chatham Lighthouse	Chatham
Nauset Light	Eastham
Highland Light	Truro
Race Point Light	Provincetown
Wood End Light	Provincetown

TABLE 13. Navigational Lights and Fog Signals

	NAVIGATIONAL LIGHTS	FOG SIGNALS
Atlantic Ocean	1	4
Buzzards Bay	13	13
Cape Cod Bay	12	11
Nantucket Sound	46	15
Total	72	43

Harbors

Charts of various ports shown in the following figures were produced by the National Oceanic and Atmospheric Administration's *Coast and Geodetic Survey*.

WOODS HOLE HARBOR

Woods Hole Harbor is located in Falmouth. It is split into two harbors by Juniper Point: Great Harbor and Little Harbor (see following figures). Little Harbor is located in the 550,000 square feet of water between Juniper and Nobska Points. Located on the western side of Little Harbor is a Coast Guard station, which is also used for recreational purposes. Great Harbor is located between Penzance Point and Juniper Point. A bascule drawbridge separates Great Harbor from Eel Pond to the north. Woods Hole Channel, which leads west to Buzzards Bay, connects at the southern end of Great Harbor. Of the more significant ones are the 15-foot deep anchorage for the Steamship Authority ferries and the 22-foot deep anchorage for the Woods Hole Oceanographic Institute. Great Harbor is home to ferry passenger service, charter and sport fishing services, research vessels, and recreational boats.

FIGURE 42. Great Harbor in Falmouth

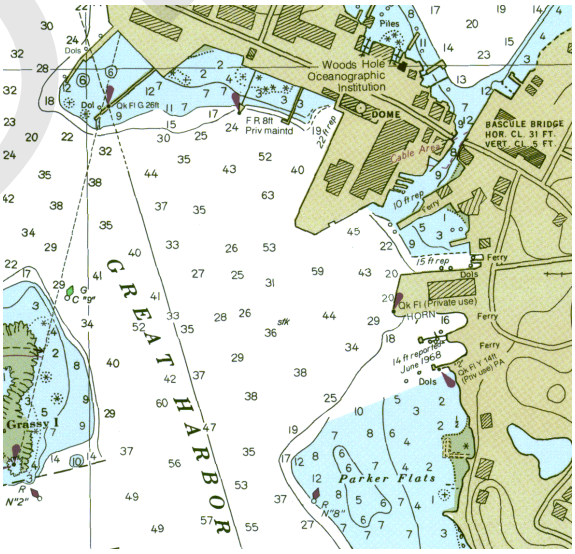
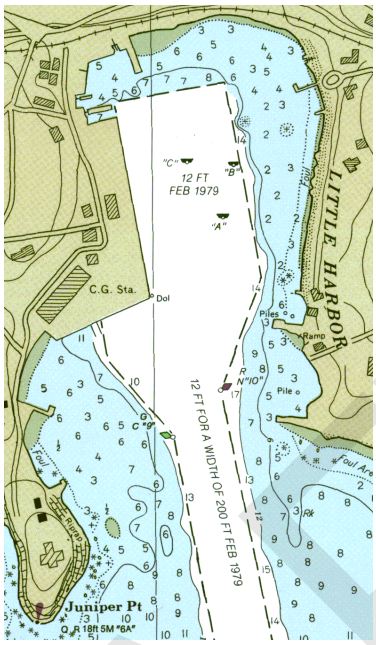


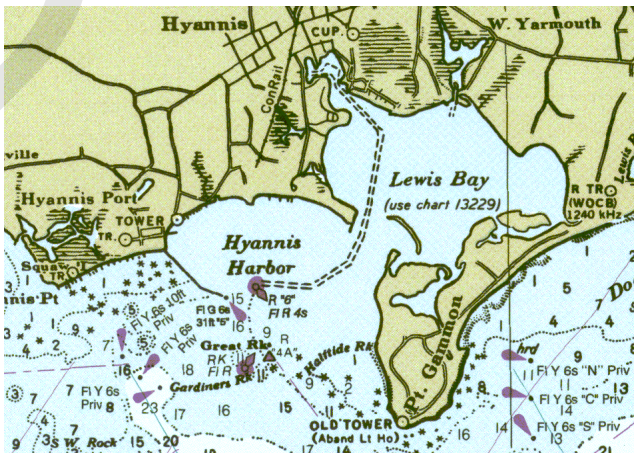
FIGURE 43. Little Harbor in Falmouth



HYANNIS HARBOR

Hyannis Harbor in Barnstable consists of an outer harbor, a middle harbor (known as Lewis Bay), and an inner harbor (see following figure). Dunbar Point, a 1,000-foot stone jetty, and the Kalmus Park Beach separate the Outer Harbor and Lewis Bay. Major boat terminals and piers are located within the Inner Harbor. The Army Corps of Engineers began construction projects in the harbor in 1882. Currently, Hyannis Harbor includes a 12-foot-deep anchorage at the eastern end of the Inner Harbor. In Lewis Bay, there is a 15.5-foot-deep anchorage of about 55 acres behind a 1,170-foot-long breakwater at Dunbar Point. A 6,000-foot-long channel, 12 feet deep and 100 feet wide, extends from the Inner Harbor into the deep water in Lewis Bay. From there, a 7,200-foot-long channel extends to the Outer Harbor. Hyannis Harbor is used as a terminal for ferry service, freight service, charter, and sport fishing services, as well as for recreational purposes.

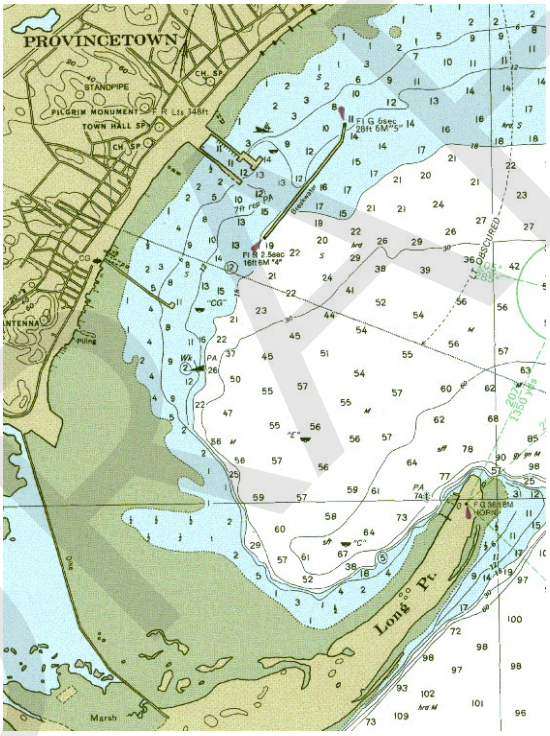
FIGURE 44. Hyannis Harbor



PROVINCETOWN HARBOR

Provincetown Harbor was initially constructed during the nineteenth century. In 1914, the Army Corps of Engineers completed improvements to the harbor, including a 6,150-foot dike from Stevens Point across the House Point Island Flats to the sandy spit at Wood End. A stone breakwater, built in 1972, runs parallel to the shore about 835 feet from the end of MacMillan Wharf. The breakwater is 15.5 feet high and 2,500 feet long. Currently, the harbor is used as a terminal for ferries, whale watching tours, and as a base of operations for fishing boats (see following figure). Local and state officials have discussed and rejected the expansion of the harbor to include a freight pier. According to a MassDOT report ("Identification of Massachusetts Freight Issues and Priorities," 1999), the narrow streets in Provincetown's historic district and the traffic congestion during peak hours make such a proposal unfeasible.

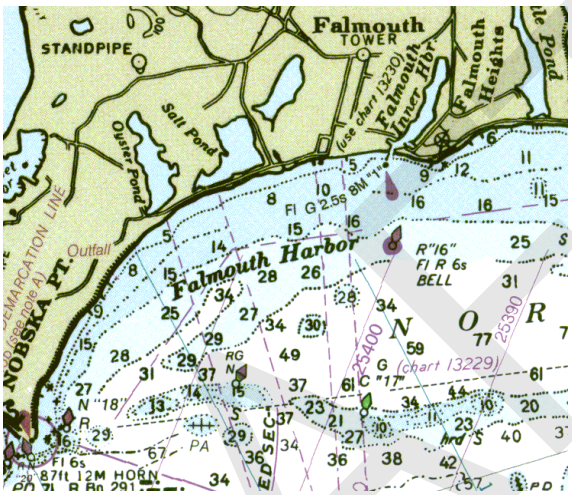
FIGURE 45. Provincetown Harbor



FALMOUTH HARBOR

Falmouth Harbor is located three miles east of Woods Hole, on the waterway between Falmouth Heights Road and Scranton Avenue. The Army Corps of Engineers began construction work in the harbor in 1957. Falmouth Harbor is 17 acres in area and 10 feet deep, with a 100-foot-wide entrance channel. It is currently used as a terminal for ferries and charter tours, as well as for fishing and recreation.

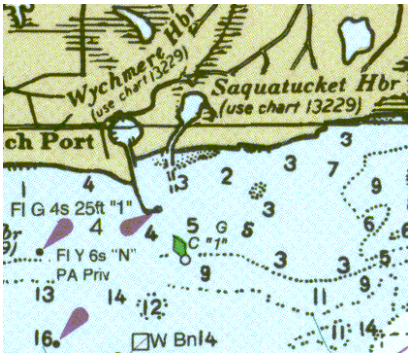
FIGURE 46. Falmouth Harbor



SAQUATUCKET HARBOR (HARWICHPORT)

Saquatucket Harbor in Harwich serves the Lower Cape (see following figure). The harbor has a 12-foot deep, 200-foot-long channel leading to a 12-foot-deep anchorage. The Coast Guard maintains a station at this facility. Accessible from Route 28 in Harwich Port, the harbor is a terminal for ferry service, tour boats, commercial fishing and recreational use. A private passenger ferry operates from this harbor to provide seasonal service to Nantucket.

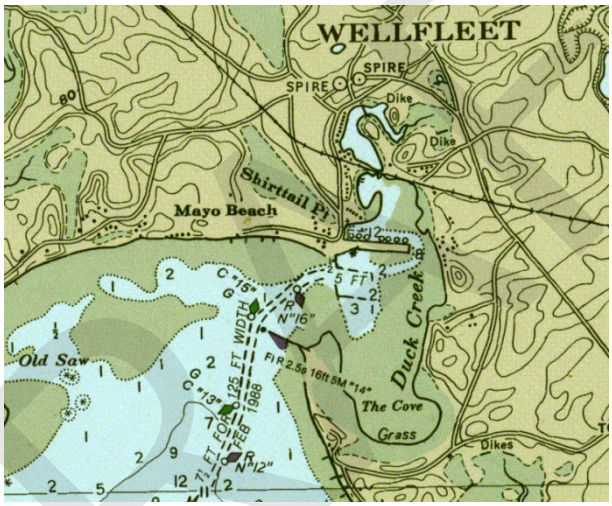
FIGURE 47. Saquatucket Harbor



WELLFLEET HARBOR

Wellfleet Harbor is located at the mouth of Duck Creek, just south of Wellfleet Center (see figure below). Work on the harbor dates to 1899 when a 4-foot-deep channel was constructed between deep water and the town wharves at Duck Creek. The state dredged the channel in 1916 and deepened it by two feet. The Army Corps of Engineers later improved the harbor by creating a 10-foot deep, 125 foot-wide, 0.8-mile-long channel from the middle of Wellfleet Harbor to the town landing, as well as a 10-foot deep, 500-foot long, 800-foot-wide anchorage area. Currently, Wellfleet Harbor serves recreational boating, boat tours, commercial fishing, and sport fishing charter boats.

FIGURE 48. Wellfleet Harbor



STAGE HARBOR (CHATHAM)

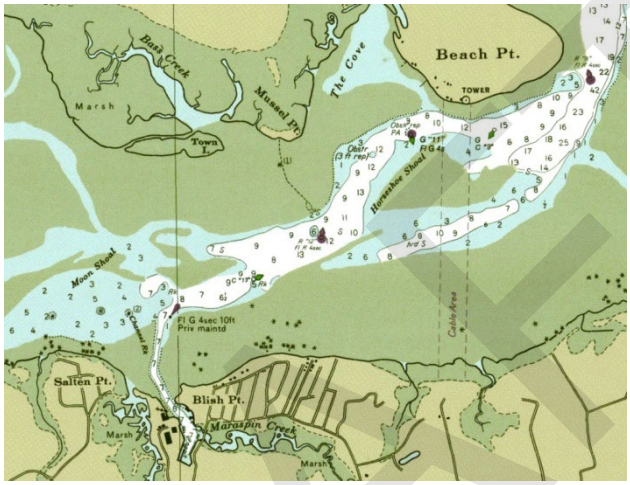
Stage Harbor, located in Chatham, is one of the major seaports in the Lower Cape (see following figure). The harbor is divided into two parts: the Upper Harbor and Stage Harbor. The Upper Harbor extends from Bridge Street to Morris Island, and Stage Harbor extends from Morris Island to the Harding Beach bars. Original work in Chatham Harbor, including the construction of a channel through the Harding Beach bars, was completed in 1901. In the late-1950s, the Army Corps of Engineers constructed a new 2.1-mile channel from Chatham Roads through Harding Beach and into the Upper Harbor. Other harbor features include a 500-foot-long stone jetty at the southwestern corner of the channel, a 2,500-foot long sand dike from Harbor Beach to Morris Island, and an adjacent 1,500-foot-long timber jetty that has been partially removed. Additionally, a boathouse facility and dock in the Upper Harbor are maintained by the Chatham Coast Guard Station. Stage Harbor is used as a base for boat tours, recreational boats and a small local fishing fleet.

FIGURE 49. Stage Harbor

BARNSTABLE HARBOR

Barnstable Harbor lies between Sandy Neck and the mainland of Cape Cod (see figure below). The marina and landing in Barnstable Village serves as the primary seaport for Barnstable Harbor. A small channel, 7 feet deep, provides access to the marina from the entrance of the Harbor at Beach Point. Barnstable Harbor is the terminal for recreational and whale watching tours, as well as fishing vessels.

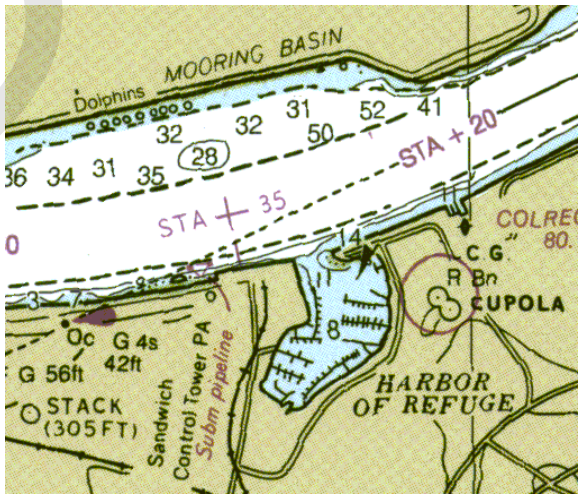
FIGURE 50. Barnstable Harbor



SANDWICH MARINA

Sandwich Marina is located on the eastern end of Cape Cod Canal in Sandwich. The marina has an anchorage of 8 feet, serving as a home to many fishing and recreational vessels. The marina primarily serves recreational and fishing vessels. With its proximity to road, rail tracks, and canal access, Sandwich Marina has the potential to be a ferry terminal for service from Boston and Plymouth (see following figure).

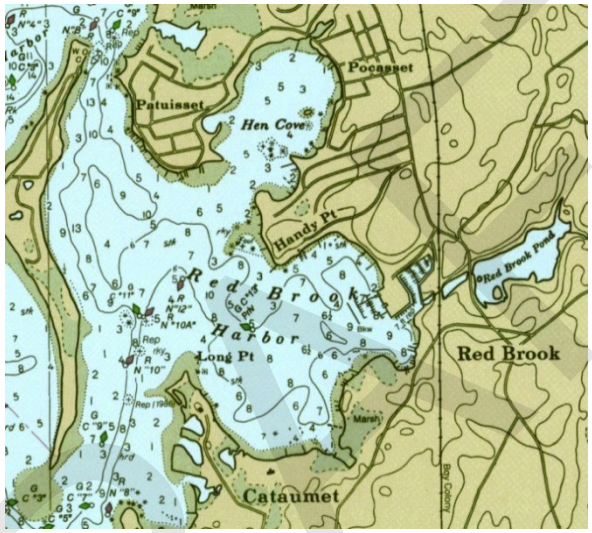
FIGURE 51. Sandwich Marina



RED BROOK HARBOR

Red Brook Harbor in Bourne is one of Cape Cod's seaports on Buzzards Bay. The harbor is located behind Bassetts Island between Handy and Long Points (see figure below). The boat docks are separated into two sections. The first, exposed to the harbor, provides an anchorage of 8 feet. The second is 7.5 feet deep and is connected to the harbor by a short channel. Red Brook Harbor serves as a base for fishing and recreational boats.

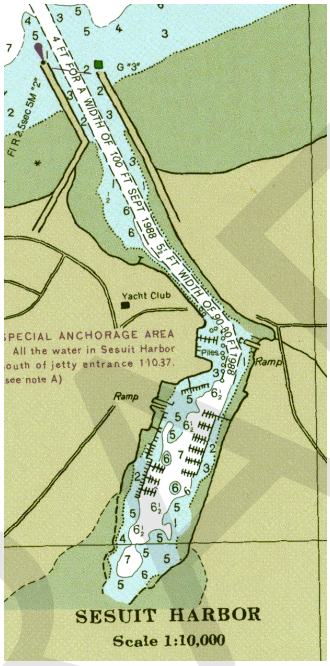
FIGURE 52. Red Brook Harbor in Bourne



SESUIT HARBOR

Sesuit Harbor is located in the Town of Dennis. It is accessible by Sesuit Neck Road and Harbor Road on the west, and Cold Storage Road and Salt Works Road on the east. The channel entering the harbor is 100 feet wide, narrowing to 80-90 feet, and approaching an anchorage of 6-7 feet (see following figure). With a yacht club located on the western side of the harbor, and a boat ramp on the eastern side, Sesuit Harbor is used for fishing and recreational use.

FIGURE 53. Sesuit Harbor in Dennis



The nine ferry routes provide connection from Falmouth (Falmouth Harbor and Woods Hole), Hyannis (Hyannis Harbor), Provincetown (Fisherman's Wharf), and Harwich Port (Saquatucket Harbor) to Martha's Vineyard, Nantucket, Boston, and Plymouth.

BICYCLE AND PEDESTRIAN INFRASTRUCTURE

There are numerous destinations and pathways for bicyclists and pedestrians to use on Cape Cod. Bicycle and pedestrian infrastructure and facilities require smaller rights-of-way and less overall investment than roadways. There are three basic types of bicycle infrastructure: shared use paths, bicycle lanes, and bicycle routes. Off-roadway paths generally have their own separated right-of-way and follow certain standards for width, grade, and accessibility. Paths can also exist adjacent but separate to roadways. Bicycle lanes are separate lanes within roadways marked for bicycle use. Bicycle routes are roadways with wide shoulders that have been designated for bicycle use.

Pedestrians utilize shared use paths and sidewalks. Facilities of this type support village centers and local businesses, and encourage travelers to walk instead of driving. According to the Rails to Trails Conservancy, bicycle and pedestrian facilities can increase property values and make areas more attractive to new residents, businesses, and tourists.

The bicycle and pedestrian infrastructure of Cape Cod along with discussion of challenges those road users face is presented in Appendix F.

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2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix C: Safety

DRAFT
2023

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Technical Appendix C: Safety

The concern over safety is made clear in the first goal of the Regional Transportation Plan:

"*Improve safety for all modes*"

Transportation users have a right to a transportation system where their person and possessions will arrive at their destinations unharmed and undamaged. Moreover, protecting the value of freight traveling over the transportation network is essential to the economy of Cape Cod. Therefore, it is important that transportation infrastructure be designed to minimize the possibility of hazardous situations or accidents. Existing traffic laws must also be enforced to prevent the improper use of the transportation system. For all of these reasons, the Regional Transportation Plan sets the goal of providing safety for people and goods.

This appendix includes sections describing the seasonal and year-round issues affecting transportation safety including a description of the Cape demographics and some information about how they will change over time. Summaries of important safety studies are presented as well.

BARNSTABLE COUNTY HIGH CRASH LOCATIONS

In 2022, the Cape Cod Commission completed an effort to rank the top intersections of critical safety concern across Cape Cod. Before the data could be gathered and sorted into any particular order or rank, it was necessary to specify the characteristics that signify an intersection as a safety concern. The Commission decided that there are several ways to interpret crash data – meaning, several possible ways to determine which intersections are of highest safety concern.

The Cape Cod Commission identified four methods of sorting data to create a top list of intersections of critical safety concern:

- **Based on Number of Crashes:** The simplest method used in this report for establishing a high crash list is ranking intersections based on the largest number of crashes. The intersection with the greatest number of crashes receives the number one ranking.
- **Based on Equivalent Property Damage Only (EPDO):** The inclusion of severity information in the MassDOT data allows for the calculation of Equivalent Property Damage Only (EPDO). A list ranked by EPDO will bring more attention to locations where the crashes have produced injuries or fatalities. The formula for calculating EPDO is as follows:

  EPDO = 21 x (# fatal crashes + injury crashes) + damage only crashes

  While the EPDO method is useful in identifying intersections with the most severe crashes, it should be noted that not all crashes and their resultant injuries can be attributed to a road's

conditions or geometry. For example, a passenger's decision of whether to wear a seatbelt may determine whether an injury will be experienced. The intersection with the highest EPDO in this list is ranked number one.

- **Based on Crash Rate:** It is expected that a road with higher traffic volumes will experience more vehicle crashes. Using a crash rate helps to avoid highlighting intersections whose problems may be magnified by a large traffic volume. With this methodology, the number of crashes is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on crash rate, the top 100 intersections based on number of crashes were analyzed with the following formula:

  R = ([C/Y] x 1,000,000)/(V x 365)
  R = Crash Rate, C = Total Crashes, Y = # Years Analyzed, V = Daily Entering Volume

  While this method is good for reducing the influence of high-volume roads, it also has the capacity to rank a very low volume road with few crashes very highly. The intersection with the highest crash rate in this list is ranked number one.
- **Based on EPDO Rate:** This method uses the same theory as the crash rate, where there is an assumption that heavily traveled roads are expected to have higher EPDO designations, and it is not necessarily indicative of poor road conditions or geometric flaws. To create this list, the intersections' EPDO is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on EPDO rate, the top 100 locations with the highest EPDO were analyzed with the following formula:

  EPDO Rate = ([EPDO/Y] x 1,000,000)/(V x 365)
  Y = # Years Analyzed, V = Daily Entering Volume

  The intersection with the highest EPDO rate in this list is ranked number one.

Base data for this analysis was provided by the Massachusetts Department of Transportation (MassDOT) in the form of geographically located crash clusters for the most recently available three years of data (2018-2020). The data provided by MassDOT included the number of reported crashes at each location and the severity of the crashes. It should be noted, however, that this dataset only includes incidents whose reports contained enough information to accurately locate them. Of the 14,405 crash reports collected by the Massachusetts Registry of Motor Vehicles, 13,753 incidents were located by MassDOT. The incidents are mapped on the following figure and listed in ranking order in the following tables.

FIGURE 1. Cape Cod Located Crashes 2018-2020

(Source: MassDOT Crash Records)

TABLE 1. Top Locations Based on Number of Crashes

Rank Crashes	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
2	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
3	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
4	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
5	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
6	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
7	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
8	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
9	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
10	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
11	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
12	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
13	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
14	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
15	Barnstable	Route 132 at Cape Cod Mall	31	149	1.050	5.048
16	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	31	151	0.839	4.088
17	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
18	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
19	Barnstable	Route 132 (Iyannough Road) at Independence Drive	26	66	0.989	2.511
20	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
21	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
22	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
23	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
24	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
25	Barnstable	Route 28 at Bell Tower Mall	23	163	0.716	5.077
26	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
27	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
28	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Enginehouse Road	23	143	1.101	6.844
29	Barnstable	Route 28 (Falmouth Road) at Main Street	22	142	1.003	6.475
30	Barnstable	Route 28 (Falmouth Road) at Route 149	22	102	0.844	3.912
31	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
32	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
33	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
34	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
35	Eastham	Route 6 at Samoset Road/Depot Road	21	81	1.107	4.271
36	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
37	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
38	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	21	101	1.108	5.329
39	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
40	Harwich	Route 124 at Route 39/Main Street	20	59	1.600	4.719
41	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
42	Barnstable	Route 28 (Iyannough Road) at Spring Street	19	99	0.912	4.750
43	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall West Entrance	19	118	0.608	3.776
44	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
45	Harwich	Route 137 at Orleans Road	19	139	0.908	6.646
46	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
47	Yarmouth	Station Avenue at White's Path/Workshop Road	19	58	0.685	2.090
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
49	Falmouth	East Falmouth Highway/Teaticket Highway at Acapesket Road	18	178	0.975	9.640
50	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260

Source: MassDOT Crash Records 2018-2020

TABLE 2. Top Locations Based on Equivalent Property Damage Only

Rank EPDO	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
2	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
3	Barnstable	Route 28 (Falmouth Road) and Bearses Way	60	339	2.070	11.694
4	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
5	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
6	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
7	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
8	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
9	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
10	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
11	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
12	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
13	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
14	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
15	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
16	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
17	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
18	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
19	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
20	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
21	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
22	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
23	Falmouth	East Falmouth Highway/Teaticket Highway at Acapesket Road	18	178	0.975	9.640
24	Barnstable	Route 28 at Bell Tower Mall	23	163	0.716	5.077
25	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
26	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
27	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260
28	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
29	Barnstable	Bearses Way at South Street	15	155	1.696	17.530
30	Mashpee	Route 151 at Market Street	14	154	0.727	7.995
31	Barnstable	Old Stage Road/Old Falmouth Road at Race Lane/Oak Street	11	151	1.114	15.293
32	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	31	151	0.839	4.088
33	Barnstable	Route 132 at Cape Cod Mall	31	149	1.050	5.048
34	Falmouth	Gifford Street at Dillingham Avenue	8	148	0.597	11.040
35	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
36	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
37	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Enginehouse Road	23	143	1.101	6.844
38	Barnstable	Route 28 (Falmouth Road) at Main Street	22	142	1.003	6.475
39	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
40	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
41	Harwich	Route 137 at Orleans Road	19	139	0.908	6.646
42	Barnstable	Route 28 (Falmouth Road) at Main Street/South County Road	15	135	0.739	6.654
43	Barnstable	Phinney's Lane at Old Strawberry Hill Road	16	135	1.648	13.906
44	Barnstable	Route 28 (Falmouth Road) at Santuit Newtown Road	14	134	0.660	6.317
45	Falmouth	Route 28 (Teaticket Highway) at Village Common Drive	10	130	0.626	8.132
46	Barnstable	Route 28 (Falmouth Road) at East Osterville Road	9	129	0.457	6.545
47	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
48	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
49	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall West Entrance	19	118	0.608	3.776
50	Barnstable	Route 132 at Shootflying Hill Road	17	117	0.614	4.222

Source: MassDOT Crash Records 2018-2020

TABLE 3. Top Locations based on Crash Rate

Rank Crash Rate	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
2	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
3	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
4	Barnstable	South Street at Pleasant Street	13	93	2.395	17.131
5	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
6	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
7	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
8	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
9	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
10	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
11	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
12	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
13	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
14	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
15	Barnstable	Stevens Street at Bassett Lane	16	96	1.818	10.910
16	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
17	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
18	Barnstable	High School Road at South Street	15	155	1.696	17.530
19	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
20	Yarmouth	Forest Road at Old Town House Road	15	95	1.674	10.601
21	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
22	Barnstable	Phinney's Lane at Old Strawberry Hill Road	16	135	1.648	13.906
23	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
24	Harwich	Route 124 at Route 39/Main Street	20	59	1.600	4.719
25	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
26	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
27	Dennis	Route 28 (Main Street at Sea Street	15	115	1.537	11.781
28	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
29	Barnstable	Barnstable Road at Center Street/Charles Street	14	54	1.526	5.886
30	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
31	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
32	Barnstable	High School Road at Main Street	14	74	1.431	7.566
33	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
34	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
35	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
36	Falmouth	Route 151 (Nathan Ellis Highway) at Route 28A (North Falmouth Highway	16	76	1.282	6.087
37	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
38	Barnstable	North Street at Stevens Street	14	113	1.255	10.129
39	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
40	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
41	Yarmouth	Route 28 (Main Street) at Old Main Street	16	14	1.234	1.080
42	Falmouth	Route 28 (Main Street) at Spring Bars Road/Dillingham Ave	15	55	1.222	4.480
43	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
44	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
45	Mashpee	Great Neck Road N at Old Barnstable Road	17	117	1.172	8.064
46	Bourne	Meetinghouse Lane at State Road/Canal Street	17	55	1.167	3.775
47	Yarmouth	Station Ave at Wood Road	15	115	1.165	8.930
48	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
49	Barnstable	Old Stage Road/Old Falmouth Road at Race Lane/Oak Street	11	151	1.114	15.293
50	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	21	101	1.108	5.329

Source: MassDOT Crash Records 2018-2020

TABLE 4. Top Locations based on EPDO Rate

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15	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
16	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
17	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
18	Dennis	Route 28 (Main Street at Sea Street	15	115	1.537	11.781
19	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
20	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
21	Falmouth	Gifford Street at Dillingham Avenue	8	148	0.597	11.040
22	Barnstable	Stevens Street at Bassett Lane	16	96	1.818	10.910
23	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
24	Yarmouth	Forest Road at Old Town House Road	15	95	1.674	10.601
25	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
26	Barnstable	North Street at Stevens Street	14	113	1.255	10.129
27	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
28	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
29	Bourne	Barlows Landing Road at County Road	8	108	0.732	9.889
30	Barnstable	Yarmouth Road atOld Yarmouth Road/Maher Road	11	111	0.963	9.717
31	Falmouth	Route 28 (East Falmouth Highway) at Old Barnstable Road/Acapesket Roa	18	178	0.975	9.640
32	Yarmouth	Station Ave at Wood Road	15	115	1.165	8.930
33	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
34	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
35	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
36	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
37	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
38	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
39	Harwich	Route 124 (Pleasant Lake Ave) at Queen Anne Road	11	111	0.834	8.415
40	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
41	Falmouth	Route 28 (Teaticket Highway) at Village Common Drive	10	130	0.626	8.132
42	Mashpee	Great Neck Road N at Old Barnstable Road	17	117	1.172	8.064
43	Mashpee	Route 151 at Market Street	14	154	0.727	7.995
44	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
45	Barnstable	High School Road at Main Street	14	74	1.431	7.566
46	Falmouth	Route 28 (Main Street) at Falmouth Schools Admin. Driveway	9	109	0.613	7.429
47	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
49	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
50	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260

Source: MassDOT Crash Records 2018-2020

CAPE COD DRIVERS

The demographics of Cape Cod depict a typical year-round resident that is older than the average population in the United States. Over 32% of Cape Cod's population as reported in the U.S Census Bureau (2020 estimates) was aged 65 or older (as compared to 17% for the national average). This trend is continuing. The migration of retirees to Cape Cod and a stable aging population is not being offset by new younger residents or births. With the trend toward an older population in America, the Federal Highway Administration (FHWA) has recognized that older drivers require special consideration. This recognition is demonstrated in the publication of several recent documents and a special address to Congress by the National Highway Traffic and Safety Administration (NHTSA). The focus in both cases was on the behavior of older drivers with respect to the "typical" driver. The NHTSA address also included issues related to younger drivers. Recommended guidelines for design standards that will help accommodate the needs of an older driver are also included in the literature.

Another dimension defining the unique character of Cape Cod drivers is their seasonal nature. The Cape is inundated with visitors, many of whom are not familiar with Cape Cod roads. Drivers that are used to city streets or parkways are also subjected to the scenic rural roads that compose a significant part of the Cape's character. The physical nature of these roadways may be somewhat unfamiliar to off-Cape drivers, leading to safety concerns.

Among the many drivers that visit to the Cape in the summer are a large number of younger motorists. These drivers have less experience in familiar surroundings and even less in the Cape driving environment. This coupled with a "vacation attitude" requires more considerations for roadway design and planning. These considerations must also be balanced with the natural qualities that bring people to Cape Cod.

The Senior Driver

A large and increasing percentage of Cape drivers are 65 and older. According to the Census Bureau 2020 estimates, 32% or 74,386 residents of Barnstable County are aged 65 or older. This steadily increasing proportion of drivers will experience declining vision, slowed decision making and reaction times, additional difficulty in dividing attention between potential conflicts and traffic information, and reductions in strength, flexibility, and overall fitness. In many cases, these difficulties will outweigh the additional experience that older drivers have operating an automobile. The large majority of drivers who suffer from age-related driving deficiencies are not aware that a problem exists.

The overwhelming majority of Cape intersections are at grade. Based on FHWA crash statistics for drivers, 80 years and older, more than 50% of fatal crashes occur at intersections. This is compared with 24% or less for drivers up to age 50. According to studies referenced in the FHWA *Older Driver Highway Design Handbook* (1998), as driver age increases, involvement in intersection crashes

increase as well. Older drivers typically experience two types of at-grade intersection difficulties. Left turn difficulties result from lack of sufficient caution and poor positioning on the road during the turn. Stopping difficulties result from a failure to stop, a failure to make complete stops at stop signs, and stops that were abrupt. Comparing survey responses of drivers aged 66 to 68 with those aged 77 and older, showed that the older group had more difficulty following pavement markings, finding the beginning of left hand turn lanes, and driving across intersections. Another study of older drivers indicated that the most challenging aspect of intersection negotiation is making left turns during the green, left turn permitted signal phase. The protected "green arrow" left hand turn has been identified as an important improvement for older drivers.

Nighttime driving is associated with a higher crash risk for all drivers; however the effect of aging on vision is particularly compounded by the effect of darkness. The aging process causes gradual declines in a variety of ways; acuity, contrast sensitivity, glare-recovery, and peripheral vision. These declining functions make night driving particularly difficult for older drivers. The ability to notice and recognize objects at night and in low-light conditions such as dawn, dusk, rain, fog, haze, and snow is a chief concern. According to studies referenced in the FHWA handbook show that between age 20 and age 70, contrast sensitivity is reduced by a factor of three. This places the typical older driver at a relative disadvantage in low-light conditions. As expected, older drivers require significantly larger letters to read unfamiliar signs. Current sign standards are based on an assumed vision of 20/25 (as opposed to "perfect" 20/20 vision). Older drivers require a standard of 20/46.

Older Driver Recommendations

Based on the issues associated with the older driving population on Cape Cod the following suggestions are recommended as considerations for Cape Cod roadway improvements. Many of these recommendations are from FHWA's *Older Driver Highway Design Handbook* (1998). This resource should be consulted for more details. The Older Driver Handbook includes other recommendations and guidelines that should be considered in Cape roadway design but their use should also be tempered to maintain the character of Cape Cod's roadways.

Recommendations to accommodate older drivers include:

- Considering protected left turn phases into signalized intersections;
- Maintaining delineation through more frequent restriping and street cleaning;
- Improving signage standards to include larger lettering;
- Improving lighting level standards, in particular at intersections. Consider placing utilities underground and installing breakaway safety poles for lighting;
- Considering "all red" phases for signalized intersections;
- Establishing driver education programs for older drivers; and
- Providing education on other options for mobility.

Mobility programs to provide alternatives to driving also need to be improved. This was a major discussion topic at the outreach focus group meeting we held in the Outer Cape as part of the 2024 RTP development. Improved or new programs to connect seniors with routine and reliable transportation service to major destinations is needed.

Young Drivers

Safety and age-related crash statistics indicate that younger drivers' (under age 25) problems exceed those of any other age group. The shorter average trip length of older drivers is accompanied by a higher frequency of fatal crashes. Young drivers outnumber, out-travel, out-crash, and die more frequently by any other measure. There are slight differences between younger and older drivers in the types of crashes they experience. For example, young drivers have more speeding and alcohol-related crashes. Using hand held devices while driving is another distraction for younger drivers .Younger drivers' crashes are frequently caused by inexperience, poor judgment, and risk taking, while older drivers' crashes are more often related to reduced physical and cognitive capabilities.

Although most crashes occur at intersections, young drivers show a greater tendency than other age groups to be involved in non-intersection crashes. According to NHTSA statistics, 43% of crashes by drivers age 15 to 24 are at non-intersection locations. That number reduces to 41% for drivers age 25 to 64 and 31% for drivers age 65 to 74.

Younger drivers are more prone to risk-taking behavior and are subject to influences of youth culture and peer pressure. Many of these characteristics are evident in young visitors to Cape Cod.

Younger Driver Recommendations

Recommendations to accommodate younger driver safety issues are divided between residents and visitors:

- Increased education for local young drivers.
- Additional enforcement and warnings during the busy traffic season to reach out to young visitor drivers.
- Develop and implement an advertising campaign and roadside signage reminding drivers that traffic, hands free and drunk-driving laws are strictly enforced on Cape Cod.

Additional Recommendations

Additional recommendations include:

- Better signage for visitors directing them to popular destinations (e.g., larger, well-located signs to direct patrons of the Hyannis Transportation Center may improve safety at the driveway on Route 28).
- Signage explaining the rotary "rules of the road" and similar information to be included in visitor brochures and Cape-related websites

THE CAPE COD ROADWAY

There are nearly 3,900 miles of roadways in Barnstable County. These include 574 miles of Arterials and 213 miles of Collectors. The remaining 3,076 miles included local roads and the many miles of unimproved ways. The typical posted speed limit on the Cape is less than 40 miles per hour (mph) and, on average, the roadways carry 175% more traffic in July and August than they do in January and February.

The character of Cape Cod's rural roads includes narrow lanes and a typical speed limit of 35 mph. Most roads do not have shoulders and bicycles must often share the lanes with motorists. Many of the older roads evolved from Native American trails and stagecoach routes. Roadway geometry is therefore less accommodating than current state and federal standards. Included in the goals of this Plan is the preservation of the scenic and rural character of Cape Cod's narrow, winding roads. However, this must be accompanied by a program of enforcement and education especially for the drivers that visit the Cape in the summer.

Safety Improvements through Intersection Modification

To help quantify the benefits of various safety treatments, several resources were consulted including *The Traffic Safety Toolbox: A Primer on Traffic Safety*, Chapter 28, Institute of Transportation Engineers, 2000; and *Prediction of the Expected Safety Performance of Rural Two-Lane Highways*, Chapter 5, Federal Highway Administration, 2000. These reports include discussions on various vehicular access treatments and predictions of "Accident Reduction."

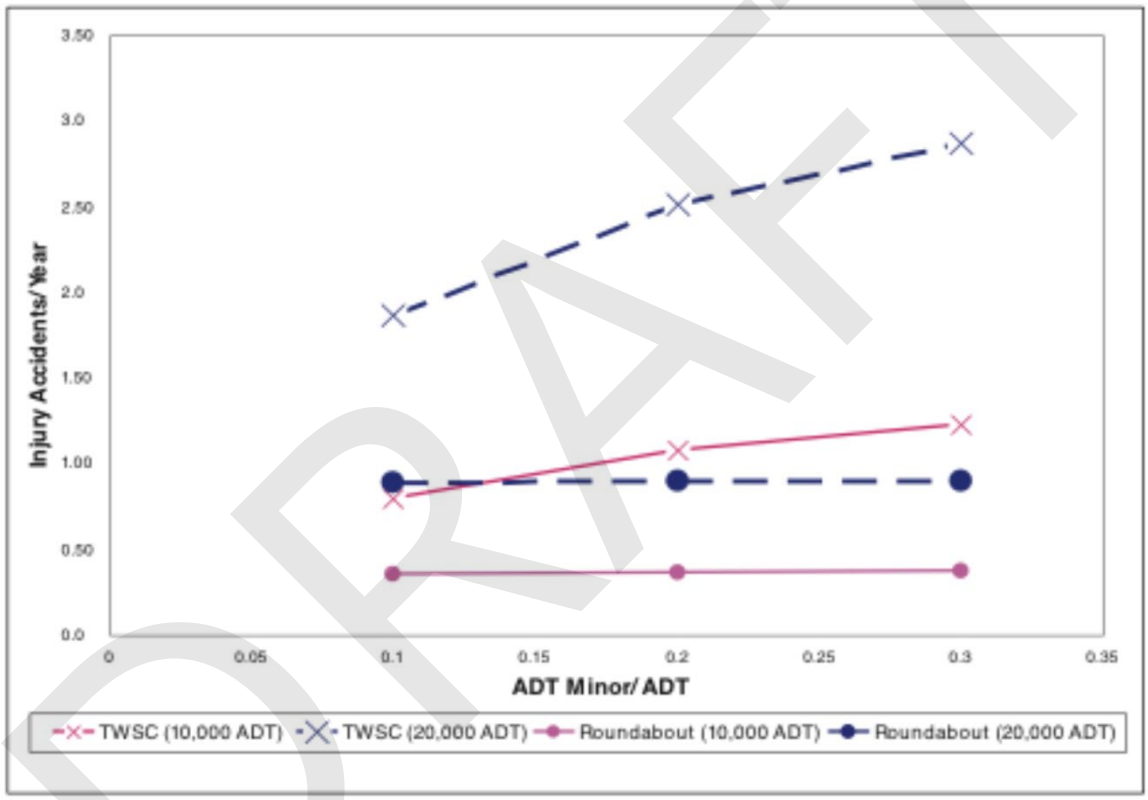
MODERN ROUNDABOUTS V. FOUR-WAY INTERSECTIONS

A roundabout is a type of circular intersection with specific design and traffic control features. These features include yield control of all entering traffic, channelized approaches, and appropriate geometric curvature to ensure that travel speeds on the circulatory roadway are typically less than 20 mph. The decision to install a roundabout as a safety improvement should be based on a demonstrated safety problem of a type susceptible to correction by a roundabout. The National Cooperative Highway Research Program (NCHRP) Research Report 1043: *Guide for Roundabouts*, (2023) provides a review of the safety improvements afforded by roundabouts. For example, safety problems that could be improved by a roundabout include:

- High rates of crashes such as right angle, head-on, left/through, U-turns, etc.
- High crash severity that could be reduced by slower speeds
- Site visibility problems that reduce the effectiveness of stop sign control
- Inadequate separation of movements, especially on single-lane approaches

The following figure shows that roundabouts have fewer annual injury crashes than rural two-way stop-controlled (TWSC) intersections, and the total number of crashes at roundabouts is relatively insensitive to minor street demand volumes.

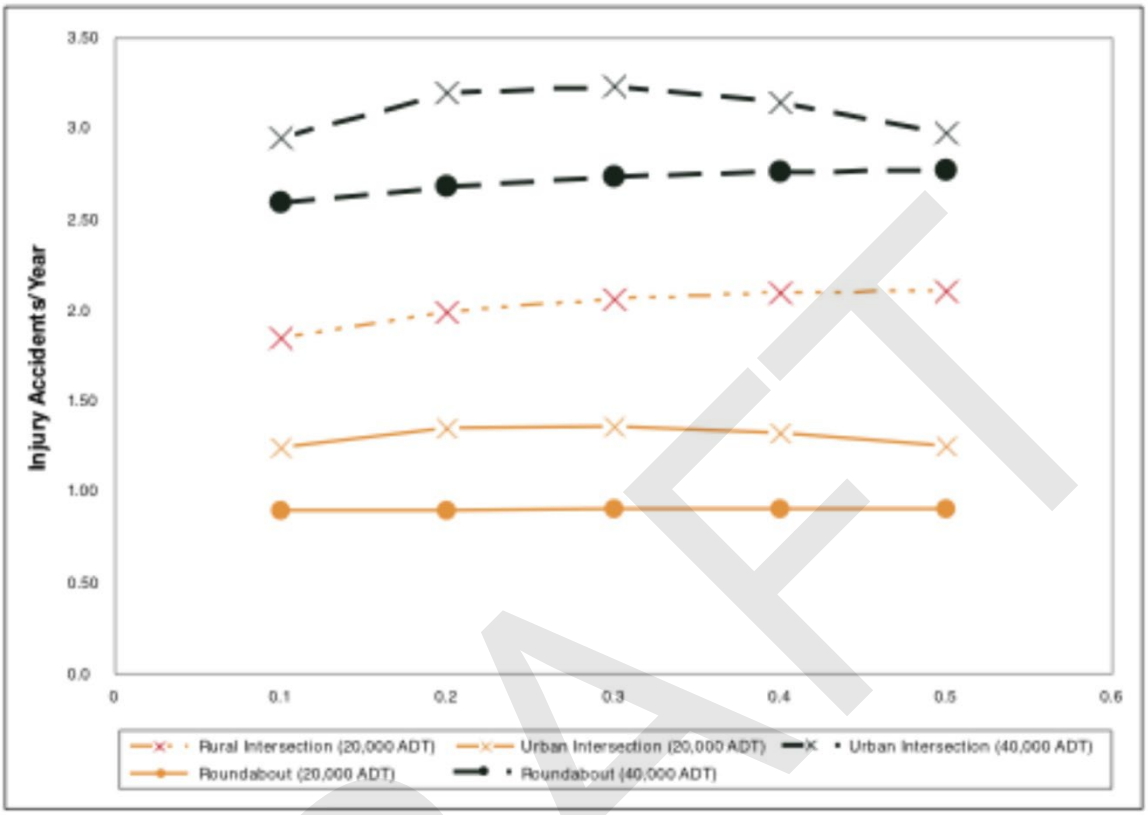
FIGURE 2. Comparison of Predicted Roundabout Injury Crashes with Rural 2-Way Stop - Controlled Intersections



(Source: FHWA)

The Roundabout guide also includes information to compare roundabouts to signalized intersections. The following figure shows that roundabouts have fewer injury accidents per year than signalized intersections, particularly in rural areas. At volumes greater than 50,000 vehicles per day (shown on the figure as "ADT" – average daily traffic), urban roundabout safety may be comparable to that of urban signalized intersections.

FIGURE 3. Comparison of Predicted Injury Crashes for Single-Lane and Double-Lane Roundabouts with Rural or Urban Signalized Intersections



(Source: FHWA)

Safety-Related Technology

Improved technology provides new options for the enforcement of traffic laws and speed control. The Insurance Institute for Highway Safety (IIHS) and the FHWA have favorable reviews of applications such as red-light enforcement and photo radar. These techniques should be coupled with education as well, since a goal is to improve safety by deterring unsafe driving. The greatest benefit of these techniques has been a "halo effect" whereby drivers are complying with traffic laws in un-monitored locations as well as those where the technology has been installed.

RED LIGHT ENFORCEMENT

According to IIHS, nationwide, drivers who run red lights are responsible for 260,000 crashes each year. Of these, approximately 750 are fatal. Motorists are more likely to be injured in crashes involving red light running than in other types of crashes: occupant injuries occurred in 45% of red light running crashes compared with 30% for other crash types. Enforcing red light laws by traditional means poses special difficulties for police, who in most cases must follow a violating vehicle through a red light to stop it. This poses a danger to motorists, pedestrians, as well as the officers. Red light running violations typically decrease by as much as 60% at intersections where cameras automatically enforce the law.

In areas where red light cameras have been installed as well as areas without cameras, most drivers have supported the use of red light cameras, 80% in cities with cameras and 76% in cities without.

EMERGENCY PRE-EMPTION SYSTEM

Many of the Cape's signalized intersections are equipped with an emergency traffic signal priority-based pre-emption system. The system includes infrared detection equipment installed adjacent to the signal heads. When an emergency vehicle (ambulance, fire engine, etc.) equipped with an infrared emitter approaches the intersection, the detector notifies the signal controller and a green phase is maintained for the emergency vehicle (other approaches are held under a red phase). Signal pre-emption is vital for emergency responders to safely and quickly travel to incident sites. Agencies responsible for intersection signal maintenance should also ensure continuous operation of the pre-emption system. Upgrades to existing signals and new signal installations should be equipped with an emergency pre-emption system.

Coordination with Massachusetts' Strategic Highway Safety Plan

Building on the success of the 2006 "Strategic Highway Safety Plan" (SHSP), MassDOT's most recent update was completed in 2022. The updated Massachusetts SHSP[1] identifies key safety needs and helps direct funding to improvements that reduce highway fatalities and serious injuries on all public roads. MassDOT developed the Massachusetts SHSP in a cooperative process with Federal, State, local, private, and public sector safety stakeholders. The SHSP is a data-driven, strategic plan that integrates the four E's: engineering, education, enforcement and emergency medical services (EMS) using the Safe System Approach.

The ultimate goal of the Massachusetts SHSP is to achieve zero roadway fatalities and serious injuries. The Massachusetts SHSP update is organized to focus on Vision Zero and the Safe System Approach.

SAFE SYSTEMS APPROACH

The Safe System Approach[2] has been embraced by the transportation community as an effective way to address and mitigate the risks inherent in our enormous and complex transportation system. It works by building and reinforcing multiple layers of protection to both prevent crashes from happening in the first place and minimize the harm caused to those involved when crashes do occur. It is a holistic and comprehensive approach that provides a guiding framework to make places safer for people.

[1] https://www.mass.gov/doc/massachusetts-shsp-2023/download

[2] https://www.transportation.gov/NRSS/SafeSystem

This is a shift from a conventional safety approach because it focuses on both human mistakes and human vulnerability and designs a system with many redundancies in place to protect everyone.

U.S. DOT's National Roadway Safety Strategy and the Department's ongoing safety programs are working towards a future with zero roadway fatalities and serious injuries. In support of this approach, safety programs are focused on infrastructure, human behavior, responsible oversight of the vehicle and transportation industry, and emergency response.

PRINCIPLES OF THE SAFE SYSTEMS APPROACH

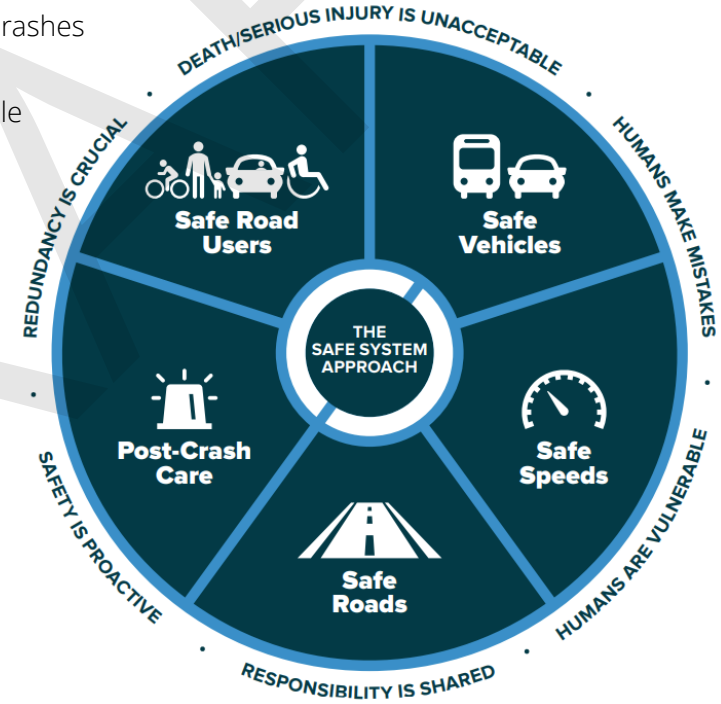
A Safe System Approach incorporates the following principles:

- Death and Serious Injuries are Unacceptable
    - A Safe System Approach prioritizes the elimination of crashes that result in death and serious injuries.
- Humans Make Mistakes
    - People will inevitably make mistakes and decisions that can lead or contribute to crashes, but the transportation system can be designed and operated to accommodate certain types and levels of human mistakes, and avoid death and serious injuries when a crash occurs.
- Humans are Vulnerable
    - Human bodies have physical limits for tolerating crash forces before death or serious injury occurs; therefore, it is critical to design and operate a transportation system that is human-centric and accommodates physical human vulnerabilities.
- Responsibility is Shared
    - All stakeholders—including government at all levels, industry, non-profit/advocacy, researchers, and the general public—are vital to preventing fatalities and serious injuries on our roadways.
- Safety is Proactive
    - Proactive tools should be used to identify and address safety issues in the transportation system, rather than waiting for crashes to occur and reacting afterwards.
- Redundancy is Crucial
    - Reducing risks requires that all parts of the transportation system be strengthened, so that if one part fails, the other parts still protect people.

OBJECTIVES OF A SAFE SYSTEM APPROACH

The Safe Systems Approach identifies five complementary objectives as listed below:

- Safer People[3]
    - Encourage safe, responsible driving and behavior by people who use our roads and create conditions that prioritize their ability to reach their destination unharmed.
- Safer Roads[4]
    - Design roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users.
- Safer Vehicles[5]
    - Expand the availability of vehicle systems and features that help to prevent crashes and minimize the impact of crashes on both occupants and non-occupants.
- Safer Speeds[6]
    - Promote safer speeds in all roadway environments through a combination of thoughtful, equitable, context-appropriate roadway design, appropriate speed-limit setting, targeted education, outreach campaigns, and enforcement.
- Post-Crash Care[7]
    - Enhance the survivability of crashes through expedient access to emergency medical care, while creating a safe working environment for vital first responders and preventing secondary crashes through robust traffic incident management practices.



[3] https://www.transportation.gov/NRSS/SaferPeople
[4] https://www.transportation.gov/NRSS/SaferRoads
[5] https://www.transportation.gov/NRSS/SaferVehicles
[6] https://www.transportation.gov/NRSS/SaferSpeeds
[7] https://www.transportation.gov/NRSS/PostCrashCare

SHSP Initiatives

To create safer roadways, the Commonwealth is pursuing the following six initiatives for coordinated multi agency and organization implementation.

- Implement Speed Management to Realize Safer Speeds
    - Evaluate and adjust operating speeds through roadway designs that are self-enforcing consistent with the new 2022 MassDOT speed management approach.
    - Develop and execute a procedure for target speed setting in all project types (e.g., roadway reconstruction, bridge, preservation, development, new roadways)
    - Amend Massachusetts regulations related to speed (expand the definition of a school zone, adjust speed limit setting, modify statutory speeds)
- Address Top-Risk Locations and Populations
    - Identify, initiate, and prioritize systemic projects involving top-risk locations
    - Identify, initiate, and prioritize systemic projects involving top-risk populations
    - Biannually update and disseminate information on locations and populations of top risk.
    - Evaluate effectiveness.
- Take an Active Role to Affect Change in Vehicle Design, Features, and Use
    - Identify opportunities for the state to champion safe vehicle designs and features to minimize injury severity with national, state, and local partners
- Accelerate Research and Adoption of Technology
    - Pursue research to test new approaches and identify new technologies for improving safety – including methods to screen and curb dangerous behaviors (e.g., drug impairment levels, testing tools)
    - Develop prospective pilots for automated enforcement for red light running, speed zones, and work zones.
    - Expand data linkages to improve our understanding of risks related to serious crashes and opportunities for intervention.
    - Evaluate and identify how roadway safety-related violation structure incentivizes or disincentivizes dangerous driving behavior and develop recommendations for changes.
- Double Down on What Works
    - Address top crash locations.
    - Expand the use of roadway pilots.
    - Expand internal state workforce training to engage the state workforce to raise awareness about the Safe System Approach and educate/train on how to implement it in their work.
    - Expand external trainings the state provides to amplify safety, Safe System, and best practices.

    - Expand resources to municipalities.
    - Get more safety equipment into the hands of road users (e.g., bicycle lights, car seats).
    - Expand data-driven targeted enforcement and high visibility police presence.
    - Improve accessibility and linkage of relevant safety-related data to professionals and the public.
    - Increase maintenance and operations.
    - Increase Road Safety Audits.
    - Provide a safe work environment for workers on roadways through increased training, education, awareness of incident management, and cutting-edge approaches.
    - Implement proven safety countermeasures in all roadway projects.
    - Develop, utilize, and provide guidance resources for effective selection and evaluation of improvements under both state and local jurisdictions.
    - Improve post-crash care through improving cell service coverage, implementing new trauma triage guidelines, increasing services for those involved in crashes, and increasing data linkages.
- Implement New Approaches to Public Education and Awareness
    - Develop new approaches, test to find what works, and implement a new type of comprehensive campaign that will have an impact on social norming/behavioral change on speeding, occupant protection, impairment, distraction, and seatbelts.
    - Develop an educational opportunity when individuals interact with the Registry of Motor Vehicles (RMV) to renew or obtain a license or ID so they can learn about safety advances including roadway design, multimodal mobility, signs, and signals.
    - Improve driver education and training for those under 18 and expand driver education for parent(s)/guardian(s) of those new drivers.
    - Improve driver education for new drivers over 18 years of age and provide refreshers for drivers transferring a license from another state.
    - Establish a state plan to communicate safety – including how we want media to talk about crashes.

Community Character/Safety Issues

The following recommendations are intended to preserve community character on Cape Cod while addressing safety issues.

- Use alternative guardrail treatments, such as steel Corten or steel backed timber - all on wood posts, where guardrail is necessary.
- Consider roundabouts as an alternative to signalized intersections.
- Continue policies that disallow business logo signs on state highways in Barnstable County.

- Preserve all state owned/town owned land along roads and other transportation rights-of-way, for transportation uses and/or conservation.
- Prohibit pruning and clearing within state rights-of-way except for safety purposes, such as making sight distance improvements.
- Encourage ornamental signal posts and mast arms.
- Develop design guidelines for Cape Cod to document preferred treatments in design concepts and details.
- Encourage use of simulated brick crosswalks and other contrasting materials in order to provide drivers with better visual identification. Crosswalks should be considered for all projects to accommodate walking as a viable mode of travel.
- Promote the Vulnerable Road Users law and other bicycle education programs.
- Right-size complete streets improvements to roadway projects to community character is not significantly changed with expansion of multimodal improvements.

ROADWAY SAFETY AUDITS

Since 2011 there have been 35 Road Safety Audits (RSAs) completed for locations throughout Cape Cod. The Audit process is overseen by MassDOT and brings together community officials and others in an intensive review of high-crash locations' operational and geometric deficiencies. Each audit includes a review of traffic and crash information, and an onsite field review.

It is important to note that the RSAs were borne directly from the U.S. DOT & MassDOT's Highway Safety Improvement Program (HSIP). This program was formally created by the federal transportation legislation (SAFETEA-LU) and these efforts are intended to align the use of data to identify the most serious safety deficiencies responsible for fatal accidents and serious injuries. All RSAs can be located at www.capecodcommission.org/safety.

TABLE 5. List of Cape Cod Road Safety Audits from 2011 to 2023

TOWN	YEAR	LOCATION
Barnstable	2012	Route 28 at Osterville-West Barnstable Road
	2012	Route 28 (Iyannough Road) at Yarmouth Road
	2014	Route 132 (Iyannough Road) at Cape Cod Community College
	2015	Route 28 (Falmouth Road) at Strawberry Hill Road
	2019	Route 28 (Falmouth Road at Route 132 (Iyannough Road)- Airport Rotary
	2019	Route 6A at Mary Dunn Road/Indian Trail
	2021	Hyannis West End Rotary (West Main Street, Main Street, Scudder Avenue)
	2021	Route 28 at Santuit-Newtown Road
	2023	Route 28 at Pitcher's Way, Lincoln Road, and Barnstable Intermediate School
	2023	Route 132 (East of Bearses Way to West of Airport Rotary)
Bourne	2012	Sandwich Road at Cranberry Highway
	2013	Route 28 between Bourne and Otis Rotary
Brewster	2011	Route 124 (Harwich Road) at Tubman Road
Dennis	2012	Analysis of High-Crash Locations in Dennisport*
	2020	Route 134 High Crash Locations
Eastham	2012	Route 6 at Governor Prence Road
	2017	Route 6 at Nauset Road/Wampum Lane
	2019	Eastham/Orleans Rotary and Route 6 at Van Dale Avenue
Falmouth	2011	Sandwich Road: Carriage Shop Road to Hatchville Road
	2017	Route 28 Corridor
	2018	Route 151 Corridor
	2021	Davis Straits (Route 28) Between the 13 Davis Straits and 80 Davis Straits
	2023	West Falmouth Route 28A between Old Dock Lane and Chapoquoit Road
Harwich	2016	Route 39 (Orleans Road) at Pleasant Bay Road
Mashpee	2014	Route 151 (Nathan Ellis HWY) at Old Barnstable Road
	2016	Mashpee Wampanoag Tribe Road Safety Audit
	2018	Route 151 at Ninigret Avenue, Algonquin Avenue, and Job's Fishing Road
	2019	Mashpee Rotary
Orleans	2019	Eastham/Orleans Rotary and Route 6 at Van Dale Avenue

Wellfleet	2016	Route 6 at Main Street
	2012	Wellfleet Route 6 Safety Study*
Yarmouth	2011	Union Street/Station Avenue: Route 6 Ramps
	2013	Route 6A: Willow Street to Union Street
	2016	Main Street (Route 28) at North Main Street and Old Main Street
	2019	Route 28 Between Iyannough Road and Parkers River Bridge

**denotes study was not an RSA, but rather a safety study. Safety studies offer similar recommendations as an RSA does.*

According to the Federal Highway Administration, an RSA is "the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users." RSA include a list of recommendations in a multitude of categories from signage, lighting, and roadway configuration. Below is an example list of what an RSA multidisciplinary team is observing when visiting the location.

FIGURE 4. Road Safety Audit Prompt List

GEOMETRIC DESIGN	
Issue	**Comment**
A. Speed – (Design Speed; Speed Limit & Zoning; Sight Distance; Overtaking	
Are there speed-related issues along the corridor? Please consider the following elements: • Horizontal and vertical alignment; • Posted and advisory speeds • Driver compliance with speed limits • Approximate sight distance • Safe passing opportunities	
B. Road alignment and cross section	
With respect to the roadway alignment and cross-section please consider the appropriateness of the following elements: • Functional class (Urban Principal Arterial) • Delineation of alignment; • Widths (lanes, shoulders, medians); • Sight distance for access points; • Cross-slopes • Curbs and gutters • Drainage features	
C. Intersections	
For intersections along the corridor please consider all potential safety issues. Some specific considerations should include the following: • Intersections fit alignment (i.e. curvature) • Traffic control devices alert motorists as necessary • Sight distance and sight lines seem appropriate • Vehicles can safely slow/stop for turns • Conflict point management • Adequate spacing for various vehicle types • Capacity problems that result in safety problems	
D. Auxiliary lanes	
• Do auxiliary lanes appear to be adequate? • Could the taper locations and alignments be causing safety deficiencies? • Are shoulder widths at merges causing safety deficiencies?	

MULTIMODAL TRANSPORTATION SAFETY

Safety information is readily available for several modes of travel. The following sections provide safety issue details on several transportation modes. Bicyclist and Pedestrian safety are discussed in the RTP Technical Appendix "Bicycle/Pedestrian Safety Plan."

Public Transit Safety

Public transit vehicles are generally considered to operate at a higher level of safety in comparison to private automobiles. Drivers are required to have higher qualifications and are subject to strict safety guidelines. The Cape Cod Regional Transit Authority prepared its Public Transportation Agency Safety Plan (PTASP) in December 2022 which outlines its safety training program, establishes safety performance targets, a safety management policy and safety performance monitoring. CCRTA has established the safety targets below by reviewing historic safety data, with the goal of operating to maximum safety, proactively addressing hazards as they are identified. The Cape Cod MPO adopted the transit safety performance targets for the Cape Cod region in March 2023.

TABLE 6. Cape Cod Transit Safety Performance Targets

MODE OF TRANSIT SERVICE	FATALITIES (TOTAL)	FATALITIES (PER 100K VRM)	INJURIES (TOTAL)	INJURIES (PER 100K VRM)	SAFETY EVENTS (TOTAL)	SAFETY EVENTS (PER 100K VRM)	SYSTEM RELIABILITY (MMBF2)
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles
Paratransit	0	0.00	4	0.1	8	0.2	150,000 miles
Human Service Transportation/ Demand Taxi	0	0.00	6	0.5	12	1.0	100,000 miles
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles

[1] Vehicle Revenue Miles

[2] Mean Miles Between Failures

Summary of General Transportation Safety Recommendations

- Work with state and local agencies to improve the accuracy and timeliness (e.g., within 12 months of the end of each year) of crash data
- Advocate for adaptive traffic signal technology for main corridors
- Consider protected left turn phases into signalized intersections
- Maintain delineation through more frequent restriping and street cleaning
- Improve signage standards to include larger lettering
- Improve lighting level standards, in particular at intersections. Consider placing utilities underground and installing breakaway safety poles for lighting
- Consider extension of "all red" phases for signalized intersections

- Establish driver education programs for older drivers
- Provide education on other options for mobility
- Increase education for local young drivers
- Support additional enforcement and warnings during busy traffic season to reach out to young visitor drivers
- Develop and implement an advertising campaign and roadside signage reminding drivers that traffic and drunk driving laws are strictly enforced on Cape Cod.
- Provide better signage for visitors directing them to popular destinations
- Install signage explaining the rotary "rules of the road" and disseminate similar information to be included in visitor brochures and Cape-related websites
- Consider conversion of conventional intersections (signalized or unsignalized) which have high crash rates to roundabouts
- Promote the use of red-light cameras at high crash rate signalized intersections
- Support road designs which are estimated to reduce crashes and improve safety for all users

INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent Transportation Systems (ITS) are applications of advanced technology in the field of transportation, with the goals of increasing operation efficiency and capacity, improving safety, reducing environmental costs, and enhancing personal mobility. A policy of Cape Cod MPO is to advocate and endorse the consideration of Intelligent Transportation Systems solutions for transportation problems as a routine part of the transportation planning process. As a stakeholder in the Southeastern Massachusetts Regional ITS Architecture, the Cape Cod MPO is committed to continuing an active role in these ITS systems. This includes maintaining channels of communication between the Cape Cod Commission and other stakeholders, including but not limited to: the MassDOT; the Southeastern Regional Planning and Economic Development District (SRPEDD); the Old Colony Planning Council (OCPC), and the Cape Cod Regional Transit Authority (CCRTA). A regional ITS architecture is a framework that defines component systems and their interconnections. Successful ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility of individual systems. The regional architecture is a mechanism design to ensure this collaboration and compatibility occurs. Inputs into ITS systems can involve any variety of a range of collection devices, including:

- Loop detectors in the pavement and sophisticated ground level radar systems are able to collect real time traffic volume and speed data.
- Video equipment is often used to monitor the transportation system, which is useful in allowing system operators to immediately detect areas of congestion that may be forming. It is also used to detect incidents such as crashes and disabled vehicles, in turn accelerating emergency dispatch and the overall incident management process. Video surveillance is also a useful tool for security and incident management in transit vehicles and around stops and terminals.

- Automatic vehicle locators (AVL) on board transit vehicles, emergency response vehicles, and roadside assistance vehicles allow operators to know where vehicles are in real time that allows for more efficient dispatch and adjustment of traffic controls if necessary.
- Automated Fare Payment Systems that allow riders on transit systems to pay electronically using a "smart card" (prepaid balance) or in the future conventional credit/debit cards rather than cash.
- Transmitters onboard transit and emergency vehicles alike are used to pre-empt traffic signals ahead or to alert travelers at a transit stop that the vehicle is approaching.
- Remote weather stations and Doppler radar provide real time weather conditions occurring throughout the transportation network and provide alerts regarding events such as icing or flooding that may be occurring. These are some of the technological applications that can be utilized for managing the regional transportation network. All of this information travels over both hard-wired and wireless communication systems to systems that manipulate the data and distribute it to users of the transportation system. End users of ITS system and the output media include:
- Transit Operation Centers that monitor the transit system through video feed, radio communications, and AVL signals, allowing operators to make improved decisions regarding security, dispatch, and incident management.
- Traffic Operation Centers that monitor the roadway system through reports from systems like loop detection and video feed, allowing operators to make improved decisions regarding congestion management, incident management, security, and maintenance management.
- Traveler Information Services such as the national 511 System or SmarTraveler locally, which receive traffic data from traffic and transit operations centers and distribute it to users via hard line and wireless communications.
- Variable Message Signage that allows operators from traffic and transit operation centers to instantly relay messages to users on the system.
- Kiosks that receive information from transit operation centers and transit vehicles, relaying it to users of the transit system.

MassDOT owns and operates several permanent variable message signs and a large fleet of portable variable message signs throughout the Commonwealth. Permanent stations are used to alert drivers to major events affecting locations such as the Route 128 belt and Interstate 93, as well as the tunnels. Portable variable message sign trailers are located throughout the state and can be dispatched to locations wherever and whenever needed. Often, they are used for a major local event, such as a road race or sidewalk carnival. They can also be dispatched for major unplanned events, such as a chemical spill that forces an extended closure of a highway. All variable message signs are controlled from the MassDOT Traffic Operations Center in South Boston. MassDOT is using automated vehicle locators on their snow removal and highway maintenance fleet, increasing the efficiency of dispatch of resources to where they are needed. Travelers are able to obtain real time traffic conditions for highways in the Commonwealth,

including highway approaches to the Cape such as Routes 3 and 495 as well as the Cape Cod Canal bridges, through SmartRoutes phone and web links, and will soon be available through a statewide 511 system and MassDOT website.

CAPE COD COMMISSION'S LOCATION-SPECIFIC SAFETY STUDIES

The Cape Cod Commission has completed several safety-related studies. The following is a summary of the locations that were studied. Full reports are available on the Cape Cod Commission's website: www.capecodcommission.org/safety

- Non-Motorist Crash Analysis (2023) - Ongoing
- Before and After Crash Analysis Report (2022)
- Route 6 Safety Analysis Report (2022)
- Route 6 Safety Study: Ramp and Shoulder Design (2019)
- Route 6 Stormwater and Vegetation Management Plan and Maps (2016)
- Route 6 Hydroplaning Crash Analysis and Alternatives Development (2014)

CONCLUSION

Safety continues to be the highest priority goal of the Regional Transportation Plan. The Cape's transportation system should ensure that travelers and their possessions will arrive at their destinations unharmed and undamaged. Travelers should be educated regarding transportation regulations and traffic laws, and these must also be enforced to prevent the improper use of the transportation system. The importance of safety requires a spectrum of strategies including education, enforcement, engineering, and emergency response.

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix D: Security

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2023

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Technical Appendix D: Security

The transportation system must prepare for natural disasters, such as hurricanes or flooding events. Moreover, post-September 11th, protecting users from man-made hazards is also a priority, as indicated by the increased emphasis on security in federal and state transportation regulations and guidelines. A variety of local, county, state, and federal agencies play key roles in ensuring the security of the Cape Cod transportation system.

EMERGENCY TRAFFIC PLANNING

The most frequently identified security concern is the threat of a weather-related event such as a hurricane. In many cases, Cape Cod residents and visitors "shelter in place," a term that refers to staying in homes or local shelters that are supplied with food, water, etc.

Residents should heed warnings of public safety officials and evacuate accordingly. A danger occurs out of panic when vast numbers of people get into their automobiles with the idea that they should "evacuate," clogging up the roadway network. These traffic jams pose a threat to those who truly need to access the network (persons with health problems, injuries, etc.). In the event of a mass exodus from Cape Cod (due to major weather-related, radiation event, etc.), planning is underway by the Barnstable County Emergency Planning Committee (BCREPC), in coordination with the Massachusetts Emergency Management Agency and implementation organizations such as the Massachusetts State Police and MassDOT. Planning for large-scale traffic flows leaving Cape Cod requires coordination with neighboring regions. For example, routing Cape Cod traffic to I-195 West during an impending hurricane may bring motorists closer to the hurricane's landfall. Landfall predictions always include some uncertainty, such as the exact time and path of impact. When the path of a storm is projected in a wide, imprecise area it can make the evacuation route itself a potentially hazardous area.

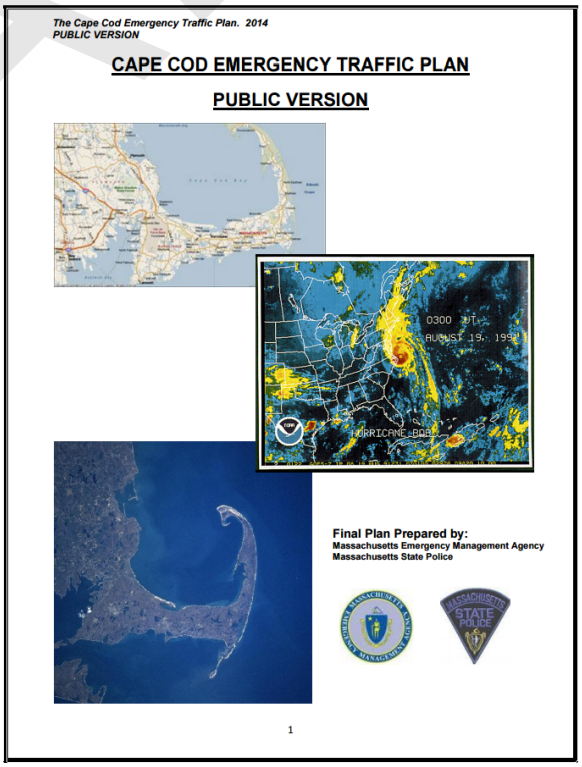

FIGURE 1. Cape Cod Emergency Traffic Plan

The "Cape Cod Emergency Traffic Plan" (ETP) has been developed by the Massachusetts State Police in cooperation with the Massachusetts Emergency Management Agency (MEMA) and several other agencies to facilitate the egress of a high volume of traffic from Cape Cod in the event of a hurricane, particularly during peak tourist season.[1] The design of the ETP is based upon the need to eliminate the causes of congestion in the area of the Bourne and Sagamore Bridges and the main arteries leading up to them, Routes 6 and 28. The following is a general outline of the plan's implementation:

- As traffic levels build before the hurricane arrives, direct access to and from off-Cape locations will be restricted at the bridges in order to allow vehicles to continue north from the bridges unimpeded.
- At higher traffic levels, and as bridge flows warrant (e.g., lower demand at Bourne Bridge than at Sagamore Bridge), traffic on Route 6 destined for Routes 25 & 495 would be diverted through the Massachusetts Military Reservation (MMR).
- When sustained winds reach 80 mph, the bridges will be closed and the motorists will have the option of going to designated emergency parking areas in the MMR and to be shuttled to shelter in the MMR.

The ready availability of advance information to the public is a vital component necessary to maximize the efficiency of the ETP. Traffic will flow only as fast as the slowest vehicles are traveling. The following measures are planned in order to provide a high level of public knowledge regarding the various aspects and the changes in traffic patterns that will be encountered during the ETP:

- Signage: MassDOT will erect ETP signs giving advance notice of all detours and changes in traffic flow. The signs will include a radio frequency for ETP information.
- FM Radio Broadcast: Changes in traffic patterns will be announced on WQRC (99.9 MHz). WQRC will continually play a variety of pre-recorded instructions geared to address the various phases of the ETP.
- Internet: Detour instructions and maps will be available on the Internet from the state police web site: www.state.ma.us/msp

SHELTER IN PLACE SCENARIOS

It is extremely important that the public is informed of the need to evacuate only under a set of specific scenarios. For example, Hurricane events may only threaten certain coastal areas. For those residents in the affected areas, public safety officials would likely direct evacuees to local or

[1] https://www.mass.gov/lists/state-emergency-management-all-hazards-plans

regional shelters. By 'sheltering in place' or relocating to the nearest emergency shelter, impacts on the roadway network are minimized, freeing up capacity for emergency responders.

Sheltering in place and waiting instructions from emergency response officials is also the recommended course of action during a radiation event as detailed on the BCREPC Radiation Emergency Reference Sheet[2]. This reference sheet details the proper actions to take in response the radioactive emergency at the Pilgrim Nuclear Power Station (PNPS) located in Plymouth. Cape Cod lies outside of the 10-mile radius Emergency Planning Zone so no emergency evacuation is planned should there be a radiation emergency at the PNPS. If a radiation event occurs, individuals on Cape Cod should get inside, stay inside, and stay tuned. For more information about preparedness, sheltering, and radiation emergencies, visit the following websites:

- Centers for Disease Control: https://emergency.cdc.gov/radiation/index.asp
- MEMA: www.mass.gov/mema
- BCREPC: www.bcrepc.org/prepare

PUBLIC TRANSPORTATION SECURITY

Security of public transportation systems has been regarded with greater importance in recent years. The Federal Transit Administration (FTA) provides guidance and a wide variety of strategies to maintain and improve security. It is also important to note that public transit may serve an important role in evacuation (e.g., moving residents from nursing homes etc. to shelters). Also, verification and certification of public transit employees in security procedures is important to assure response capability.

AIR TRAVEL SECURITY

Security for travel by air is a primary function of the Transportation Security Administration (TSA). The TSA has been required to make a number of improvements to aviation security. The improvements included that by November 19, 2002, screening of individuals and property in the United States would be conducted by TSA employees and companies under contract with TSA. Federal law also requires enhanced qualifications training and testing of individuals who perform screening functions. It requires that Federal law enforcement officers be present at screening locations. More information is available at: http://www.tsa.gov

[2] http://www.bcrepc.org/wp-content/uploads/2014/09/BCREPC_Radiation-Emergency-Reference-Sheet-092214.pdf

INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent Transportation Systems (ITS) technologies are applied to vehicles and roadways that perform communications, data processing, traffic control, surveillance, navigation, sensing, and various other functions that aid in the management of the security process. ITS elements, such as traffic cameras, signal preemption devices and Variable Message Boards (VMB), would provide timely responses for emergency vehicles and the ability to monitor evacuations during times of natural, or other disasters.

The Massachusetts Department of Transportation's Traffic Operations Center (TOC) is located in South Boston. The TOC's primary mission is traffic incident management throughout the Commonwealth of Massachusetts. The MTOC is the headquarters for the application of Intelligent Transportation Systems (ITS) around the state. From the MTOC, reports on traffic incidents are relayed to the involved MassDOT district office, which assigns the necessary personnel and equipment, required to abate the incident.

The TOC integrates information from the Cape Cod Canal Area Intelligent Transportation System. The Cape's system will include about 10 adjustable (point-tilt-zoom) high definition cameras and supplemental speed detectors and fixed-view webcams. This system will yield travel time and incident data to travelers and emergency responders.

Security is a high priority goal of the Regional Transportation Plan. The transportation system must be prepared for natural disasters, such as hurricanes. This plan also adds emphasis on security from federal and state transportation regulations and guidelines.

The most pressing security issue facing Cape Cod is the heavy volume of traffic departing during weather events, such as impending hurricanes.

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2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix E: Freight

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Technical Appendix E: Freight

Freight transportation is the movement of goods in large quantity. The movements are generally split up in to four major categories, truck, rail, and water and air freight, each with their own types of contracts. On Cape Cod, freight travel mostly reaches its end point for goods to be bought by consumers or movements are internal to the region. Few goods are exported. Cape Cod exports including solid waste, parcel post and seafood products.

Local economies typically depend on freight transportation to export and import goods. The freight industry on Cape Cod is different because of the seasonal tourist industry, abundance of waterways, and historic culture. The tourist industry creates more demand on goods in the summer months; the waterways create opportunities for sea freight, but also require crossings for truck freight. The historic character and geographic placement of Cape Cod limits the ability to create large-scale freight infrastructure.

In 2014 the Cape Cod Commission performed a regional freight study. The purpose of the study was to provide recommendations to improve freight flexibility, speed-efficiency, fuel-efficiency, and safety by transport method. The study overviewed freight infrastructure, featured data from a survey presented to local freight businesses, and finally provided recommendations for the improvement of freight operations and infrastructure on Cape Cod.

TRUCK FREIGHT

Vehicle transportation is the primary method of freight distribution in the region. It is important to note that all vehicle traffic on Cape Cod experiences two different seasons, extreme congestion in the summer or peak season, and normal congestion in the remaining seasons or off season.

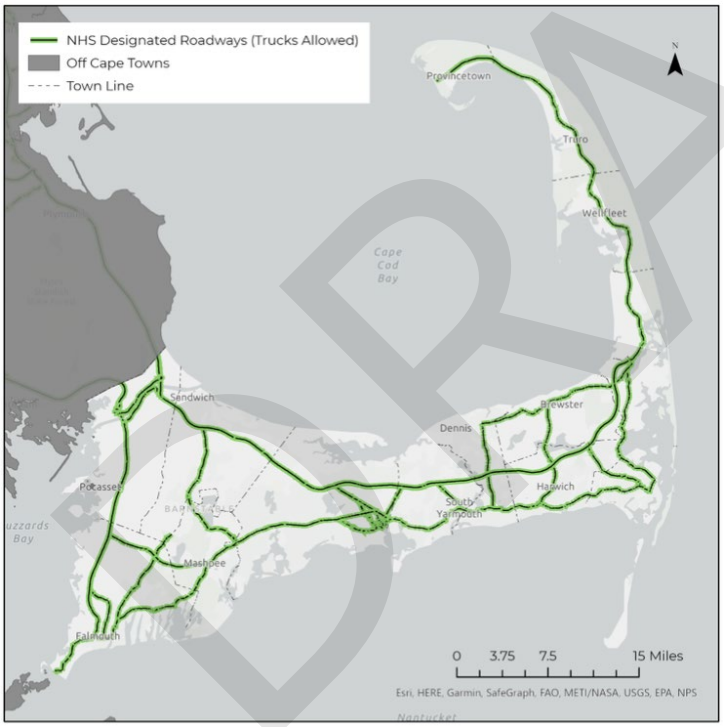
Maintaining properly designed intersection controls is important for the freight industry to ensure safety, and minimize delays. At signalized intersections this may mean optimizing signal timing and phases and providing turning lanes. At roundabouts this may mean the provision of truck aprons adjacent to the center island and on exit/entrance shoulders.

The maximum legal speed limit on most Cape Cod highways is 55 mph. Exceptions include Route 3 (60 mph) and Route 25 (65 mph) in Bourne. The speed limits on the road affect the movement of freight traffic by governing travel time. In order to encourage truck freight to remain on the limited-access portions of freeways such as the Mid Cape Highway, an evaluation of safety and free-flow travel speeds should be performed – possibly leading to an increase in some speed limits (perhaps limited to daytime hours).

Freight traffic is affected by congestion on Cape Cod. At certain times of the year freight carriers are not able to make trips due to travel times. Congestion is found on almost all Cape Cod roads in the summer. Year round, heaviest travel occurs on the Cape Cod Canal roads and bridges and the Mid-Cape Highway. High volumes of traffic are also found on the roads leading to and within the Hyannis area (an area that receives/sends goods to/from many businesses, institutions such as Cape Cod Hospital and multimodal facilities such as the ferry ports).

Freight traffic has the most significant effect on pavement conditions because of the stress that truck weight causes on the pavement. Freight is also affected by pavement conditions because potholes and other pavement issues can create safety hazards for truck drivers and cargo. Pavement condition data are collected with the intent to keep the roadway system in the best possible condition with the most efficient use of available funds.

MassDOT Designated Truck Routes



There are over 200 miles of designated truck routes under state authority (shown in Figure 1). These routes are only located on state highways (e.g., Routes 6, 28, 6A and 28A). There are several obvious gaps in connectivity, due to changes in jurisdiction (e.g., Route 6A in Barnstable Village, Route 28 in downtown Falmouth). Other gaps in connectivity occur between the truck route network and intermodal facilities such as the ferry ports in Hyannis and Provincetown.

FIGURE 1. MassDOT Truck Routes

Source: Massachusetts Roadway Inventory File 2021

Critical Freight Corridors

In 2017, the Cape Cod MPO identified the following as Critical Freight Corridors which provide access and connection with the national freight network and important ports, public transportation facilities, or other intermodal freight facilities :

- Route 6 from Cahoon Hollow Road in Wellfleet to Whitmanville Road in Truro.
- Willow Street/Yarmouth Road from Route 6 in Yarmouth to Route 28 in Barnstable
- Route 28 in Barnstable from Yarmouth Road to Airport Rotary
- Route 132 in Barnstable from Airport Rotary to Attucks Way

Canal Bridges

As detailed in the Appendix G, the largest bottlenecks on Cape Cod occur at the canal bridges. The Bourne Bridge and Sagamore Bridge permit vehicular travel over the Cape Cod Canal.

The bridges first opened to traffic in 1935. Historic records indicate a general upward trend in the annual bridge crossings and this traffic is currently over 100,000 vehicles per average day. Over the decades, the bridges have been exposed to deicing salts, the effects of which include progressive deterioration of the concrete deck and some steel members of the bridges. These effects are compounded by the fact that the bridges are located near salt water. An additional maintenance activity is the periodic painting of the exposed steel portions of the bridges.

For certain maintenance activities, including repairs to the concrete deck, the worksite requires the closures of two lanes. The ACOE is committed to minimizing these conditions by avoiding daytime lane reductions during the summer months and limiting work to one bridge at a time.

The Army Corps of Engineers established a website and email notification system for major maintenance efforts on the bridges. By providing timely warnings of impending closures, travelers may adjust travel mode, choice of bridge crossing and approach routes, or timing. The bridges do need to be maintained in order to continue to provide safe passage to and from the region. Foul weather may interfere sometimes in the maintenance efforts, and as a result the schedule prolonged. Some further strategies to minimize impacts are listed below.

- Scheduling Maintenance Activities for Off-Peak Periods minimizes disruptions to traffic during heavy travel periods. The Army Corps is already making efforts to achieve this - and should continue to do so. To the greatest extent possible, lane closures should avoid summer months and daytime periods during the spring and fall.
- Intelligent Transportation Systems (ITS) is collection and dissemination of real-time information through means such as cameras and/or cell phone data collection. The information is available on the state traffic information website and 511 telephone system. This allows for travelers to check online or via cell phones on current traffic conditions at the bridges. Radio stations also

look up and provide updates on bridge traffic. The Cape Cod Commission website provides links to transportation providers (www.capecodcommission.org) including a link to the ACOE website to provide travelers with the latest information on lane closures.

- Improve Transportation Alternatives to Offset Automobile Crossings by increasing express bus service, and improving marketing of bus and other alternatives. The marketing should inform travelers of the advantages of using alternatives and the disadvantages of driving during the lane closures. An additional strategy to enhance the attractiveness of buses and high-occupancy vehicles would be to allow travel on the shoulders (currently nonexistent on Route 6) of Routes 3, 6, 25, and 28 to bypass the queues (under police supervision). This concept would include construction of shoulders/breakdown lanes that could be used as a bus lane during peak times. This would encourage a shift from single-occupant vehicles and would likely result in an overall reduction of vehicles traveling through the lane closures.
- Traffic Management reduces traffic conflicts. During periods of traffic congestion at the Canal crossings, motorists seek alternate routes - regardless of whether or not such routes actually save travel time. In addition, such routings have effect on the capacity of the bridges, and may actually create bottlenecks in other locations such as the Exit One on-ramp at the approach of the Mid-Cape Highway westbound at the Sagamore Bridge. Techniques to be considered should include police officer traffic control, signage, and turn restrictions.

RAIL FREIGHT

Freight service is the major user of Cape Cod's rail network in addition to scenic excursions and weekend passenger service. The Commonwealth of Massachusetts, through MassDOT, still owns most railroad tracks on Cape Cod today. Massachusetts Coastal Railroad (a company of Cape Rail, Inc.) operates under contract to provide freight service.

Currently, the primary use of Cape Cod's rails is for transporting solid waste by Mass Coastal Railroad. Mass Coastal is a short line freight railroad serving Cape Cod and southeastern Massachusetts between Middleboro, Joint Base Cape Cod, Hyannis, and South Yarmouth. The majority of Cape Cod's solid waste is transported to the SEMASS trash-to-energy plant in Rochester, MA via Mass

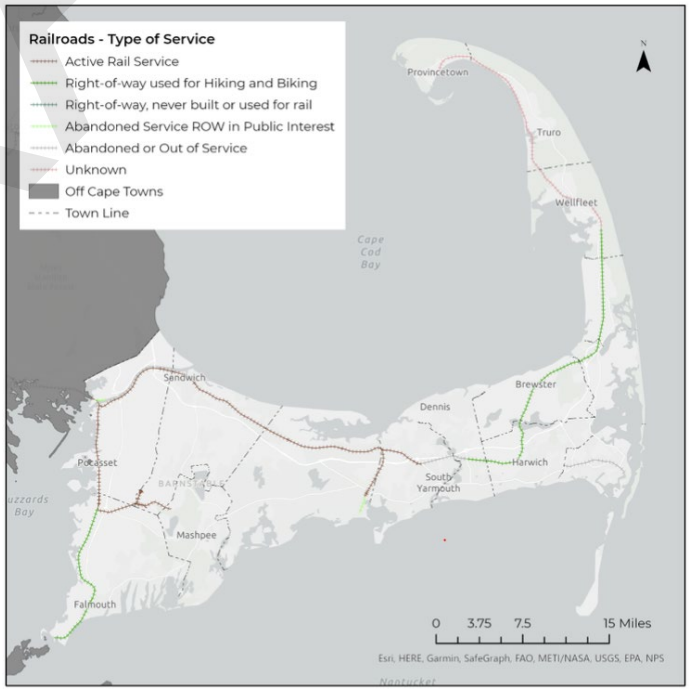


FIGURE 2. Cape Cod Rail Infrastructure

Coastal's Energy Train. Other freight Mass Coastal carries includes food, construction materials, chemicals, heavy equipment amongst many other things.

Rail service has a long and rich history on Cape Cod. The region's early growth was in part brought about by the railroad. Many miles of usable track still exist on Cape Cod, intersecting the roads and waterways. MassDOT owns the majority of rail tracks on Cape Cod, but some tracks are owned by federal agencies. If freight rail service were to be expanded, upgrades would be necessary to the tracks, stations, and signals. Moreover, issues of accessibility, mobility and connectivity would need to be addressed. Funding for these improvements would need to be identified and secured. As many tracks are converted in bicycle paths, the future of rail on Cape Cod is still uncertain. A major advantage of rail freight is the movement of goods across the Cape Cod Canal without adding vehicle crossings to the congested highway bridges.[1]

Mass Coastal operates the "Energy Train" transporting solid waste from the Yarmouth Transfer Station to the Southeastern Massachusetts Resource Recovery Facility – "SEMASS"). Given the current regulatory, with an increasing reluctance to permit new landfill capacity in the Massachusetts region, additional solid waste transportation capacity is likely needed. A transfer facility on the Upper Cape may be needed should there be a desire to transport additional solid waste out of the region by rail.

WATER FREIGHT

Waterborne freight to and from Cape Cod uses a variety of vessel types and seaports. The primary form of public water transportation on Cape Cod is ferry service, carrying passengers between the mainland and the islands of Martha's Vineyard and Nantucket. A significant amount of freight is carried by water transportation as well. As a result, the region's seaports and channels are vital in addressing the economic and transportation needs of Cape Cod.

Cape Cod Seaports

Cape Cod has 586 miles of tidal coastline, with many inlets and bays that provide marine access to the land. Seaports have been constructed along several of these bays and inlets to facilitate the transfer of people and goods from water to land transportation. Significant Cape Cod seaports are recognized in reports by the Army Corps of Engineers, the agency that maintains many of them. These and other seaports are discussed in the Existing Conditions appendix.

[1] More information available at www.capecodcommission.org/CapeRailStudy

Ferry Freight

The Steamship Authority records movements of trucks between Cape Cod and the Islands. Generally, these trucks are transporting goods from the mainland to the Islands. In 2022, truck movements exceeded 95,000 vehicles. The total number of trucks carried excludes pick-up trucks, vans, and other commercial vehicles under 20' in overall length. In The numbers of trucks, automobiles, or passengers are reported as one-way segments or movements. A truck carried round trip is reported as two trucks carried.

TABLE 1. Trucks Carried by Steamship Authority Ferries

Source: Steamship Authority

YEAR	TO AND FROM MARTHA'S VINEYARD	TO AND FROM NANTUCKET
2003	44,159	25,276
2004	45,846	26,622
2005	45,703	28,074
2006	47,072	30,499
2007	47,856	30,992
2008	47,335	28,615
2009	44,246	24,137
2010	44,467	23,233
2011	44,037	23,524
2012	42,617	24,545
2013	45,638	26,720
2014	47,344	27,707
2015	49,069	29,588
2016	50,343	31,584
2017	52,305	32,936
2018	53,526	33,293
2019	53,366	33,672
2020	47,999	30,456
2021	56,522	34,933
2022	59,233	36,000

Channels

CAPE COD CANAL

The Cape Cod Canal is a significant aspect to freight infrastructure in the region. This channel allows safe passage from ports north and south of Cape Cod, relieving the hazard of navigation around the peninsula. Details on the Cape Cod Canal can be found in the Existing Conditions Sections.

The Cape Cod Canal is owned and operated by the Army Corps of Engineers. In 2017 there were more than 21,000 vessel transits of the Canal, of which about 7,500 were ships of more than 65 feet in length. Cargo tonnage for 2016 was about 6.9 million tons. Auto carriers, cruise ships and military vessels are among the largest ships that use the Canal today.[2]

WOODS HOLE CHANNEL

The Woods Hole Connects Buzzards Bay with Great Harbor in Woods Hole. Freight vessels traveling to Boston and points north can also use the channel on their way to the Cape Cod Canal. The channel is used by seasonal passenger ferries from New Bedford to Martha's Vineyard. As a result, the channel is heavily traveled.

NANTUCKET CHANNEL

The Nantucket Channel provides passage through the Nantucket Sound and between Cape Cod and the Islands. Ferries, ships navigating around the Cape, and other vessels used this channel.

CAPE COD FREIGHT STUDY

This 2015 Cape Cod Freight Study was the first attempt by the Cape Cod Metropolitan Planning Organization to bring a comprehensive assessment of issues facing freight haulers to, from and within Barnstable County. In order continue to make progress in improving freight safety and reliability, the following strategies were offered in the report:

Identify "Critical" Freight Commodities

Work with planners to identify commodities critical in all stages of emergency preparedness and response. These stages include advanced planning and resiliency preparations, emergency management during events, and follow-up/rehabilitation.

[2] "Cape Cod Canal Highway Bridges Major Rehabilitation Evaluation Report And Environmental Assessment" US Army Corps of Engineers New England District (March 2020)

Encourage Specific Types of Freight Transportation

Freight modes that minimize travel over Cape Cod's narrow and congested roadways are to be encouraged. Such modes include rail and waterborne. Trucking deliveries during off-peak times are also encouraged.

Make Infrastructure Improvements for Freight Industry

Maintain and rehabilitate bridges and roads – focusing on higher functional class facilities. During roadway and intersection rehabilitation on truck routes, include properly-engineered pavement, turning radii, and avoid height obstructions.

Update Truck Routes

Work with town and state officials to refine preferred truck routes. Currently, truck routes are based on a limited number of state roads and may be discontinuous based on jurisdiction. Refined truck routes would be included in the MassDOT's Roadway Inventory.

Bridge Maintenance Scheduling

To reduce impact to freight traffic, restructure Bourne and Sagamore bridge repair contracts (night work or 24-hour shift).

MASSDOT FREIGHT PLAN

The 2023 Massachusetts Freight Plan is currently in a 30-day public comment period which ends on June 29, 2023. The Freight Plan is a planning document that will define short and long-term vision for the freight system in the Commonwealth. The principles of the draft plan are reflected in the Freight Mobility goal in the RTP.

CAPE COD COMMISSION

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CAPE COD COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix F: Bicycle & Pedestrian

DRAFT

2023

COUNTY OF BARNSTABLE MASSACHUSETTS

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Technical Appendix F: Bicycle & Pedestrian

This appendix presents an overview of bicycle and pedestrian planning on Cape Cod, including discussion of crash and road safety data, existing facilities, safety and planning studies, and planning efforts related to bicycles and pedestrians on Cape Cod.

CAPE COD BICYCLISTS AND PEDESTRIANS

Bicycling is popular throughout Cape Cod, both as a transportation mode and a recreational activity. Cape residents and visitors alike bicycle and walk along area roads and off-road paths to reach local shops and services, town centers, workplaces, beaches, and other destinations. Bicycling and pedestrian improvements are underway in all Cape Cod communities. The regional bicycle and pedestrian facility network is growing, particularly with the extension of the Cape Cod Rail Trail through Yarmouth and continued future extensions westward to Barnstable and eastward through Outer Cape communities. Ten towns have designated committees that are working to address bicyclist and pedestrian needs in their communities and several non-profit bicycle advocacy groups are active on Cape Cod. MassDOT and the Cape Cod Commission are working with local communities to address deficiencies and encourage "Complete Streets" projects. The American League of Bicyclists designated both Provincetown and Falmouth "Bike Friendly Communities." Additionally, *People For Bikes*, rated Provincetown the #1 small city for biking in the United States in both 2021 and 2022.

Despite the popularity of bicycling and walking and recent improvements to the bicycle/pedestrian facility network, many areas are hazardous and uncomfortable to bike or walk to due to roads with high traffic volumes and speeds and no bicycle or pedestrian accommodations. Identifying and addressing gaps in the network is important for encouraging healthy transportation options on Cape Cod.

EXISTING CONDITIONS

VEHICULAR CRASH RECORDS

The following sections provide discussions of vehicular crash records that involve bicyclists or pedestrians.

Non-Motorist Crash History

Vulnerable roadway users, such as bicyclists and pedestrians, face challenges navigating the transportation network on Cape Cod. The mixture of narrow roadways, high traffic volumes, and pleasant summer weather create difficult vehicle-non-motorist interactions. Cape Cod's summer weather brings bicyclists onto roadways at the time when vehicular traffic is at its peak. As a healthy transportation mode that provides pollution-free travel, improving roads and providing facilities that are comfortable for cyclists and pedestrians is a critical goal for Cape Cod communities. All reported non-motorist crashes are shown in the figure on the following page. There were 406 reported crashes, with 392 being geolocated on the below figure. 237 of the crashes involved a cyclist and 155 of the crashes included a pedestrian.

Table 1 includes a town-by-town breakdown of non-motorist fatalities and serious injuries for the years 2012-2021. With 112 reported crashes over the three-year period, Barnstable had the greatest number of bicyclist-vehicle crashes (Falmouth was second with 63 crashes). The 4 non-motorist (all pedestrians) fatalities occurred along the Route 28 corridor.

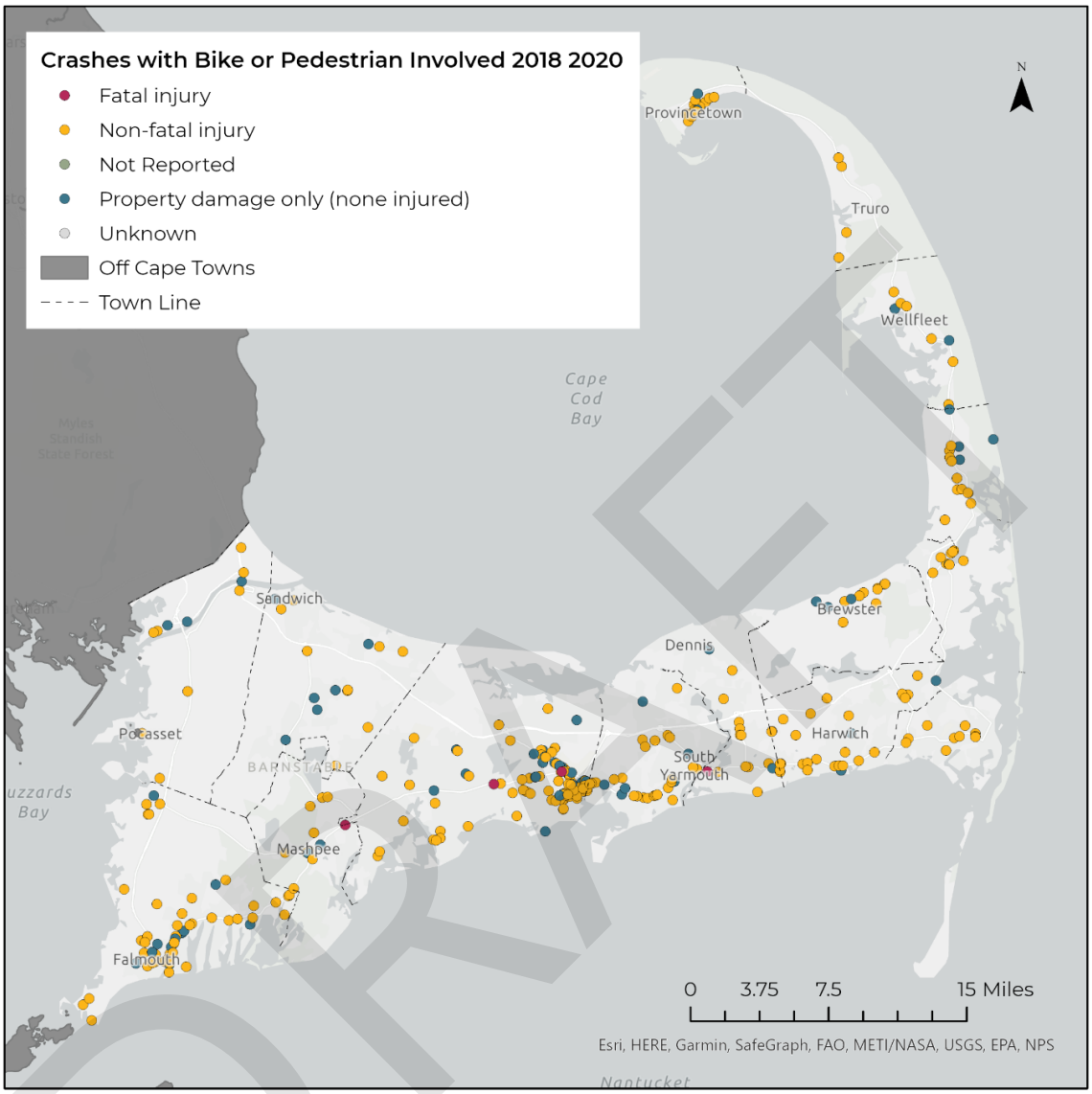

FIGURE 1. Non-Motorist Vehicular Crashes

TABLE 1. Non-Motorist-Vehicle Crash History (2012-2021)

TOWN	FATALITIES (10-YEAR TOTAL)	SERIOUS INJURIES (10-YEAR TOTAL)
SANDWICH	2	11
BOURNE	2	9
MASHPEE	3	8
FALMOUTH	3	46
BARNSTABLE	7	59
YARMOUTH	7	25
DENNIS	3	8
BREWSTER	1	7
HARWICH	1	10
CHATHAM	2	3
ORLEANS	0	2
EASTHAM	2	7
WELLFLEET	1	5
TRURO	0	1
PROVINCETOWN	1	7
Total	35	208

(Source: MassDOT)

ROADWAY SAFETY AUDITS – BICYCLE/PEDESTRIAN RECOMMENDATIONS

MassDOT oversees Road Safety Audits (RSAs), a process that brings together a multi-disciplinary group of state and community officials and other stakeholders in an intensive review of high-crash locations' operational and geometric deficiencies. Each audit includes a review of traffic and crash information and onsite field review. The audits include analysis of bicyclist and pedestrian safety. The RSA team looks at crossing conditions, accessibility, bicyclist and pedestrian comfort; vehicle conflicts; visibility; and other bicycle/pedestrian safety factors. Improvement recommendations might include installing curb ramps; repainting crosswalks and lanes; installation of an island for bicyclist/ pedestrian refuge; shoulder widening or bike lane; bicycle detection; advance pedestrian/bicyclist warning signage; etc.

For further information on individual RSA's, please refer to the Safety Appendix of this document. In addition to RSA's Cape Cod Commission staff also conduct location-specific safety studies throughout the region, upon request by a town or MassDOT. These studies and the full list of the RSA's are available at: www.capecodcommission.org/safety.

BICYCLE AND PEDESTRIAN PLANNING

The following sections provide discussion on types of bicyclists; references to bicycle and pedestrian facility design guidelines, discussion of the regional network vision; descriptions of the Cape's existing bicycle and pedestrian infrastructure and a summaries of recent bicycle/pedestrian studies and plans.

The Commission is currently involved in bicycle/pedestrian planning efforts with several Cape Cod communities. It is anticipated that recommendations from these studies will yield projects for inclusion in the Regional Transportation Plan.

Types of Bicyclists

Bicyclists with different levels of experience, confidence, and purpose for riding have varied accommodation needs. A strong and effective bicycle plan meets the needs of bicyclists with varied abilities through a combination of facility types, both on and off-road. Transportation planners/designers also consider their levels of comfort and stress. A new bicyclist typology has emerged over the last decade that helps planners understand the facility needs of the different types of cyclists.[1]

- Strong and fearless – people willing to ride with limited or no bike infrastructure

[1] Jennifer Dill and Nathan McNeil, "Revisiting the Four Types of Cyclists: Findings from a National Survey," Transportation Research Record: Journal of the Transportation Research Board, 2587: 90-99, 2016.

- Enthused and confident – people willing to ride if some bike infrastructure is provided
- Interested but concerned, wants to ride and would if they felt safer on the roadways—if cars were slower and less frequent, and if there were more quiet streets with few cars and paths without any cars at all.
- "No way, now how" – people who are unwilling to ride under any circumstance

In both nation-wide and local surveys, most respondents identified as "interested but concerned." Such riders want to bicycle more and would if they felt safer – either by accessing low-speed roads or using bicycle infrastructure. Designing bicycle networks for this type of rider would encourage more everyday riding. While the typologies are based on surveys and responses from urban riders, they are likely applicable for bicyclists on Cape Cod.

TYPES OF BICYCLE AND PEDESTRIAN FACILITY

There are three general types of facilities to accommodate bicycles and pedestrians:

- **Mixed Traffic Facilities** such as yield roadways, bike boulevards, and advisory shoulders.
- **Visually Separated Facilities** such as paved shoulders and traditional bike lanes.
- **Physically Separated Facilities** such as shared-use paths, sidepaths, sidewalks, and protected bike lanes.

On Cape Cod, we have a mix of multimodal facilities. Multimodal accommodations can be shared within or adjacent to a roadway or along the region's network of shared use paths alignments, such as the Cape Cod Rail Trail. Additional multimodal facilities are being designed and constructed in our region thanks to MassDOT's GreenDOT Implementation Plan and their Healthy Transportation Policy Directive. These MassDOT initiatives ensure all MassDOT projects are designed and implemented in a way that there are safe and comfortable healthy transportation options on all MassDOT facilities. Additionally, MassDOT's Complete Streets Program has furthered implementation of improved multimodal facilities to assist the municipalities with funding complete streets projects.

MassDOT has developed the following guides which assist in the design of bicycle and pedestrian facilities in the Commonwealth.

- MassDOT Project Development and Design Guide
- MassDOT Separated Bike Lane Planning and Design Guide
- MassDOT Bike Wayfinding Design Guide

REGIONAL VISION & GOALS

Cape Cod's "Vision 88" proposes a continuous shared-use path network of 88 miles from Woods Hole to Provincetown. The route will consist of existing facilities such as the Cape Cod Rail Trail, the Shining Sea Bikeway, and the Cape Cod Canal bike path. Newer segments are in various stages of planning and design. As an overall framework, the following figure represents an overall vision for bicycle path connections to and within Cape Cod. The segments shown in green represent existing bicycle paths. Orange line segments represent generalized routes; detailed alignments are to be defined. This figure represents the Cape Cod Commission's vision for expansion of the Cape's bicycle path infrastructure.

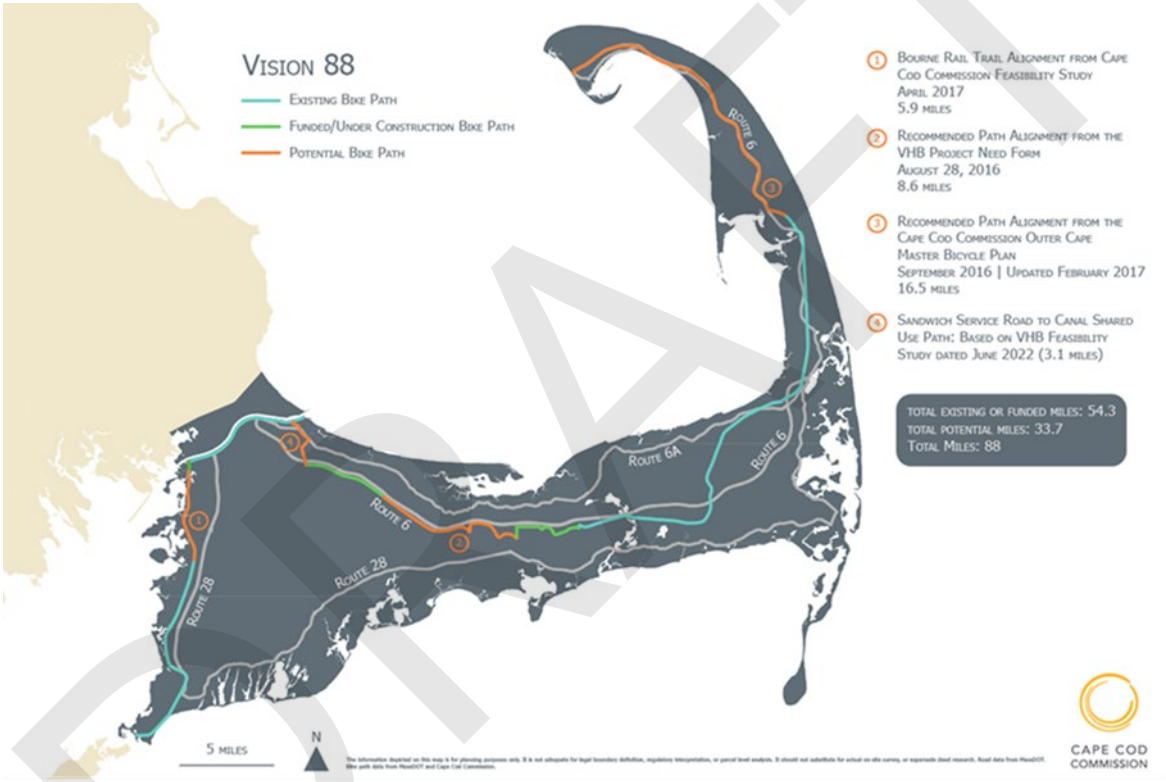

FIGURE 2. Shared Use Path Vision Map

In addition to Vision 88's goal of providing a bicycle facility network "spine" from Falmouth to Provincetown, a long-term goal is to support connections from Bourne with adjacent bicycle paths planned in the adjacent regions of southeastern Massachusetts. The Southeastern Planning and Economic Development District (SRPEDD) has a shared use path vision that will end in Wareham and it is envisioned that a connection via the Cape Cod Canal path can be constructed to connect to towns northwesterly of Cape Cod. Similarly, the Old Colony Planning Council (OCPC) has a goal to provide bicycle connections to the Cape Cod region via Plymouth and will likely connect on State Road (Route 3A) or Herring Pond Road.

EXISTING BICYCLE AND PEDESTRIAN FACILITY NETWORK

The following subsections include text, figures and tables that define and describe the bicycle and pedestrian infrastructure of Cape Cod. This information forms the baseline of the existing system and helps planners identify gaps and opportunities to improve bicycling and walking on Cape Cod

Shared Use Paths

A multi-use path is a path or trail that is physically separated from motor vehicle traffic located either within the road right of-way or within an independent right-of-way. Also referred to as multi-use paths, they include bicycle paths, rail-trails or other facilities built for bicycle and pedestrian traffic and allowing other non-motorized travel modes such as skateboards, rollerblades and strollers. Path width and surface materials may vary depending on local conditions. In areas with sensitive resources and character, designers might opt for a narrower path and non-asphalt treatment to minimize impacts to habitat and rural character.

Shared Use Path Dimensions

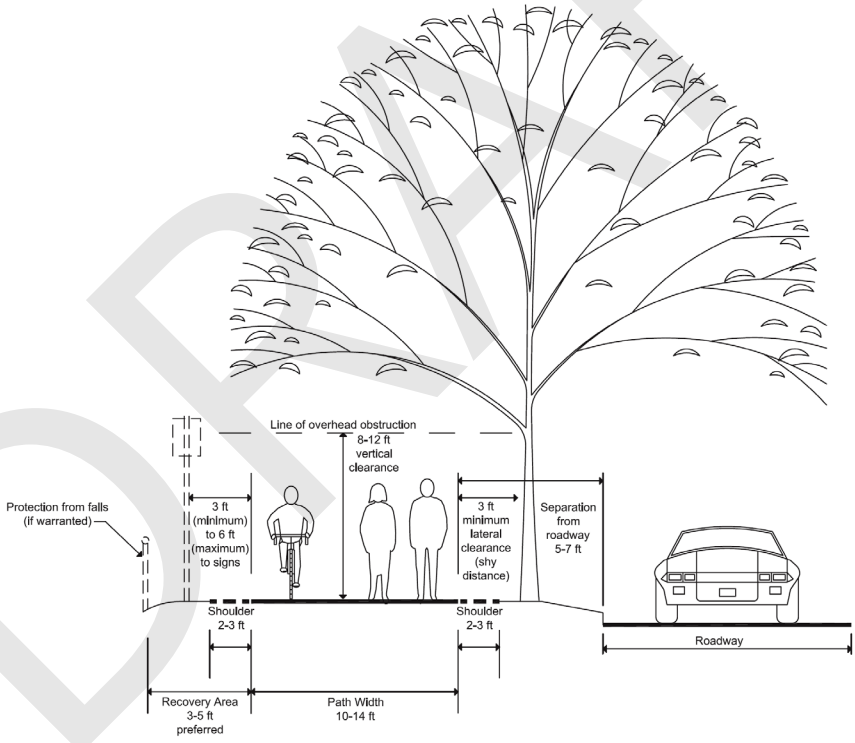

FIGURE 3. MassDOT Shared Use Path Dimensions

(Source: MassDOT Project Development and Design Guide)

Region-wide Shared-use Paths

Cape Cod is home to a growing network of shared use paths, as seen in Figure 4.

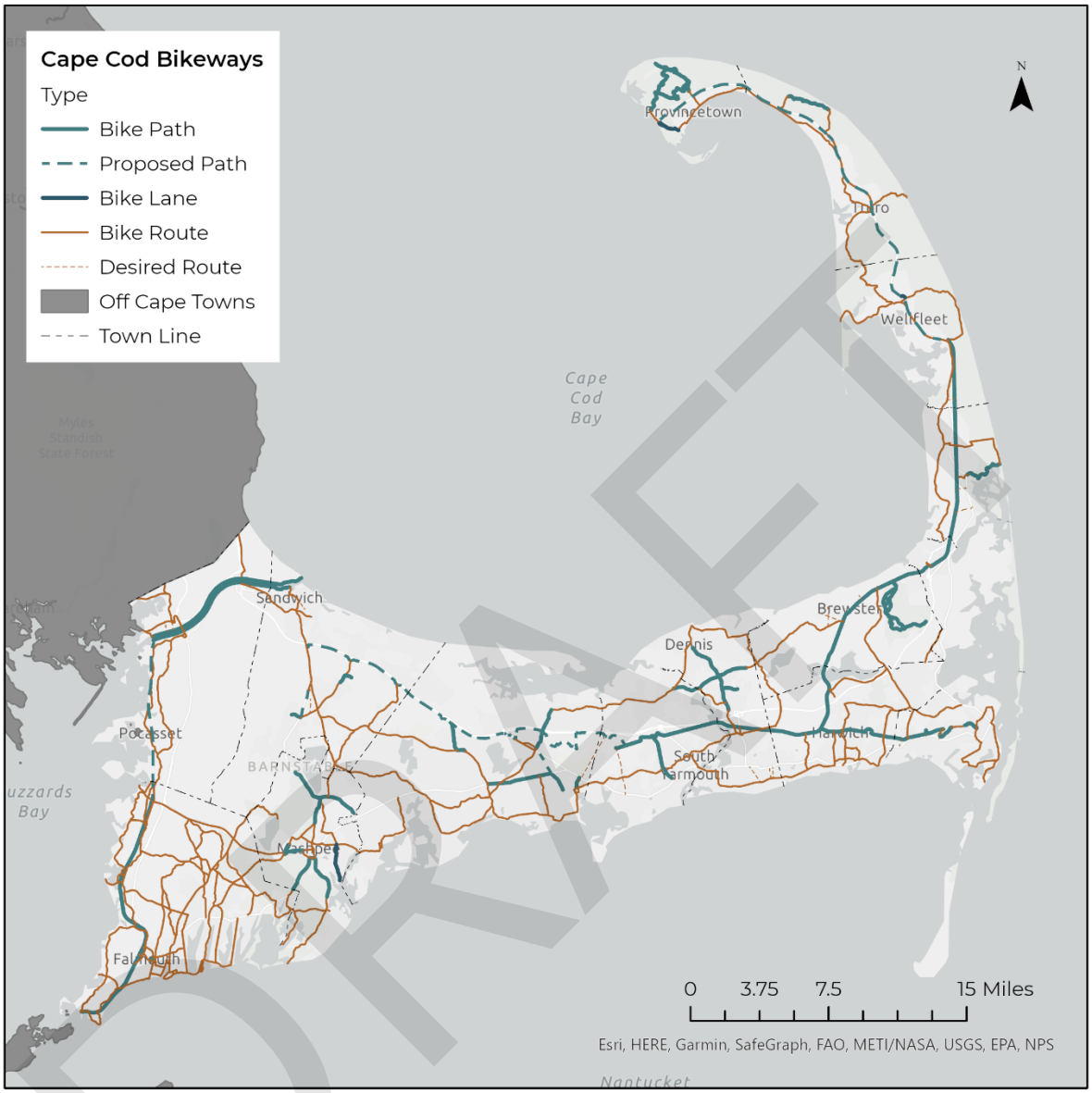

FIGURE 4. Bike Paths and Routes on Cape Cod

CAPE COD RAIL TRAIL

The Cape Cod Rail Trail was constructed in the 1970s from the out of service Cape Cod Line rail right-of-way. Several additions, including bridges over Route 6 and a tunnel beneath it, have been completed since then, with more extensions planned westward through Barnstable and Sandwich and eastward from the current terminus in Wellfleet to Provincetown. The Massachusetts Department of Conservation and Recreation (DCR) owns and is responsible for maintaining the Rail Trail.

FIGURE 5. Bicycle Roundabout on the Cape Cod Rail Trail, Harwich

Cape Cod National Seashore Bike Paths

PROVINCE LANDS TRAILS AND HERRING COVE BEACH PATH

The 7.6 miles of Province Lands Trails are located at Race Point in Provincetown. They provide a path from near Route 6 to the Provincetown beaches and the Provincetown Municipal Airport. Travelers primarily use the Province Lands Trails for recreation rather than commuting. The Park Service rehabilitated/repaired the path in 2014 to address safety concerns. The 0.1 miles long Herring Cove Beach Path serves as a connection between the Herring Cove Beach parking lot and Province Lands Road. It also connects to the Province Lands trails through the parking lot. In 2023 the Park Service programmed rehabilitation/reconstruction of the Race Point Road bike path segment from Beech Forest to the transfer station, as identified in the Outer Cape Bicycle and Pedestrian Master Plan. NPS also plans to provide a shared use path connection in the former Route 6 layout to Herring Cove Beach parking lot, also part of the OCBPMP, that eventually will link to the Town's construction of a shared use path on the south side of Route 6 as part of the Shank Painter roundabout project.

FIGURE 6. Province lands Trail at the Race Point Visitors Center, Facing West

HEAD OF THE MEADOW TRAIL

The 2-mile Head of the Meadow Trail in Truro runs from Head of the Meadow Road to High Head Road in Pilgrim Heights. As part of the OCBPMP, the National Park Service repaired and rehabilitated the trail in 2019 and added a connector piece from Highland Road along Old King's Highway. The new segment is notable for its hardened yet non-asphalt surface treatment that preserves the rural and unspoiled character of the surrounding area.

FIGURE 7. Head of the Meadow Trail in Truro

NAUSET TRAIL

The 1.9-mile Nauset Trail in Eastham runs between Salt Pond Visitor Center and Coast Guard Beach.

FIGURE 8. Nauset Trail from Coastguard Beach Parking Lot in Eastham

CAPE COD CANAL BIKE PATHS

The Cape Cod Canal Bike Paths run along both sides of the Cape Cod Canal between Bourne and Sandwich. The Army Corps of Engineers owns and maintains the paths as frontage roads for the Cape Cod Canal. Both sides have benches and sitting areas and are lit at night. The southern-side path is 6.5 miles long, 8 feet wide and has 2 roadway crossings. The mainland-side path is 7 miles long, 8 feet wide and has 7 roadway crossings.

FIGURE 9. Southern-Side of the Canal Bicycle Path, East of Sagamore Bridge

FIGURE 10. Mainland-Side of the Canal Bicycle Path, East of Railroad Bridge

FIGURE 11. Shining Sea Bicycle Path in North Falmouth

FIGURE 12. Shining Sea Bicycle Path at Palmer Ave., Falmouth

SHINING SEA BIKE PATH

The Shining Sea Bike Path, located in Falmouth, was constructed from a portion of the out-of-service Woods Hole Branch rail right-of-way. The first phase of construction, which runs from the Steamship Authority terminal in Woods Hole to the Falmouth Bus Depot on Depot Street, was completed in 1976. The bike path has been extended northward over a series of phases to its current terminus at County Road (Route 151). The trail is currently 10.7 miles long. The Cape Cod Commission completed a feasibility study in 2017 for extending the bike path into Bourne, eventually connecting to the Cape Cod Canal bike path. The 6.5-mile proposed Bourne Rail Trail extension project is in planning stages with Phase 1 expected to begin construction in 2025. The Towns of Bourne and Falmouth are jointly planning Phase 4 of the Bourne Rail Trail to connect to the current terminus of the Shining Sea Bikeway in North Falmouth.

SETUCKET ROAD AND DENNIS PATHS

Several bike paths exist in Dennis, creating a network for bicyclists and pedestrians. The longest path runs along Old Bass River Road from just south of Bob Crowell Road. The Old Bass River Road Path is 3.1 miles long. The 3.2-mile Setucket Road Path begins in Yarmouth at Route 6A and ends west of Airline Road. The path crosses Route 134 and Old Bass River Road. The third path in Dennis is the 0.7-mile Old Chatham Road path between Old Bass River Road and Route 134. These paths are owned and maintained by the Town of Dennis except for the section in Yarmouth, which is owned and maintained by that town.

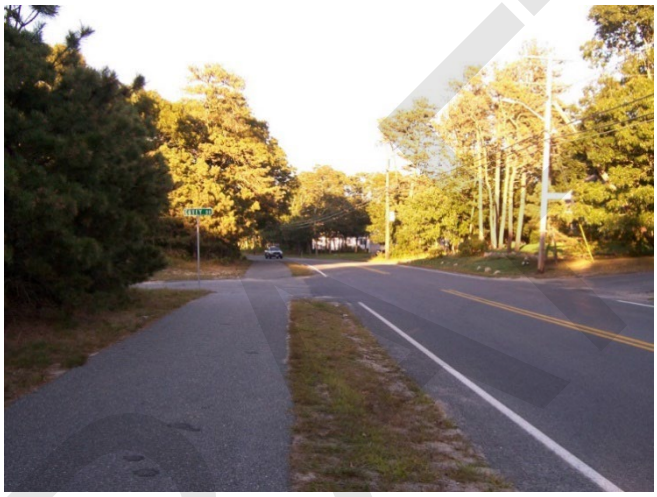

FIGURE 13. Setucket Road Path East of North Dennis Road, Looking East

FIGURE 14. Setucket Road Path East of North Dennis Road, Looking West

NICKERSON STATE PARK TRAILS

Several bicycle paths are located within Nickerson State Park in Brewster, in addition to the Cape Cod Rail Trail, which runs adjacent to and through the park. These local paths are used for recreation, offering a scenic ride through the park. They are owned by DCR, with a total of 6.8 miles of bicycle path, with six roadway crossings.

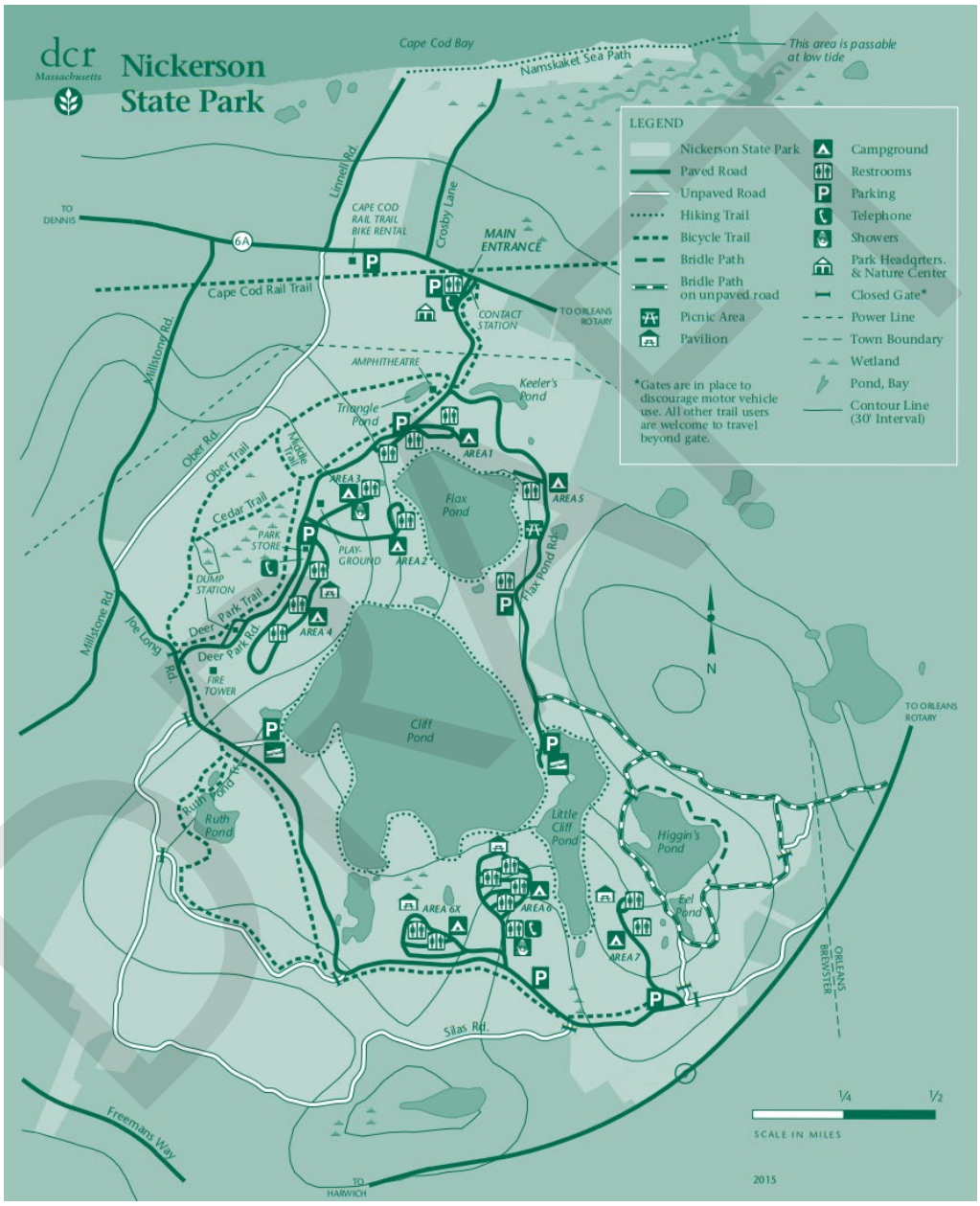

FIGURE 15. Map of Nickerson State Park Trails

(Source: Massachusetts Department of Conservation and Recreation)

ROUTE 28 PATH

The 2.5-mile Route 28 Path runs along Route 28 in Barnstable from Bearses Way to Old Stage Road. The path was constructed in 1980 by the Town of Barnstable as a safe route to the middle and high schools, but sections of the path were not designed to bicycle path standards, with narrow pavement, insufficient shoulders, and inadequate roadway crossings. The path is used primarily for commuting, as it connects residences, businesses, schools and other points of interest. The Cape Cod Commission is currently conducting a side path inventory report which includes this section of Route 28 and will identify areas needed for improvement.

ROUTE 130 PATH

The 2.4 miles Route 130 path runs along Route 130 from Heritage Memorial Park to just north of Route 28 in Mashpee. The path is owned by the town of Mashpee.

FIGURE 16. Looking North on Route 130 Bicycle Path at Lovells Lane, Mashpee

FIGURE 17. Looking South on Route 130 Bicycle Path at Lovell's Lane, Mashpee

HIGGINS CROWELL PATH

The Town of Yarmouth is constructing a 10-foot wide shared use path on Higgins Crowell Road in various segments to provide improved access to adjacent schools, recreation areas and the future extension of the Cape Cod Rail Trail. The path will extend 7,700 feet from the Higgins Crowell Road roundabout to Buck Island Road. Phase 1 of the project as sen in Figure x was constructed in 2021. Phase 2 will be completed in Summer 2023 and Phase 3 is scheduled for Fall and Winter 2023. Funding assistance is being provided through the MassTrails grant program. More details about future trail connections in Yarmouth are available at https://www.yarmouth.ma.us/1904/Shared-Use-Path

FIGURE 18. Phase 1 constructon of the Higgins Crowell Shared Use Path

OLD TOWNHOUSE ROAD PATH

The 2 mile long Old Townhouse Road shared use path runs from near Station Avenue, along Old Townhouse Road, behind the Bayberry Hills Golf Course, to Higgins Crowell Road in Yarmouth. The trail will be upgraded and become part of the Cape Cod Rail when the CCRT is extended from Peter Homer Park to Barnstable, which is expected to begin construction in 2024.

FIGURE 19. Old Townhouse Road Path at the Bayberry Golf Course in Yarmouth

FIGURE 20. Old Stage Road Path at the Service Road in Barnstable

OLD STAGE ROAD PATH

The 1.9 miles Old Stage Road Path begins at Route 149 in Barnstable, continues along the Service Road, and turns down Old Stage Road. The path ends at Oak Street, where travelers can continue by sidewalk to Route 28 and Centerville shopping areas. The path was constructed in the early 1980s and is owned by the Town of Barnstable. It is used for both recreation and commuting, connecting West Barnstable and Centerville.

FOREST ROAD PATH

The 1.4 miles Forest Road Path runs from Old Townhouse Road to Winslow Gray Road in Yarmouth. Continuing south on Forest Road, users can reach South Yarmouth and Route 28.

FIGURE 21. Forest Road Path, Looking South

ROUTE 151 PATH

The 1.1 miles Route 151 Path runs along Route 151 from Mashpee Commons to Old Barnstable Road in Mashpee and is owned by the town. At Old Barnstable Road, 2 forks turn south to access Mashpee High School. Currently, the Town of Mashpee has a Route 151 corridor improvement in various stages of design and construction from the Falmouth town line to Mashpee Rotary. Phase 1 of the project is reconstructing the existing shared use path and extending the path to Mashpee Commons. Phase 2 of the project will extend the path westerly from its current terminus at Mashpee High School to the Falmouth town line.

HYANNIS TRANSPORTATION CENTER PATH

The 0.4 Hyannis Transportation Center Path runs from Route 28 in Barnstable to Main Street

FORESTDALE SCHOOL PATH

The 0.4 Forestdale School Path in Sandwich connects Route 130 to the Forestdale School. The shared-use path serves the needs of students traveling to and from the school.

DOWNTOWN FALMOUTH PATH

The 0.2 mile Downtown Falmouth Path is located on Hamlin Street in Falmouth, between Dillingham Avenue and Katherine Lee Bates Road and is owned by the Town of Falmouth. As a connection to downtown Falmouth, the path is used to access town hall, the library, and businesses. The Downtown Falmouth Path is 0.2 miles long and has no roadway crossings

TABLE 2. Bicycle Path Mileage by Path

PATH NAME		LENGTH IN MILES	WIDTH IN FEET
Cape Cod Canal Bike Path	Total Mileage both Sides	13.6	8
Cape Cod Rail Trail	Main Path	27	8.5 / 10
Cape Cod Rail Trail	Harwich-Chatham Ext.	6.9	8.5
Downtown Falmouth Path		0.2	-
Forest Road Path		1.4	8.5
Forestdale School Path		0.4	10
Head of the Meadow Trail (with 2020 rehab)		1.9	8.5 -10
Higgins Crowell Road Path		1.4	10
Hyannis Transportation Center Path		0.4	10
Nauset Trail		1.9	8
Nickerson State Park Trails		6.8	-
Old Stage Road Path		1.9	8
Old Townhouse Road Path		2.0	8
Provincelands Trail		7.6	8-10
Herring Cove Beach Path		0.1	8
Route 130 Path		2.4	8
Route 151 Path		1.3	-
Route 28 Path		2.6	8
Setucket Road and Dennis Paths		7.0	8.5
Shining Sea Bikeway		10.6	8.5

Bicycle Lanes

MassDOT upgraded the paved shoulders on Route 6 in Truro and Wellfleet to stripe bicycle lanes in 2017 with bike lane symbols, signage and lane striping. It is currently conducting an analysis of bike lane extension into the 4-lane section of North Truro and Provincetown. The National Park Service also installed an unprotected bike lane on Province Lands Road Bradford Street and Herring Cove beach in 2011. Additionally, as part of MassDOT's Healthy Transportation Directive, small sections of bicycle lanes have been constructed as part of recent Transportation Improvement Projects (TIP) at Route 28 at Bearses Way in Barnstable, Route 28 at Jones Road in Falmouth, Route 28 at Osterville-West Barnstable, in Barnstable.

FIGURE 22. Bicycle lanes on Route 28 (North of the Jones Road Intersection) in Falmouth

Bicycle Routes

A bicycle route is any road, path, or trail that has been designated for bicycle use. These may be on side streets with low volumes of traffic or on roads with wide shoulders. Local bicycle routes are mapped and signed in towns such as Falmouth, Sandwich, Harwich, and Chatham.

CLAIRE SALTONSTALL BIKEWAY

In 1978 the Massachusetts General Court established the Claire Saltonstall Memorial Bikeway (also known as "Mass Bike Route 1" and the "Boston to Cape Cod Bikeway") as a memorial to Claire Saltonstall, daughter of Senator William Saltonstall, who died in a bicycle accident in 1974. The bike route consists of a series of interconnected on-road segments and multi-use paths beginning in Boston and ending in Provincetown. A secondary leg extends from Bourne to Falmouth. Overall, the Claire Saltonstall Bikeway is about 165 miles long.

FIGURE 23. Existing Signage on State Bicycle Route 1. A new design is underway.

The route for Cape Cod was recently revised/updated by MassDOT to maximize use of shared-use paths and more comfortable road segments where available. MassDOT is also

redesigning the Claire Saltonstall Bikeway signage and locations to improve wayfinding. New signage is scheduled to be installed in 2023/2024.

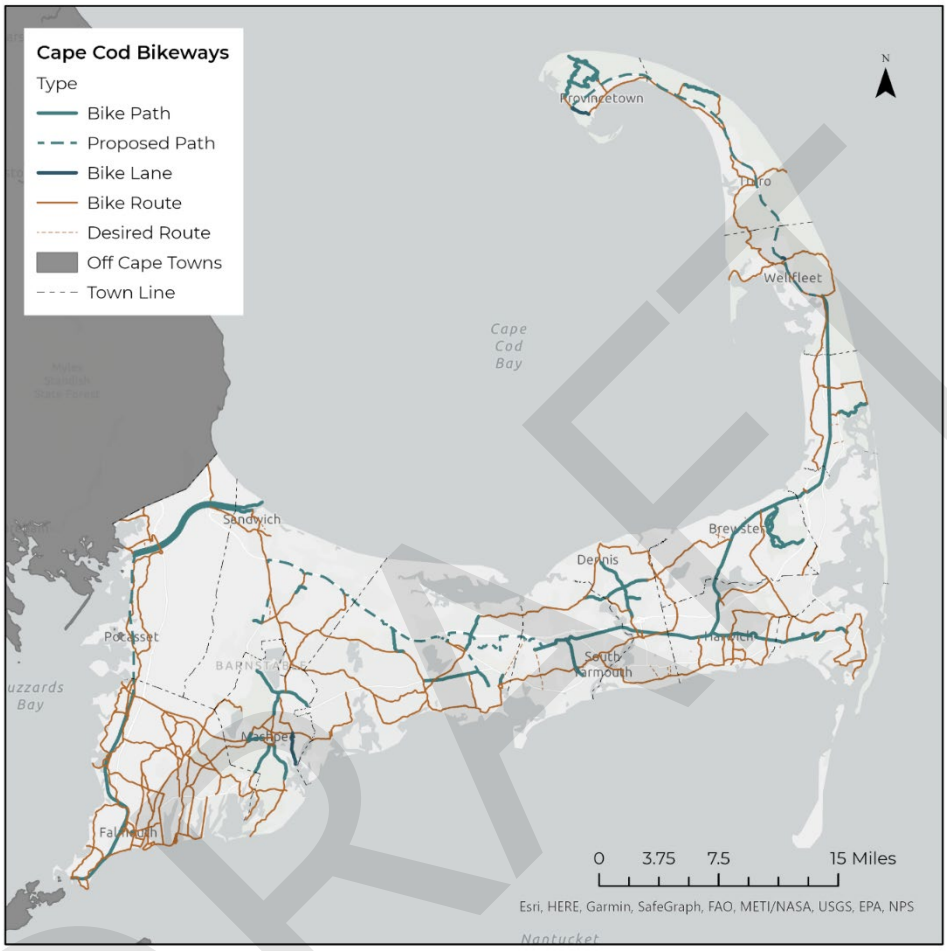

FIGURE 24. Claire Saltonstall Bikeway – Map showing recommended revised route that will be updated with new maps and signage

LOW VOLUME ROADS

Bicyclists and pedestrians can utilize low volume roads with minimal automobile conflicts. Cape Cod has over 450 miles of major roads with summer average daily volumes (ADT) of 5,000 vehicles per day or less, and over 90 miles of major roads with 1,000 vehicles per day or less. For reference, an ADT of 5,000 is equivalent to about one vehicle every seven seconds during daylight hours. An ADT of 1,000 is equivalent to about 1 vehicle every 35 seconds during daylight hours. Low volume roads are an important piece of a bicycle network, as many bicyclists are comfortable using them without a separated bicycle accommodation. Trips usually begin or end on side streets or in low traffic residential neighborhoods where they provide readily available route connections.

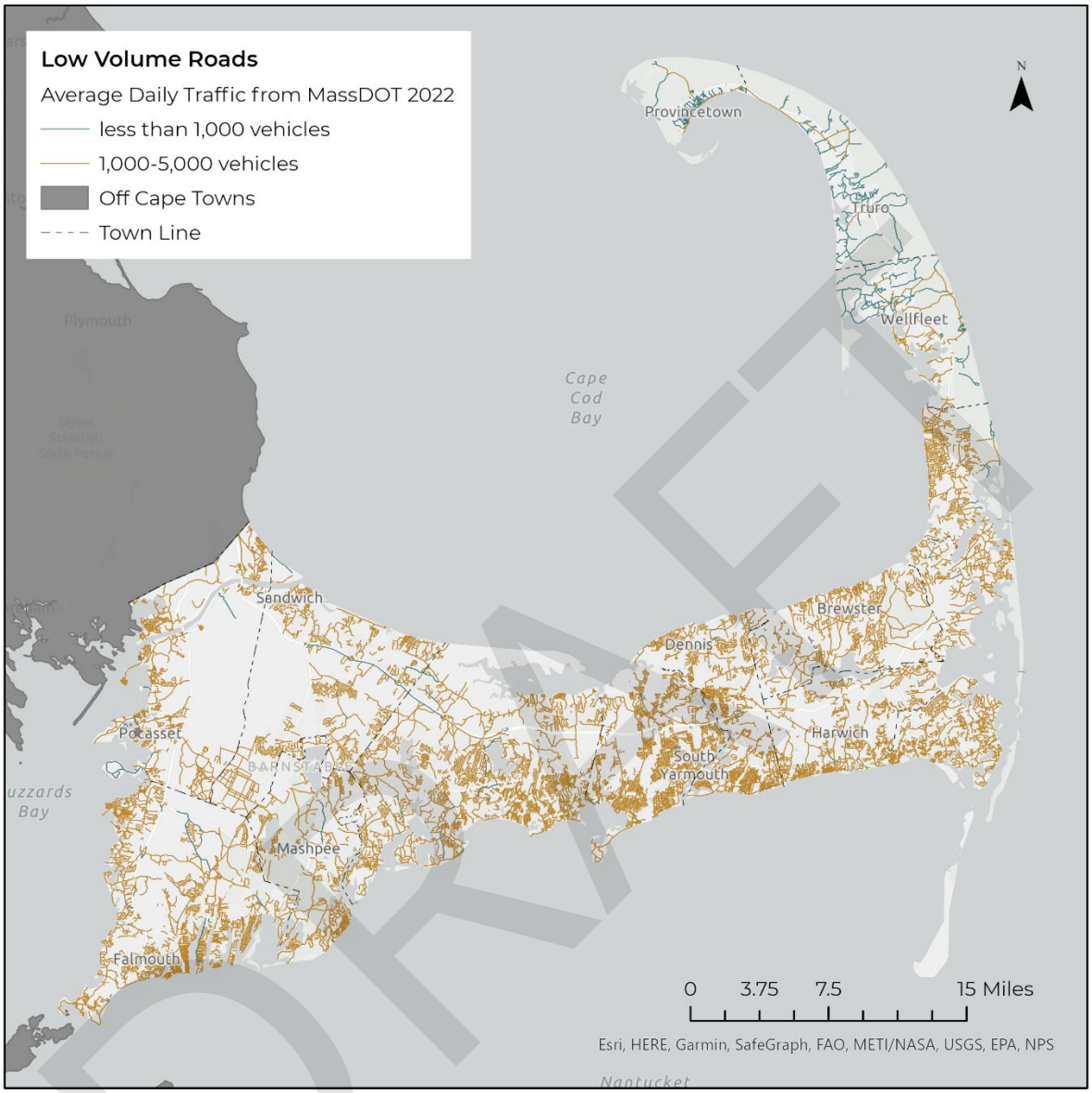

FIGURE 25. Low Volume Roads

Sidewalk Network

Sidewalks are paved surfaces, usually adjacent to roadways, which are designed primarily for pedestrian usage. Sidewalks are typically 4 to 6 feet wide, made with slabs of concrete, paved asphalt, bricks, or other hard substances. The Americans with Disabilities Act requires sidewalk curb cuts to be large enough and shallow enough for wheelchair usage. Telephone poles, road signs, and other architectural barriers must also be removed to create an unobstructed path for

walking. In Massachusetts, bicyclists may ride on sidewalks outside business districts unless otherwise prohibited by local ordinances.

Over 90% of Cape Cod roadways do not have sidewalks. While many of these streets are low volume and residential, some are not and do warrant sidewalks. On a street without sidewalks, pedestrians must walk in the shoulders or on private property. Expanding the existing sidewalk network and correcting improperly designed sidewalks will help to encourage pedestrian usage in, around, and between business and population centers.

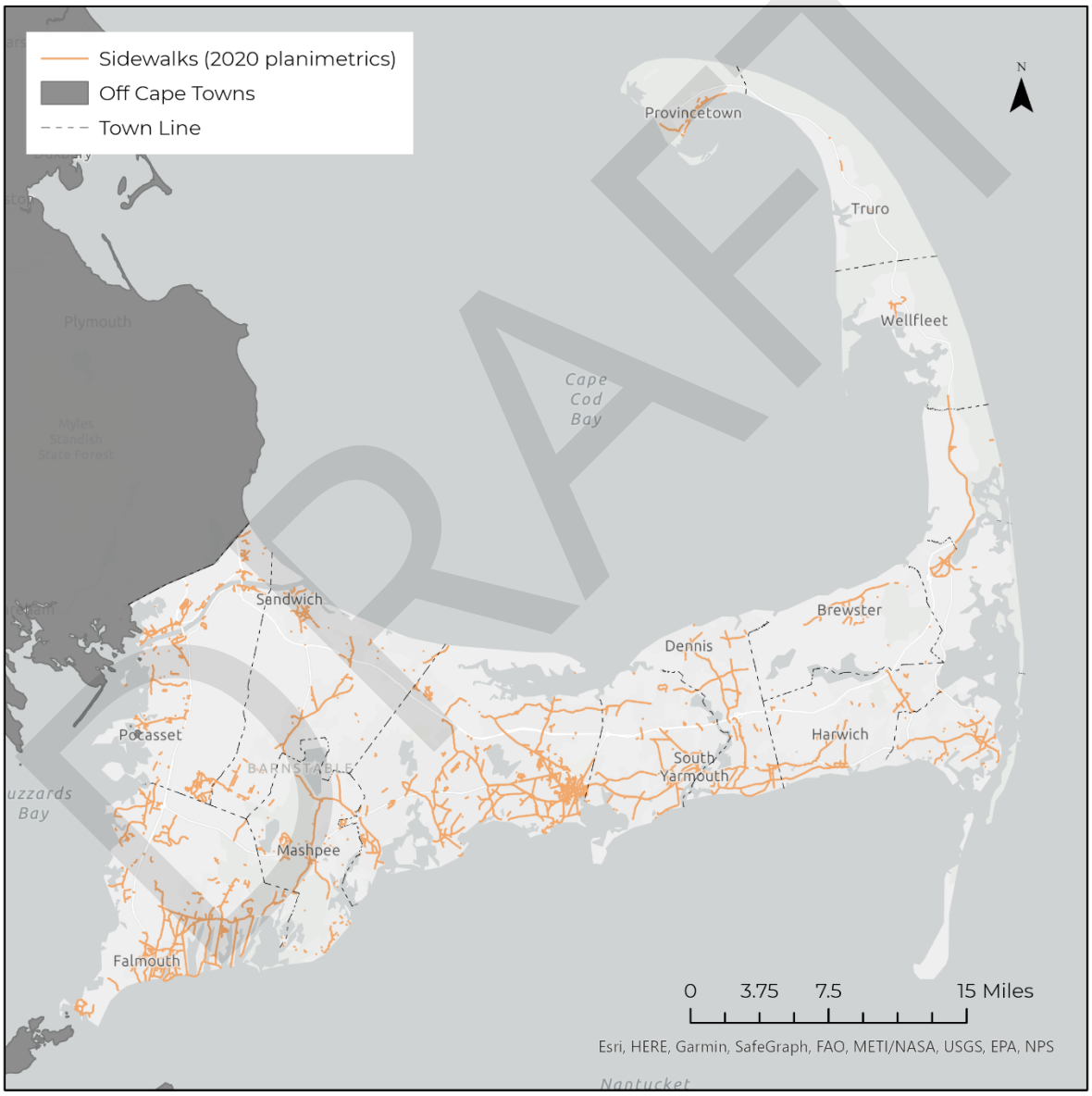

FIGURE 26. Sidewalk Network

The sidewalk network also includes crosswalks. Crosswalks provide a safe means for pedestrians and other sidewalk users to cross roadways. All crosswalks are marked on the roadway surface by white paint. Generally, crosswalks located on lower volume roads have no traffic control devices but many crosswalks have crossing signals that stop traffic, allow pedestrians to cross, and warn pedestrians when traffic is about to resume. Additionally, rectangular rapid flashing beacons (RRFB) have been installed in the region at crosswalks to provide a higher level of visibility for the vulnerable users. Several examples are seen along the region's shared use path network. An example of an RRFB installation on Great Neck Road South in Mashpee is shown below in Figure 27.

FIGURE 27. Rectangular Rapid Flashing Beacon located at the intersection of Great Neck Road South at Donna's Lane in Mashpee

Typically, crossing signals are located with traffic signals at roadway intersections but several pedestrian signals on Cape Cod are located outside of intersections. In recent years, there have been installations of Pedestrian Hybrid Beacons (PHB) which are a new traffic signal system intended to allow for a protected signalized outside of a stan. Figure 28. shows a recent PHB installation on Route 28 in Falmouth. The PHB in Falmouth provides a new safe crossing for non-motorists to access Goodwill Park and the Shining Sea Bikeway. Table 3 presents a list of PHBs located on Cape Cod.

TABLE 3. Pedestrian Hybrids on Cape Cod

PEDESTRIAN HYBRID BEACON LOCATION	TOWN	YEAR INSTALLED
Route 6 (south of Governor Prence Road)	Eastham	2020
Belmont Circle	Bourne	2022
Route 28 at Goodwill Park	Falmouth	2023

FIGURE 28. Pedestrian Hybrid Beacon located on Route 28 in Falmouth which provides a connection between the Shining Sea Bikeway and Goodwill Park

Ensuring that crosswalks are located at high pedestrian areas throughout Cape Cod will help to improve safety as well as access. Access can also be improved by ensuring that crosswalks accommodate all users, including the elderly and disabled. Properly designed curb cuts that are usable by wheelchairs, tones at crosswalk signals for the blind, and other amenities can significantly improve sidewalk access for people with mobility challenges.

Bicycle and Pedestrian Amenities

Beyond bicycle and pedestrian infrastructure, various amenities address the needs of the traveler. Employers and businesses usually have enough automobile parking. The same does not always hold true for bicycles. Bicycle racks allow the traveler to securely park their property without

fearing that it will be stolen or damaged. Water fountains, vending machines or nearby cafes provide the traveler with nourishment after their ride or walk. Fix-it repair stations allow bicyclists access to make quick repairs during their journey. The repair tool kits usually include items to change a flat tire or adjust brakes. The Cape Cod Commission's Bike Rack program[2] has allowed municipalities and other governmental agencies to install bike racks and repair stations in the region at a reduced cost through this reimbursable grant program. The program is made available from Transportation Improvement Program (TIP) funds from MassDOT and the Federal Highway Administration. Public restrooms are also useful to both pedestrians and bicyclists. Showers and locker facilities allow employees to change into clean clothes. These amenities help to encourage non-motorized transportation.

FIGURE 29. Bike repair station installed at a CCRTA bus stop located on Highland Road in Truro

According to the Massachusetts State Bicycle Plan, all such amenities address the "destination barriers" that bicyclists and pedestrians perceive, such as not being able to safely park their bicycle, showing up to work sweaty, or arriving at their workplace hungry and thirsty. By making non-motorized travel more attractive to potential users, more people will be inclined to ride a bicycle and walk to work.

[2] https://www.capecodcommission.org/our-work/bike-rack-program/

Bicycle and Pedestrian Facility Accessibility and Mobility

Not everyone can ride a bicycle or walk as their primary mode of transportation. Users must live relatively close to where they work and shop to ensure a reasonable travel time. The low density of Cape Cod development is in this way not conducive to bicycle travel. Moreover, a certain level of fitness is necessary to deal with the physical exertion. On Cape Cod, where many residents are elderly, bicycling or walking may not be practical for some travelers. Despite these barriers, potential users who can be targeted and encouraged to travel by bicycling or walking for its positive environmental, physical, and economic benefits. Bicycle paths and routes can be made more accessible by providing adequate entry points, safe roadway crossings, and proper signage.

Cape Cod Commission Transportation Staff recently performed a Rail Trail Crossing Inventory[3] and identified potential safety, accessibility and uniformity improvements for the 95 rail trail crossings. As a follow up study, staff are currently performing a side path inventory to similarly identify paths that are adjacent to the region's roadways that are in need of improvement for safety and accessibility.

Bicycle transportation can help to connect users to other modes of transportation. Because bicycles are small and lightweight, they are portable and easy to transfer from mode to mode. Bus services, such as the CCRTA, Plymouth and Brockton, and Peter Pan Bus Lines, can accommodate cyclists with racks and storage areas. The Steamship Authority and other ferry services allow passengers to bring their bicycles for a fee. Special reservations can also be made with air carriers to transport bicycles.

BICYCLE IMPROVEMENT PROJECTS

The following is a comprehensive list of ongoing or recent bicycle improvement projects on Cape Cod that are currently in conceptual planning, engineering design or in construction.

RECENTLY COMPLETED PROJECTS
Cape Cod Rail Trail Bass River Bridge construction (Dennis/Yarmouth)
Cape Cod Rail Trail extension Dennis/Yarmouth (over Route 134 & Station Ave)
Head of the Meadow Trail extension/rehabilitation (Truro)
Adams Street Bike Lane (Bourne)
DCR Cape Cod Rail Trail extension (Wellfleet)
Conwell Street Bike Lanes (Provincetown)
Belmont Circle Multi-Modal Improvements (Bourne)

[3] https://www.capecodcommission.org/our-work/rail-trail-crossing-inventory/

PROJECTS UNDER CONSTRUCTION
Cape Cod National Seashore Shared Use Path (Provincetown - Beech Forest to Transfer Station)
Cape Cod National Seashore Shared Use Path (Provincetown - Herring Cove)
Service Road Shared Use Path (Sandwich)
Phase 1 Route 151 Shared Use Path reconstruction (Mashpee)

PROJECTS UNDER DESIGN AND FUNDED
Upper Cape
Bourne Rail Trail Phase 1
Phase 2 Route 151 Shared Use Path extension (Mashpee)

Mid Cape
Cape Cod Rail Trail Phase 3 Extension (Yarmouth/Barnstable)
Higgins Crowell Road Shared Use Path (Yarmouth)
Bearses Way Shared Use Path (Barnstable)
Route 28 Shared Use Path construction (Yarmouth)

Lower Cape

Outer Cape
Route 6 Shared Use Path construction (Wellfleet)
Shank Painter Road/Route 6 Shared Use Path (Provincetown)

PROJECTS IN PLANNING STAGE/NOT CURRENTLY FUNDED
Bourne Rail Trail Phase 2
Bourne Rail Trail Phase 3
Bourne Rail Trail Phase 4/Falmouth Shining Sea Bikeway Extension
Cape Cod Rail Trail Extension Phase 4 (Barnstable)
Mashpee Rotary Shared Use Path
Airport Rotary Shared Use Path (Barnstable)
Route 6 Shared Use Path (Wellfleet to Provincetown)
Sandwich Shared Use Path (Route 130 to Canal)
Route 6 Modernization Project (Truro to Provincetown)

RECENT & ONGOING BICYCLE/PEDESTRIAN PLANNING EFFORTS

This section summarizes recent and ongoing bicycle & pedestrian studies and planning efforts underway by MassDOT, the Cape Cod Commission and/or Cape Cod towns. More information about these studies as well as links to previous studies/plans is available at: https://www.capecodcommission.org/our-work/bikeped

Massachusetts Bicycle Transportation Plan

The 2019 Bicycle Transportation Plan is the State's roadmap to make biking a safe, comfortable and convenient option for everyday travel. https://www.mass.gov/service-details/bicycle-plan

Massachusetts Pedestrian Transportation Plan

The 2019 Pedestrian Transportation Plan is the State's roadmap to make walking a safe, comfortable and convenient option for short trips for all people. https://www.mass.gov/service-details/pedestrian-plan

Massachusetts Municipal Resource Guide for Bikeability

The Municipal Resource Guide for Bikeability provides an introduction to the core concepts of bikeability and outlines additional resources available on each topic. https://www.mass.gov/files/documents/2019/06/13/2019_Municipal_Resource_Guide_for_Bikeability.pdf

Complete Streets Program

The MassDOT Complete Streets Funding Program addresses critical gaps in transportation networks by giving Massachusetts municipalities tools and funding to advance Complete Streets projects in their community. Currently, 10 Cape towns have an approved Complete Streets policy, three have an approved Complete Streets Prioritization Plan and have received a Tier 3 construction grant. https://www.capecodcommission.org/our-work/complete-streets/

MassTrails Impacts of Shared Use Paths

MassDOT and its consultant Kittleson & Associates, Inc. explored, measured and analyzed the impacts of shared use paths in respect to health, social well-being, the environment, transportation, safety and the economy. The project studied four shared use paths in Massachusetts, including the Cape Cod Rail Trail. The study, finalized in 2021, found that the Cape Cod Rail Trail generated the greatest economic output with $9.2 million in economic output with $1.5 million in local/state taxes collected and 99 jobs created or sustained.

Cape Cod Route 28 Corridor Study

MassDOT and its consultant Kittleson Associates completed a Complete Streets evaluation of Route 28 on Cape Cod in 2020 to identify short- and long-term recommendations to improve multimodal conditions. The report serves as a comprehensive guide for future corridor development.

Route 6 Truro and Provincetown Bicycle Lane Extension Study

This 2017 Cape Cod Commission study presents alternatives for accommodating bicycles on the four-lane section of Route 6 between North Truro and Provincetown as an interim step until full

implementation of the Outer Cape Bicycle and Pedestrian Master Plan, which recommends a separated multi-use path adjacent to Route 6.

Cape Cod Safe Routes to Schools Bicycle/Pedestrian Network Facility Connections

This 2017 Cape Cod Commission study provides recommendations for improved connectivity between schools and the bicycle and pedestrian facility network.

Shining Sea Extension Feasibility Study

This 2017 Cape Cod Commission study presents potential alternatives for extending the Shining Sea Bikeway from its terminus in North Falmouth to the Cape Cod Canal bike paths.

Outer Cape Bicycle and Pedestrian Master Plan

This 2017 study provides a recommended alternative for extending the Cape Cod Rail Trail from South Wellfleet to Truro and Provincetown. It also provides recommendations for bicycle and pedestrian connections to destinations in the three communities and Cape Cod National Seashore. The project was funded by the National Park Service who contracted with the Cape Cod Commission to write the plan, in partnership with the three Outer Cape towns. A steering committee comprised of two representatives from each community (town staff and bicycle committee member) plus CCNS and CCC staff guided development of the plan. The map below presents the primary route and secondary route recommendation. Several recommendations have been implemented, including extension of the Cape Cod Rail Trail along the railroad bed (though DCR did not extend to new segment to Old County Road/OKH) and improvements to Head of the Meadow Trail and the additional connection to Highland Road on Old Kings Highway. Currently programmed projects include extension of the Beech Forest Path on Race Point Road to the transfer station; construction of a bike path along the old Route 6 right of way to Herring Cove beach parking lot, construction of a bike path along the southern lanes of Route 6 between Shank Painter Road and Herring Cove. In addition, MassDOT is exploring shared use path design needs along Route 6 from Wellfleet to Provincetown.

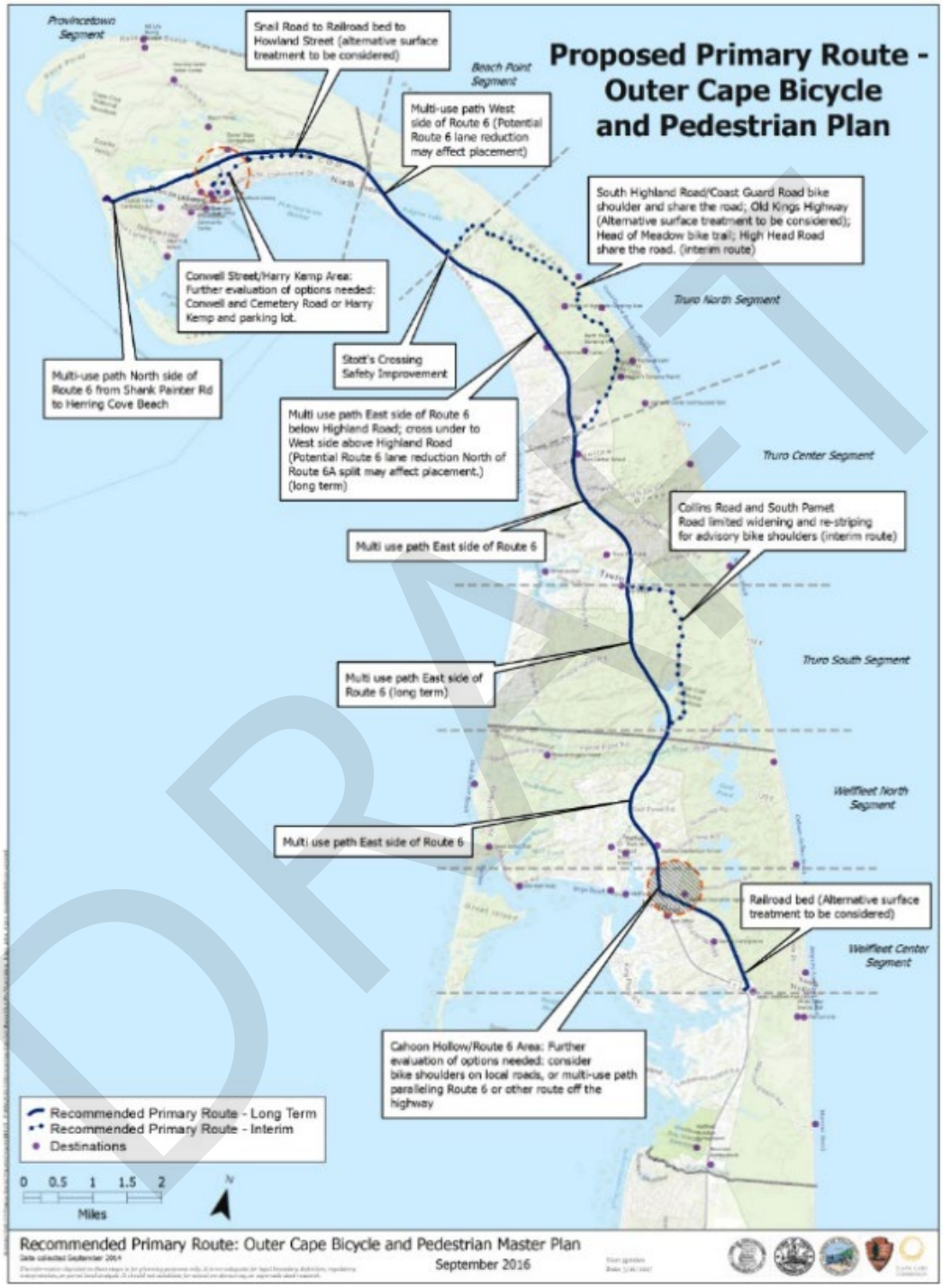

FIGURE 30. Proposed Primary Route for Outer Cape Bicycle and Pedestrian Plan

CAPE COD COMMISSION

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix G: Congestion Management Plan

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INTRODUCTION

Any urban area with a population over 200,000 is considered a Transportation Management Area, which subjects it to additional planning requirements under the U.S. DOT's Surface Transportation Program. The Cape Cod Region has been designated as a Transportation Management Area (TMA) following the 2000 Census. Under the federal statutes that define the MPO processes and requirements, these conditions make the establishment of a Congestion Management Program (CMP) a requirement of the Cape Cod Metropolitan Planning Organization (MPO).

Since the last CMP there has major changes to the federal legislation that contains requirements for transportation plans, programs, and projects. At the time of the previous CMP, the current legislation was *Moving Ahead for Progress in the 21st Century* (MAP-21) and the outgoing legislation was the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU) as well as the *Clean Air Act Amendments of 1990*. Since then, MAP-21 has been replaced by the *Fixing America's Surface Transportation Act* (FAST Act) which has since been replaced with current legislation of the *Bipartisan Infrastructure Law* (BIL).

Significant Legislative Elements

The CMP shall be developed, established, and implemented as part of the metropolitan planning process in accordance with 23 CFR 450.322(d). The statute includes the following requirements:

1. Methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of congestion, identify, and evaluate alternative actions, provide information supporting the implementation of actions, and evaluate the efficiency and effectiveness of implemented actions.

2. Definition of parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion-reduction and mobility-enhancement strategies for the movement of people and goods. Since levels of acceptable system performance may vary among local communities, performance measures and service thresholds should be tailored to the specific needs of the area and established cooperatively by the State, affected MPO(s), and local officials in consultation with the operators of major modes of transportation in the coverage area.

3. Establishment of a program for data collection and system performance monitoring to define the extent and duration of congestion, to help determine the causes of congestion, and to evaluate the efficiency and effectiveness of implemented actions. To the extent possible, existing data sources should be used, as well as appropriate application of the real-time system performance monitoring capabilities available through Intelligent Transportation Systems (ITS) technologies.

4. Identification and evaluation of the anticipated performance and expected benefits of appropriate traditional and nontraditional congestion management strategies that will contribute to the more efficient use of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, should be appropriately considered for each area:

    - Transportation demand management measures, including growth management and congestion pricing;
    - Traffic operational improvements;
    - Public transportation improvements;
    - ITS technologies; and,
    - Where necessary, additional system capacity.

5. Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy (or combination of strategies) proposed for implementation.

6. Implementation of a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures. The results of this evaluation shall be provided to decision makers to provide guidance on the selection of effective strategies for future implementation.

CONGESTION MANAGEMENT PLAN PROCESS

The CMP follows the federal guidance for an objectives-driven, performance-based approach consisting of the following eight actions:

- Develop Regional Objectives
- Define CMP Network
- Develop Multimodal Performance Measures
- Collect Data/Monitor System Performance
- Analyze Congestion Problems and Needs
- Identify and Assess Strategies
- Program and Implement Strategies

- Evaluate Strategy Effectiveness [1]

CONGESTION MANAGEMENT BACKGROUND

The Congestion Management Program is a collaboration of other ongoing regional efforts including the Regional Transportation Plan, Transportation Improvement Plan (TIP) and the Unified Planning Work Program (UPWP). The goals and objectives developed for the RTP are echoed in the CMP as well. As part of these on-going documents, congestion management is continually monitored, evaluated, and measured within the regional transportation system. Our annual traffic count program monitors traffic volumes and travel patterns within the region, while our annual studies conducted as part of the UPWP evaluate existing congestion roadway links and recommend alternative strategies to mitigate regional congestion.

The CMP is also intended to be a planning tool to help reduce mobile source emissions and improve regional air quality. To support this planning tool, monitoring of transportation system performance is an ongoing activity for the Cape Cod region.

"Congestion" is defined as travel time or delay more than that normally incurred under light or free-flow travel conditions. There are two primary types identified for congestion and a successful congestion management program should address both types of congestion. The two types of congestion are:

1. Recurring congestion that tends to be concentrated into short time periods, such as "rush hours" and is caused from excessive traffic volumes resulting in reduced speed and flow rate within the system, and
2. Non-recurring congestion caused from unforeseen incidents (road accidents, weather events, construction work zones) which affect the driver behavior to a considerable extent.

Regarding the Cape Cod region, there are several factors that attribute to recurring congestion:

- Natural geometry of the region as it is surrounded by water and uniquely shaped with only two regional roadways.
- Vehicular access to the region is limited by two antiquated bridge structures across the Cape Cod Canal that are subject to frequent maintenance activities.
- Limited presence of multi-modal options connecting Cape Cod to the urban areas of Massachusetts (i.e., commuter rail and ferry routes).

[1] Congestion Management Process: A Guidebook. Federal Highway Administration. April 2011. Report No. FHWA_HEP_11_011.

- The Cape Cod region is home to an established community of secondary summer homes and is a vacation destination, which greatly increases traffic volumes and congestion periods.
- Access to the highly seasonal islands of Nantucket and Martha's Vineyard is provided from Cape Cod via ferry routes and airline connections.

However, the Cape Cod region also has some strengths that present unique opportunities for the management of congestion:

- The region has an established and active public transit authority (Cape Cod Regional Transit Authority (CCRTA)), consisting of seven (7) fixed route transit bus routes, dial-a-ride (DART) or paratransit service, seasonal trolley service and the Hyannis Transportation Center.
- The CCRTA is piloting a service that provides an app based, on-demand service called SmartDART that is a door-to-door, ride-hail service using the SmartDART App which is similar to Uber and Lyft. This service is currently only available in Yarmouth and Barnstable.
- A seasonal commuter passenger rail service, known as the CapeFlyer, was established in 2013 in collaboration with MassDOT, the Massachusetts Bay Transportation Authority (MBTA) and the CCRTA, and provides passenger rail service between Boston and Cape Cod. The service runs on the weekends, beginning Friday evenings between Memorial Day weekend and Labor Day weekend.
- The Cape Cod region has GO Time Intelligent Transportation signs which are able to display average travel times to locations by anonymously tracking Bluetooth technology carried by drivers, measuring speeds and travel times. These intelligent transportation systems are helpful in reducing the amount of congestion on major routes. Motorists can see the current travel times to popular destinations from their current position allowing for them to seek alternative routes if need be.
- The region has an established network of multi-use paths and rail trails, including the Cape Cod Rail Trail, the Old Colony Rail Trail, Cape Cod Canal Path, and the Shining Sea Bikeway with several expansion routes planned. In addition, the region's municipalities have a growing interest in bicycle accommodation for on road facilities.

Critical to the concept of congestion management is the understanding that the acceptable system performance may vary by type of transportation modes and systems, geographic location, season, and/or time of day. The philosophy of the Cape Cod RTP and CMP is not to build to accommodate the peak season demand, but to provide adequate transportation for year-round travel and to provide and promote alternatives to the automobile. This is different from many of the regions in Massachusetts and across the nation. The Cape Cod CMP places much more emphasis on management of traffic and providing alternatives to the automobile for transportation rather than accommodating traffic demand.

CONGESTION MANAGEMENT NETWORK

The Congestion Management Network for the Cape Cod region was developed based on its unique attributes of its landscape and seasonal nature. The Cape Cod region includes 15 towns with an average population of over 200,000 year-round residents, which spikes to approximately 500,000 during the summer peak season. Due to the unique geography of the Cape Cod landscape, the region is mainly served by two main linear corridors, Route 6 and Route 28, that provide a regional connection to all 15 towns. The network for the congestion management focuses on these two main arterial roadways which handle many of the regional vehicular trips, experience reoccurring congestion and have a known crash history. Both corridors currently provide transit service and have the greatest potential for an improved multi-modal environment. As shown in Figure 1, Route 28 and Route 6 are the two main arteries that serve the Cape Cod region and coincide with other multi-modal facilities in the region. Also included in the Network are Scenic Highway, Sandwich Road and the sections of Route 25 and Route 3 that are in Barnstable County. These roadways are important to the Network as traffic that moves through the region to Route 28 and Route 6 utilize these roadways.

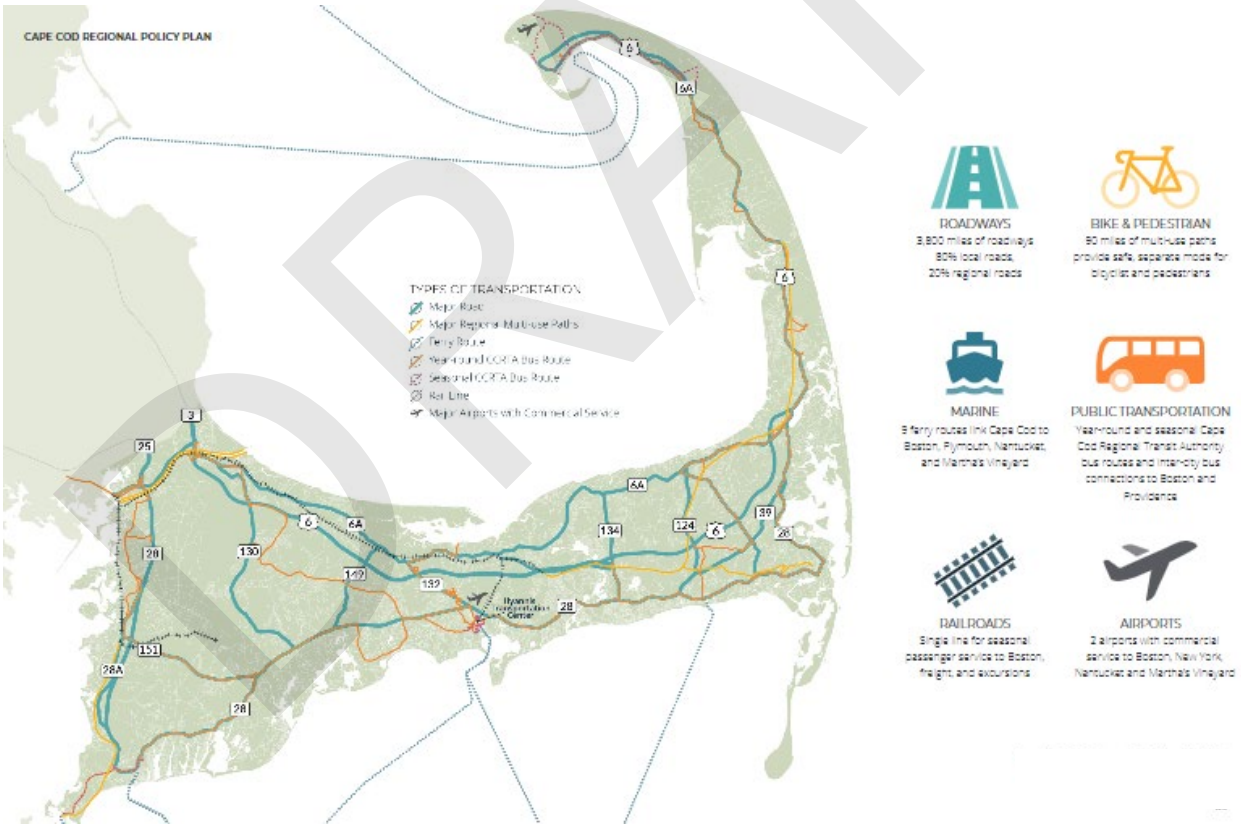

FIGURE 1. Cape Cod Regional Roadways

Route 6

On Cape Cod, Route 6 is the major transportation corridor, particularly for those traveling long distances. From where it enters Barnstable County in Buzzards Bay until its end in Provincetown, it provides a primarily limited-access high-speed means of traveling along the spine of the Cape for commercial traffic and is under the jurisdiction of MassDOT. The Route 6 corridor in the Outer Cape does not have limited access and consists of a four-lane cross section with commercial curb cuts. This portion of Route 6 also contains segments of the Claire Saltonstall Bikeway, or State Bicycle Route 1, but with limited pedestrian and bicycle accommodations. The CCRTA runs transit service on Route 6 on the Outer Cape via the Flex Route from Harwich to Provincetown. Within the Mid-Cape, Route 6 carries a summer ADT count of approximately 65,000 and within the Outer Cape, Route 6 carries a summer ADT of approximately 24,000. The posted speed limit on Route 6 is 55 miles per hour (mph) within the four-lane divided highway section from Sagamore Bridge to Exit 9, 50 mph on the two-lane divided highway section from Exit 9 to the Orleans Rotary and 40 mph on the Outer Cape portion.

During peak travel periods in the summer, it is not unusual for westbound traffic to be stopped for several miles east of the Sagamore Bridge or at various bottleneck points. The two most notable bottlenecks on Route 6 are at the Sagamore Bridge and the section of Route 6 in Dennis where is changes from a four-lane cross section to a two-lane cross section. A third bottleneck is on Route 6 in Wellfleet where the cross section again changes from four lanes to two lanes. MassDOT has installed "Go Time Intelligent Transportation" signs on Route 6, which provide real-time traffic travel times to major points, such as Hyannis, Provincetown, and the Sagamore Bridge.

Route 28

Route 28 runs for almost sixty-five miles after crossing the Cape Cod Canal and passing through villages adjacent to Buzzards Bay/Nantucket Sound/the Atlantic Ocean from Bourne to Orleans Center. Route 28 is a regional roadway, but it does not provide direct inter-regional travel options in most cases. The cross section of Route 28 varies greatly throughout the Cape. For the purposes of the CMP, there are two primary sections to Route 28, which are identifiable by their roadway characteristics. Both sections are under the jurisdiction of MassDOT. Most notably is the section within the towns of Bourne and Falmouth that is classified as a limited-access highway with high travel speeds and carries a summer ADT of approximately 38,000. MassDOT installed "Go Time" signs on this portion of Route 28, providing real-time traffic travel times to major points, such as Woods Hole and the Bourne Bridge. The other notable section is the urban major arterial section of Route 28 which spans from Falmouth to Orleans. This section has varying travel speeds and changing levels of pedestrian and bicycle accommodations. Route 28 within the Mid-Cape carries a summer ADT of approximately 31,000. The CCRTA runs two transit bus lines, the Sealine and the H2O line along Route 28 from Falmouth to Orleans.

Traffic flow along the corridor is generally heavy during the summer, with gridlock occurring in many locations. However, the level of traffic varies greatly along the corridor. Much of the Route 28 corridor is congested during summer peak hours. Some sections, such as in Hyannis and Falmouth, can experience congestion year-round. One of the most notable regional bottleneck areas on Route 28 is at the Bourne Bridge and the Bourne Rotary.

REGIONAL GOALS AND OBJECTIVES

The congestion management goals and objectives are in concert with the goals developed as part of the Cape Cod Region RTP. Specially, the following three goals are the focus for the CMP:

Goal 1: Improve Safety

- Objective: Reduce crashes on Route 28 and Route 6 for all modes of travel.

Goal 2: Increase Multi-modal Accommodations

- Objective: Increase multi-modal options for non-motorists along Route 28 and Route 6 to reduce single occupancy vehicles and reduce congestion.

Goal 3: Reduce Congestion

- Objective: Aim to reduce congestion at specific bottleneck intersections on Route 28 and Route 6 on Cape Cod.

MULTI-MODAL PERFORMANCE MEASURES

The following multi-modal performance measures have been identified as part of the congestion management process and mirror the vision that has been developed for the RTP.

Traffic Volumes

Traffic volumes are at the core of the data collection process, especially for a seasonal area such as Cape Cod. Traffic volumes are collected during the summer peak season on area roadways and intersections and reveal our most heavily traveled corridors. Traffic volume data reveals peak days and time periods, as well as where congestion points may occur. Many of the other safety performance measures listed below are dependent on traffic volumes (i.e., crash rates, volume to capacity ratio).

Travel Time Reliability and Planning Time Index

On Cape Cod, like other high traffic regions, travel times can vary greatly from day to day and therefore it is useful to have a measure of expected total travel times. To measure Travel Time Reliability (TTR), Planning Time Index (PTI) can be utilized to calculate the extent of this unexpected delay. The PTI represents the total travel time that should be planned for a trip when an adequate buffer time is included. TTR is significant to many transportation system users as it can better quantify the benefits of traffic management and operation activities than simple averages.

Number of Crashes (All Modes)

The total number of crashes directly relate to problem areas with safety issues based on the frequency. Crash data for the Cape Cod region is inventoried on an annual basis to identify the worst intersections in our region based on several different factors, including the total number.

RITIS Bottleneck Ranking Data

Regional Integrated Transportation Information System (RITIS) is a data-driven platform for transportation analysis, monitoring, and data visualization. MassDOT is using RITIS data for tracking congestion patterns and bottlenecks on roadways. This system is useful to the Cape Cod Commission for seeing real-time and past roadway congestion events as well as to develop a bottleneck ranking list for the region.

Transit Ridership

The number of transit riders is regularly collected by transit agencies and indicate how well the transit route is performing from a location and service perspective.

Park and Ride Lot Usage

Park and Ride lots provide people with the opportunity to carpool or take alternative transportation, such as bus service or bicycling. Parking counts at the three Park and Ride lots on Cape Cod are performed regularly throughout the course of a year. Park and Rides are used frequently by area residents to commute to Boston and/or Logan Airport.

Walkability Rating

Walkability rating refers to the sidewalk condition, connectivity, and comfortability for the pedestrian. Sidewalks along the Route 6 and Route 28 corridors will be rated based on these parameters.

Transportation Demand Management

Transportation Demand Management (TDM) measures assist in reducing congestion on areas roadways by encouraging alternate modes of travel, such as carpooling, walking, bicycling, and transit service. Employers may also provide benefits to help reduce off-site vehicle trips throughout the workday. TDM measures are encouraged for private development projects on Cape Cod through Development of Regional Impact (DRI) permitting through the Cape Cod Commission.

DATA COLLECTION AND SYSTEM PERFORMANCE MONITORING

A multitude of data collection processes are performed annually for the Cape Cod region and will be analyzed as part of the CMP process. The data collected in the monitoring process will be continually compared to the measures developed to define congestion. The comparison will be used to identify congested areas and trigger an investigation into the nature of the demand problems. These demand issues are expected to include regional traffic flows, local traffic generators, geometric problems, and access problems. The annual traffic studies pursued by the Cape Cod MPO staff will be guided by the CMP and target areas for further study.

The following programs are currently underway and will continue an annual basis. These existing programs are anticipated to provide the bulk of the data for the CMP.

Traffic Volumes

The Cape Cod Commission, funded by MassDOT, has been collecting traffic data since 1984. This data includes traffic volumes on key roadway segments around Cape Cod and turning movement counts collected at key intersections. The traffic counting program is established in a systematic way to provide historic data at key locations as resources allow. Counts are also made to support traffic studies and, in areas of concern, to identify congested situations. Development of the annual traffic counting program is done in consultation with the Cape Cod Joint Transportation Committee. The principal product of this effort is the annual traffic counting report.

The traffic counting program will continue to provide data for the CMP. Examination of changes in traffic volume will be done and trends will guide further investigation of traffic problems as part of the CMP. As the traffic counting program is defined each spring, counts to investigate suspected or identified congestion areas will be included. In addition, counts will be programmed to monitor congestion in areas where CMP initiatives are in place.

Measures of seasonal as well as year-round congestion need to be developed through the traffic counting program in addition to monitoring of the travel times as well as transit usage. Development of relative conditions and trends between seasonal demand and winter demand periods must also occur to help determine appropriate strategies for addressing congestion.

Recurring congestion often occurs during "rush hours" in the off-season, however, during the peak summer season volumes are found to generally be consistently high throughout the day on Route 28 and Route 6, as shown in Figure 2.

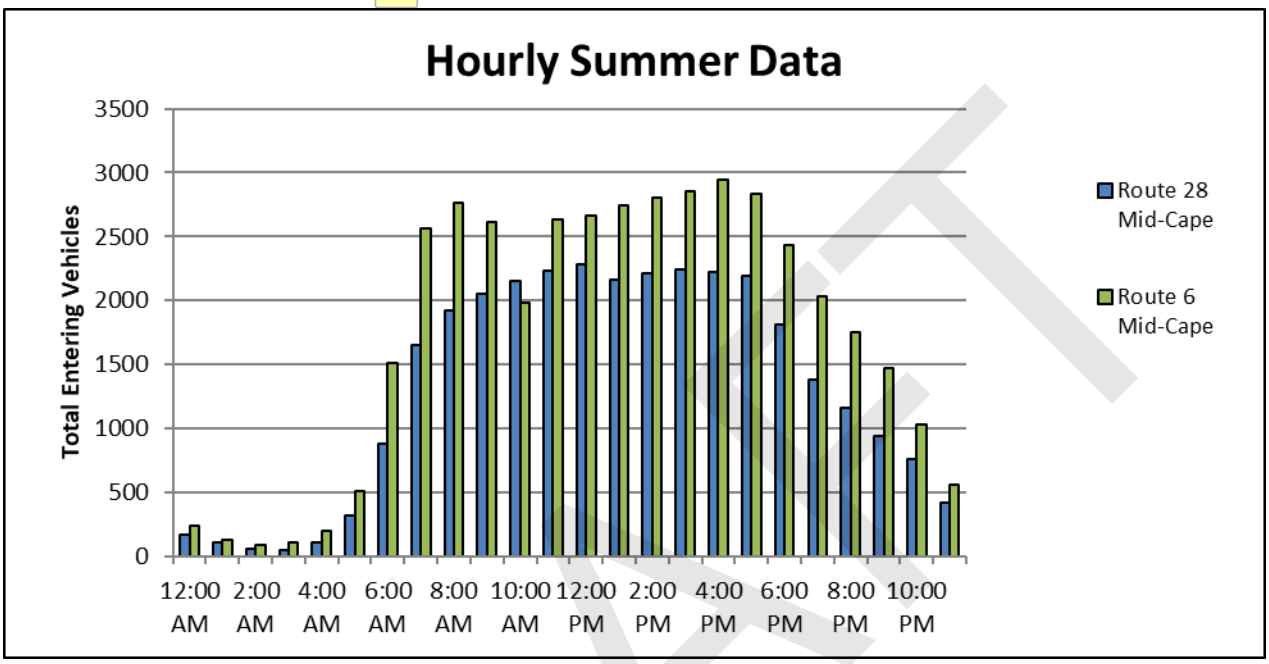

FIGURE 2. Route 6 and Route 28 Hourly summer volume data

In addition, during the summer peak season there are the well-known weekend congestion periods on Route 6 and at the Cape Cod Canal bridges, most notably on Friday afternoons and Saturday mornings for visitors arriving to the Cape and on Sundays with visitors leaving the Cape. Additionally, most weekly rental homes turn over on Saturdays, so this change-over period also adds to the congestion period. Unfortunately, the traffic woes and congestion periods have become the norm to most roadway users and motorists plan accordingly around the congestion.

The traffic counting program is the base data source for developing trends in traffic growth and potential for growth in traffic congestion. The following information is from the *Cape Cod 2019 Traffic Counting Report* published in September 2022. The full report and access to mapped traffic counts are available at:

www.capecodcommission.org/counts

The Massachusetts Department of Transportation (MassDOT) maintains seven permanent counter locations on or near Cape Cod on some of the more heavily trafficked roads. The following table displays those locations with their ten-year growth, ten-year average annual growth, and one-year growth rate (2018-2019).

TABLE 1. Growth Rates - Permanent Counting Stations and Bridge Crossings

PERMANENT TRAFFIC COUNTING STATION	10 YEAR TOTAL GROWTH	10 YEAR AVERAGE ANNUAL GROWTH RATE	ONE YEAR GROWTH RATE 2017-2018
#15: Rt 6 E of Rt 149 (Ex. 5)	-4.30	-0.44	n/a
#20: Rt 3 N of Bourne TL	6.26	0.60	0.63
#707: Bourne Bridge	-2.32	-0.24	-0.12
#708: Sagamore Bridge	12.11	1.14	9.03
#709: Rt 28 E of Higgins Crowell	-7.44	-0.77	n/a
#7322: Rt 28 S of Otis Rotary	6.44	0.62	n/a
#7351: Rt 28 W of Old Post Rd	0.25	0.02	7.89

It is important to note that growth is based on summer traffic volumes, not off-season values.

MassDOT's permanent counting stations can be used to show a trend in road usage over time. Table 1 shows that, traffic volumes on Route 6 and Route 28 have decreased over the last ten years. Route 3 north of the Bourne/Plymouth town line has seen 6.26% growth since 2009. The Sagamore Bridge has seen 12.11% growth since 2009, while the Bourne Bridge has seen a negative growth of -2.32%. Due to equipment problems, not all stations were available for analysis. A new MassDOT counting station on Route 28 south of the Otis Rotary in Bourne became operational at the beginning of 2015 and is now included in growth calculations.

TABLE 2. Cape Cod Summer Traffic Growth (2009-2019)

REGION*	NUMBER OF COMPARISONS**	10-YEAR TOTAL GROWTH (%)	10-YEAR ANNUAL AVERAGE GROWTH RATE (%)	ONE-YEAR GROWTH RATE 2018-2019 (%)
Upper Cape	160	6.10	0.59	1.29
Mid-Cape	151	1.85	0.18	3.00
Lower Cape	108	2.42	0.23	4.07
Outer Cape	79	6.15	0.59	-4.52
All Roads	**498**	**3.99**	**0.39**	**2.15**

*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 Cape Cod Center for Sustainability traffic congestion indicator is based on average annual daily bridge crossings over the Sagamore and Bourne bridges. While there are many possible indicators of congestion, bridge traffic is easy to measure, provides data on long-term trends, and has significant implications for traffic Cape wide, as many who bring their cars across the bridge use them for virtually all local or regional trips.

Bridge crossings have been rising steadily for most of the past 50 years. Traffic data has been collected at permanent count stations at both bridges since 1972. Carrying roughly twice as many vehicles today as in 1972, the story of traffic over the bridges is the story of traffic on Cape Cod.

As shown in the figure below, both summer and annual average daily traffic (ADT) over the bridges showed an overall upward trend from the early 1970's through the early 2000's. Traffic volumes, on average, dropped from 2002 to 2007 before trending slightly upward in recent years. This figure is missing date from 2013 to 2019 due to traffic counters have not able to supply consistent data throughout those years. Since the COVID-19 Pandemic in 2020, there was a major dip in ADT over the Bourne and Sagamore Bridges as most of the country experienced lockdowns and or were placed in quarantine. In 2020, the ADT over the bridges was close to the same amount as in 1990 and 1991. Since the initial start of the pandemic, the ADT in this location has see a new maximum, in 2021, and has been leveling out to the same ADT range as the early 2000s and the 2010s. As ADT data becomes available for 2023, it will be interesting to see if there is a downward or upward trend developing after such massive extremes.

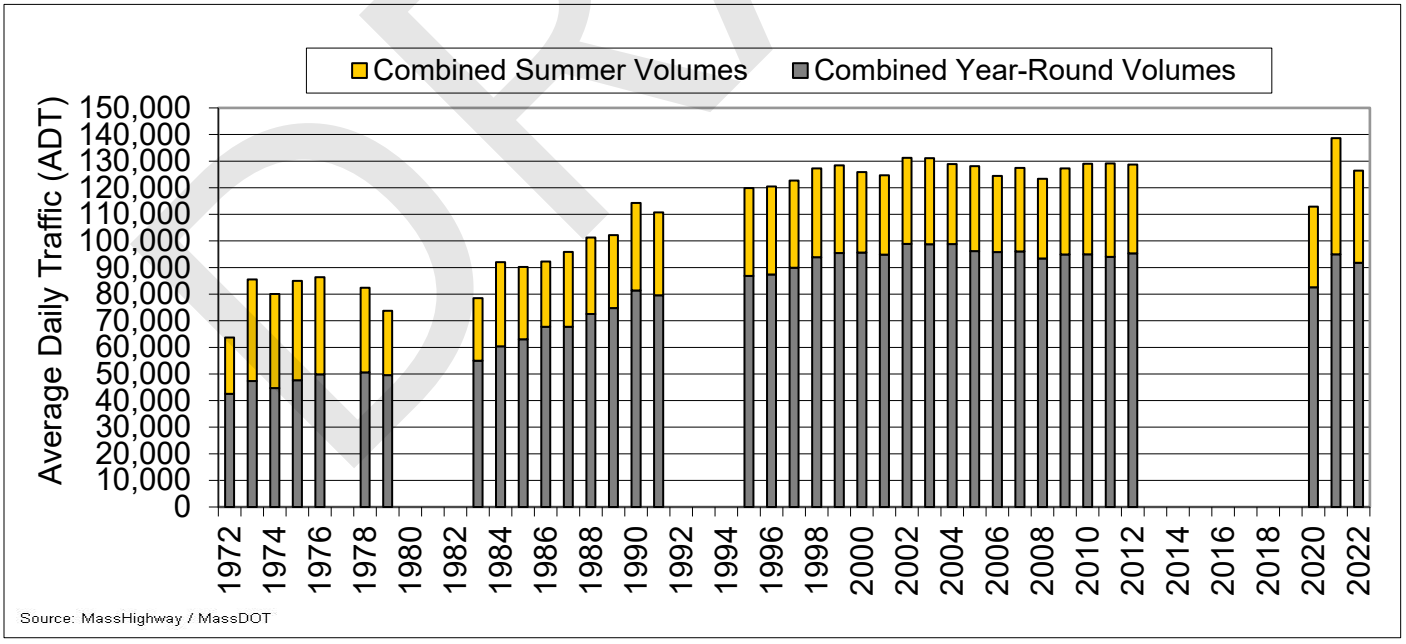

FIGURE 3. Combined Average Daily Traffic over Bourne and Sagamore Bridges

Seasonal traffic trends over the bridges have also changed considerably over the years. Since 1972, traffic has tended to be more spread out over 12 months as opposed to concentrated during the summer months. In the following figure this trend, ADT from 1972, 2011, 2018 and 2022 can be seen. In the past decade, ADT has been nearly double for every month when compared to 1972. There were a variety of ten months of available data for 2018, these counts are displayed below to show the traffic volume trends along with 2011 for comparison. The 2022 ADT for each month is also displayed, as that is the latest yearly ADT data available for contrast.

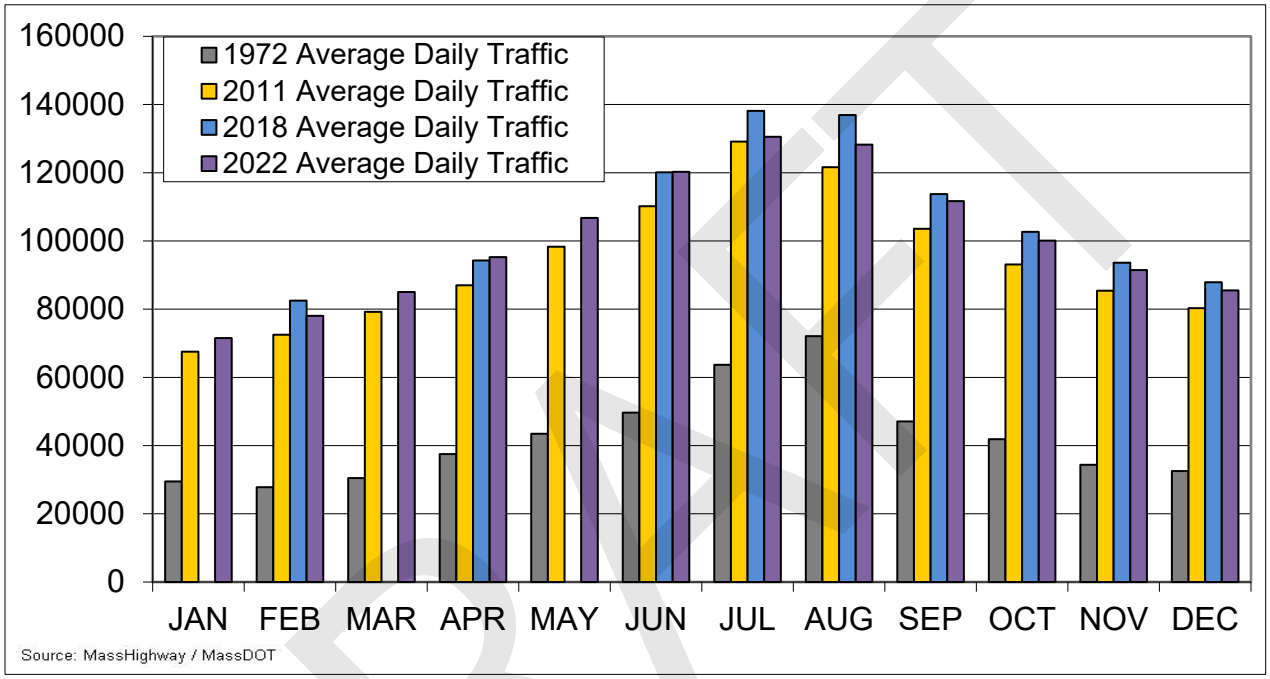

FIGURE 4. Historic Monthly ADT Changes at the Cape Cod Canal Bridges

The following figure compares the monthly directional ADT in both directions on the Bourne and Sagamore Bridges 2022. The Sagamore Bridge was consistently crossed more each month. In the summer months, both bridges received increased traffic and the difference in usage between the bridges increased.

The different usage of the two bridges shows a similar trend when examining directional volumes, as shown by the following figure. More vehicles cross the Sagamore Bridge than the Bourne Bridge each month. The larger number of users on the Sagamore could indicate that drivers tend to favor this bridge over the Bourne Bridge as a way of traveling to and from their Cape Cod destinations. The access to and from the Canal roadways to the bridges varies in each crossing direction.

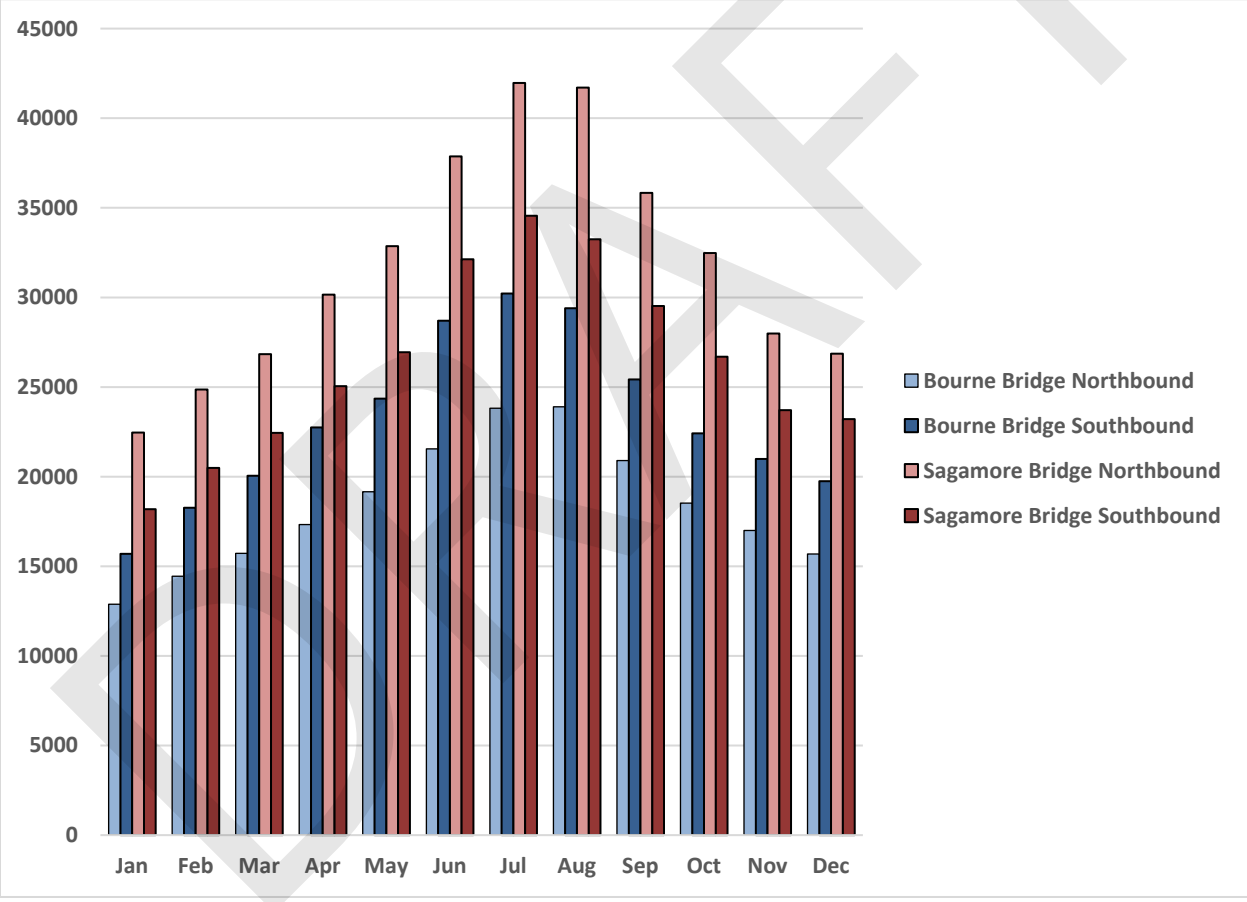

FIGURE 5. 2022 Monthly Directional Average Daily Traffic at the Cape Cod Canal Bridges

A MassDOT remote counting station located on Route 28 in the town of Barnstable shows useful insight into traffic trends on Route 28 during the summer and in the off-season. The figure below shows the hourly volumes during a typical summer day and an off-season day at the location of Route 28 west of Old Post Road. The data shows that traffic volumes on Route 28 do not have a distinct peak hour, as you would typically see on a typical arterial roadway during commuter peak hours. Instead, traffic peaks in the morning and traffic volumes remain steady throughout the day until the typical evening peak period.

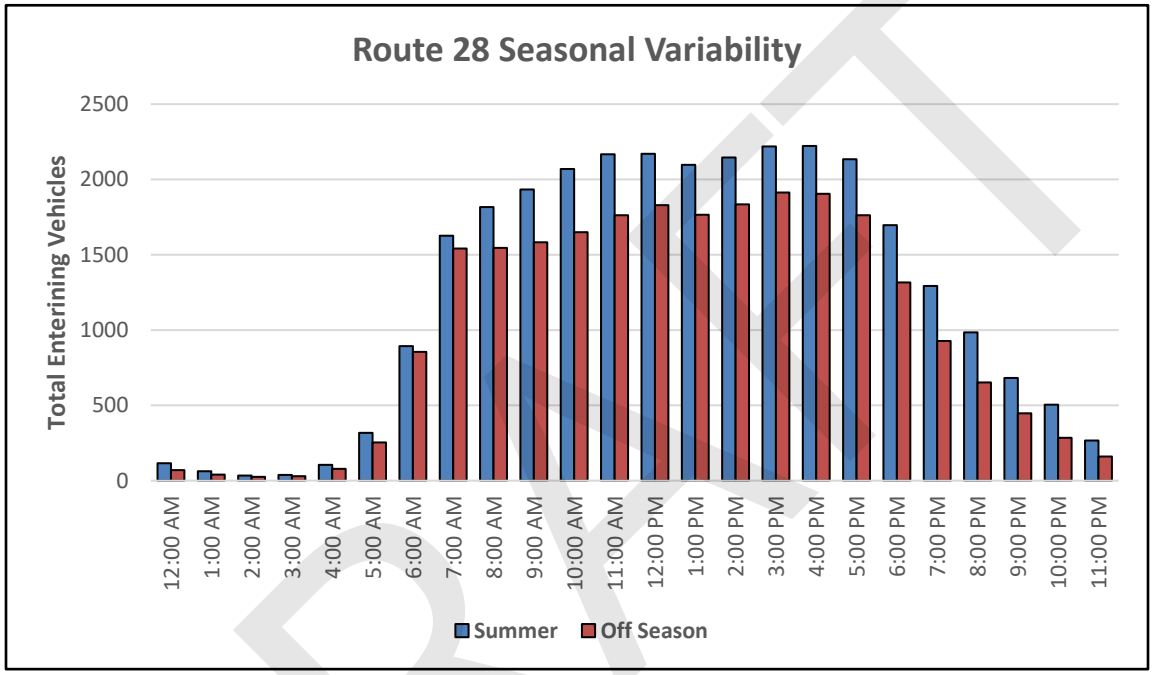

FIGURE 6. Hourly Summer Data at MassDOT Permanent Counting Station on Route 28

The graph below shows the monthly ADT volumes that were counted by Cape Cod Commission permanent counting stations in 2022. The intersection at Route 28 and Lumbert Mill Road in Barnstable showed the highest volumes of the two locations in each month. The remote counter in Harwich shows traffic volumes closer to the amount shown at Route 28 and Lumbert Mill Road in the months of July and August. The intersection in Harwich, Route 124 at Queen Anne Road, showed a larger increase in volume during the summer months. The intersection at Route 28 and Lumbert Mill Road showed more consistent volumes year-round.

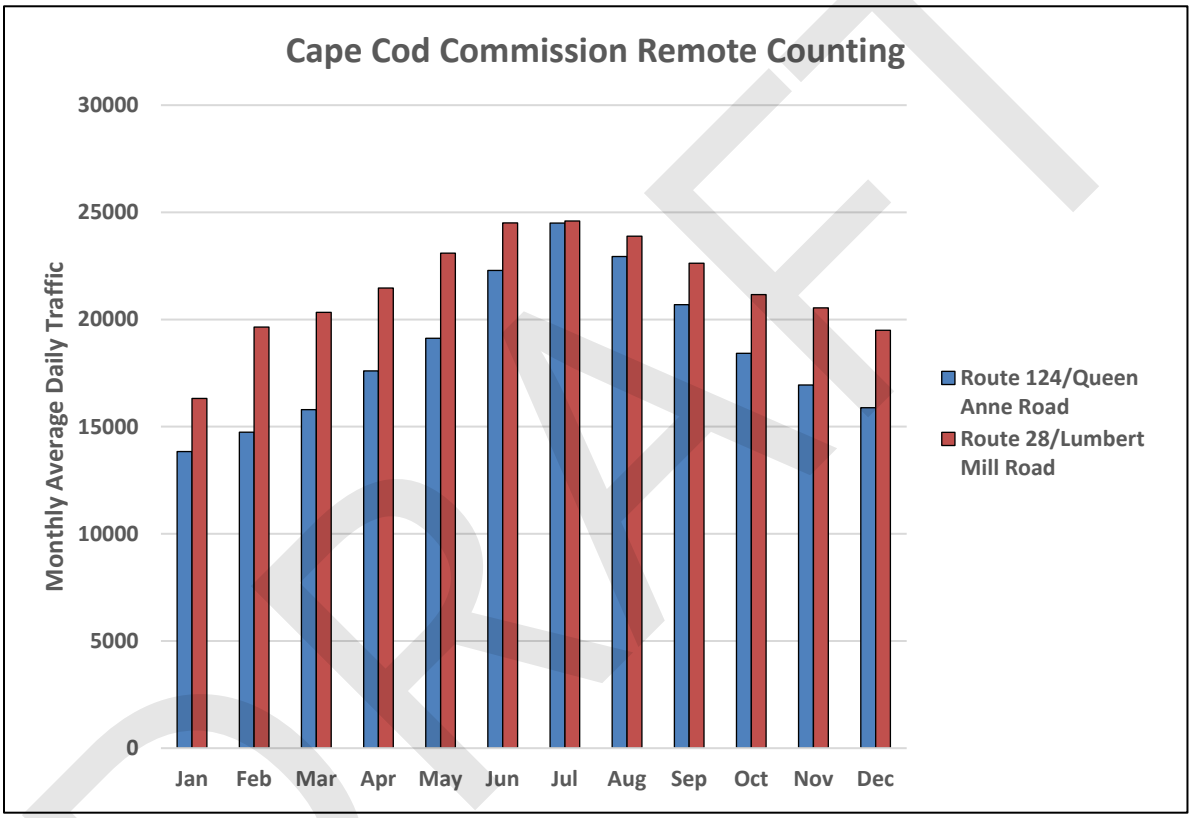

FIGURE 7. Monthly ADT at Cape Cod Commission Permanent Counting Stations

Travel Time Reliability and Planning Time Index

The Planning Time Index (PTI) data represents the total time that should be planned when an adequate buffer time is included. This includes the typical delay as well as unexpected delay and is computed as the 95th percentile travel time divided by the free-flow travel time. With the PTI calculated, more consistent and dependable travel times can be obtained. This in turn leads to having a more accurately represented Travel Time Reliability (TTR) based on worst days and not the average day. The PTI can be obtained for Route 28 and Route 6 on Cape Cod using RITIS data. RITIS (Regional Integrated Transportation Information System) is a real-time traffic monitoring system that provides information on traffic flow, congestion, and incident management. By providing this data, more accurate travel times and better prior-to-trip planning by roadways users can occur. For example, knowing that the PTI value for a trip is 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned. Knowing where the high index areas are is essential for commuters, residents, and businesses in the Cape Cod region.

The following tables and figures display the PTI data from 2022 on Route 28 and Route 6.

TABLE 3. Planning Time Index – Index Value and Corresponding Color Threshold

Planning Time Index Value	Color Threshold
0 to 0.5	
0.5 to 1.1	
1.1 to 1.6	
1.6 to 2.1	
2.1 to 2.6	
2.6 to 4	

TABLE 4. Delta Planning Time Index – Index Value and Corresponding Color Threshold

Delta Planning Time Index Value	Color Threshold
< -1	
-1 to -0.5	
-0.5 to -0.1	
-0.1 to 0.1	
0.1 to 0.5	
0.5 to 1	
1 to > 2	

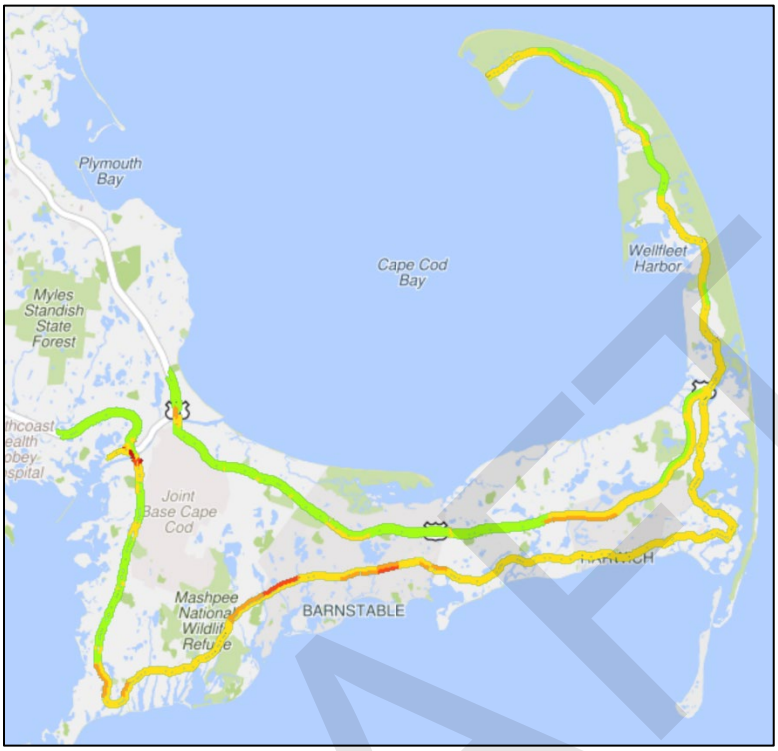

FIGURE 8. Planning Time Index 2022 AM Peak (6AM-10AM)

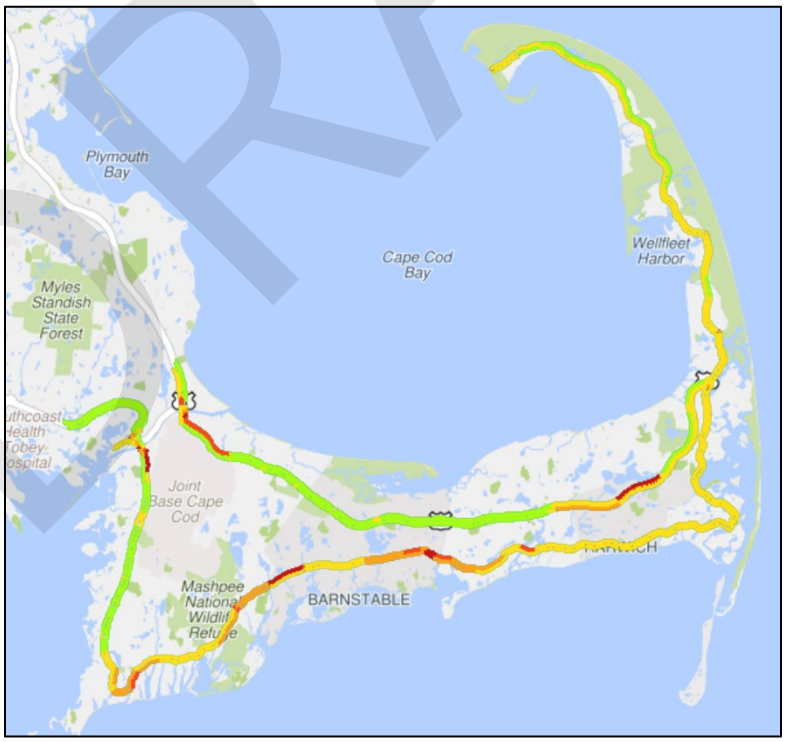

FIGURE 9. Planning Time Index 2022 PM Peak (4PM-8PM)

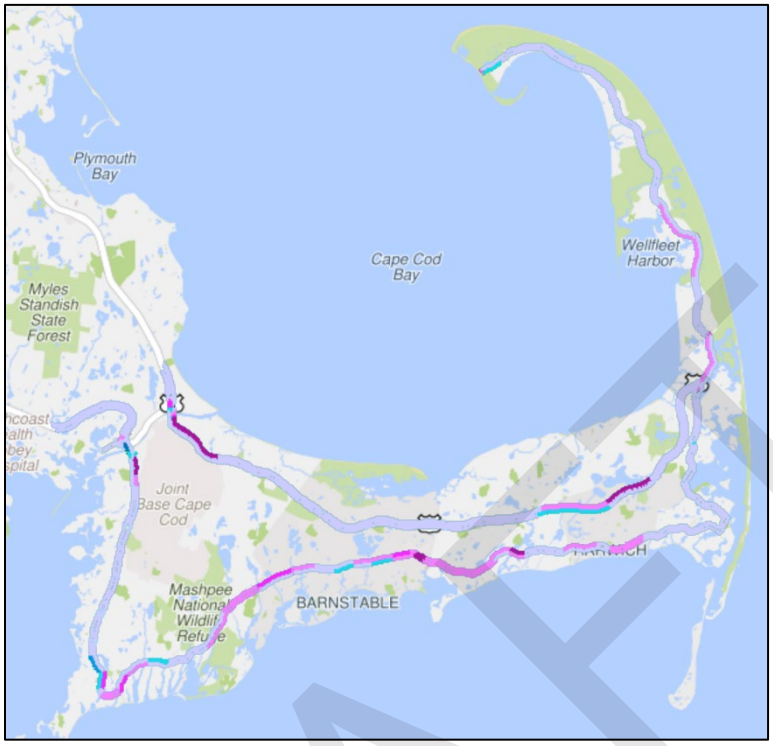

FIGURE 10. Delta Planning Time Index – AM vs PM

Figure 8 and Figure 9 show the Planning Time Index for the year of 2022 on Cape Cod for the regional corridors of Route 28 and Route 6. The AM peak traffic period shows that there are high index value points located on Route 28 at Bourne Rotary Circle (South), Route 28 around Route 130, and Route 28 around Pitcher's Way. Some of the same AM peak locations can also be seen to increase in index value in the PM peak period. Other locations emerge in the PM peak period as well such as Route 6 and Sandwich Road, Route 6 at Route 124 and Exit 82, and Route 28 at Yarmouth Road and Camp Street. The darker red in color corresponds to having a higher index value, these values are shown in Table 3.

Figure 10 shows the change between the AM peak travel period and the PM peak travel period. The darker purple in color corresponds to worsening conditions, an increase to the index value, these values are shown in Table 4. Overall, the areas with higher PTI values correspond to areas that are experiencing congestion and are noted bottlenecks within the region.

RITIS Bottleneck Ranking

The Bottleneck Rankings for Route 28 and Route 6 on Cape Cod can be obtained using RITIS data. RITIS (Regional Integrated Transportation Information System) is a real-time traffic monitoring system that provides information on traffic flow, congestion, and incident management. Using RITIS data, traffic patterns on Route 28 and Route 6 can be analyzed and locations where traffic flow is restricted causing delays and congestion can be identified. Bottlenecks are points in the roadway where traffic is forced to slow down due to various factors such as a high volume of vehicles,

merging or diverging lanes, or road construction. By ranking the bottlenecks on these two routes, we can identify the areas that require improvement and develop strategies to reduce congestion and improve travel times.

The following table is a summary of the top 50 bottleneck locations from 2022 on Route 28 and Route 6 ranked in order of total delay.

TABLE 5. 2022 Top 50 Bottlenecks on Route 28 and Route 6

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
US-6 W @ Sagamore Bridge	3.82	48 m	12 d 7 h 24 m	183,508	86,335,595
US-6 E @ US-6/MA-3	2.58	2 h 45 m	42 d 1 h 14 m	241,720	75,527,464
MA-28 N @ AIRPORT ROTARY	1.4	4 h 29 m	68 d 4 h 41 m	156,623	38,942,167
MA-28 N @ MA-130	2.35	1 h 9 m	17 d 15 h 50 m	84,203	27,680,545
MA-28 S @ SANDWICH RD	1.69	2 h 17 m	34 d 20 h 38 m	96,642	26,341,839
MA-28 N @ W MAIN ST (FALMOUTH)	2	2 h 9 m	32 d 18 h 53 m	100,466	26,025,478
MA-28 S @ YARMOUTH RD/CAMP ST	0.85	3 h	45 d 15 h 10 m	71,596	19,531,351
US-6 W @ MA-124/EXIT 10	1.33	1 h 23 m	21 d 3 h 36 m	107,669	18,434,291
MA-28 S @ PITCHERS WAY	1.83	1 h 16 m	19 d 9 h 52 m	56,691	12,420,855
MA-28 N @ MAIN ST (CENTERVILLE)	1.83	1 h	15 d 5 h 59 m	47,912	9,593,469
MA-28 N @ MAIN ST (SOUTH YARMOUTH)	0.94	1 h 12 m	18 d 8 h 49 m	35,152	8,945,068
MA-28 N @ PALMER AVE	1.25	1 h 12 m	18 d 9 h 25 m	40,930	8,693,451
MA-28 N @ FALMOUTH HEIGHTS RD	1.1	1 h 30 m	23 d 1 h 25 m	38,435	8,571,308

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
MA-28 S @ ACAPESKET RD	3.09	21 m	5 d 8 h 24 m	28,833	7,910,517
MA-28 S @ FALMOUTH HEIGHTS RD	1.06	1 h 10 m	17 d 20 h 42 m	28,788	7,369,927
MA-28 S @ MA-28/CONNERY AVE	1.52	48 m	12 d 9 h 11 m	36,420	6,413,932
MA-28 S @ MA-151/GREAT NECK RD/NATHAN ELLIS HWY	0.57	2 h 11 m	33 d 10 h 38 m	28,295	6,183,603
MA-28 S @ YARMOUTH RD	2.1	29 m	7 d 13 h	24,671	5,604,577
MA-28 S @ CENTRAL AVE	2.16	25 m	6 d 13 h 22 m	20,858	5,209,681
MA-28 S @ TOWN BROOK RD	1.77	25 m	6 d 9 h 7 m	18,565	4,775,930
MA-28 N @ ACAPESKET RD	1.48	33 m	8 d 10 h 15 m	20,277	4,740,604
MA-28 S @ MA-130	3.46	15 m	3 d 21 h 45 m	21,721	4,605,276
MA-28 N @ Old Stage Rd	1.49	29 m	7 d 11 h 52 m	16,218	4,189,317
MA-28 N @ YARMOUTH RD/CAMP ST	1.28	28 m	7 d 4 h 17 m	15,519	3,717,939
MA-28 N @ PITCHERS WAY	1.62	26 m	6 d 16 h 17 m	16,172	3,341,419
MA-28 S @ FOREST RD	3.43	10 m	2 d 17 h 31 m	13,672	2,866,745
US-6 W @ WILLOW ST/EXIT 7	2.42	4 m	1 d 2 h 54 m	6,542	2,617,689
MA-28 S @ OLD STAGE RD	1.43	12 m	3 d 5 h 42 m	8,067	2,444,168
MA-28 S @ US-6/HWY	0.46	33 m	8 d 13 h 38 m	6,806	2,212,194
US-6 E @ LAWRENCE RD/SCHOOL ST	3.81	7 m	2 d 8 m	12,239	2,138,554
US-6 E @ LECOUNT HOLLOW RD	3.58	6 m	1 d 17 h 14 m	11,536	2,096,413

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
MA-28 N @ TOWN BROOK RD	2.24	12 m	3 d 3 h 22 m	10,273	1,992,804
MA-28 N @ MA-149/COTUIT RD	0.09	3 h 40 m	55 d 23 h 19 m	6,422	1,893,403
US-6 W @ MA-149/MEETINGHOUSE WAY/EXIT 5	2.42	3 m	20 h 7 m	3,911	1,651,853
MA-28 S @ MAIN ST (CENTERVILLE)	1.38	9 m	2 d 12 h 14 m	5,962	1,600,235
MA-28 N @ MA-151/GREAT NECK RD/NATHAN ELLIS HWY	3.25	3 m	23 h 21 m	5,751	1,410,015
MA-28 S @ RED BROOK RD	4.05	4 m	1 d 1 h 7 m	6,941	1,404,075
US-6 W @ WEST RD	4.01	2 m	18 h 2 m	7,191	1,342,016
US-6 E @ MA-149/MEETINGHOUSE WAY/EXIT 5	2.23	2 m	16 h 37 m	2,868	1,282,695
MA-28 N @ YARMOUTH RD	1.93	7 m	1 d 22 h 8 m	6,116	1,253,961
US-6 E @ WEST RD	1.66	5 m	1 d 9 h 38 m	5,190	1,175,934
US-6 W @ UNION ST/EXIT 8	1.52	4 m	1 d 1 h 50 m	3,367	1,175,134
US-6 W @ MA-130/WATER ST/EXIT 2	3.03	2 m	16 h 5 m	2,675	1,100,156
US-6 W @ MA-132/IYANNOUGH RD/EXIT 6	2.46	2 m	16 h 48 m	2,933	995,913
MA-28 S @ OSTERVILLE WEST BARNSTABLE RD	2.05	4 m	1 d 2 h 25 m	3,187	885,721
US-6 E @ NAUSET RD/SALT POND RD	0.17	1 h 11 m	18 d 4 h 10 m	4,191	846,487
MA-28 N @ N MAIN ST (FALMOUTH)	1.52	6 m	1 d 14 h 34 m	3,336	831,655

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
US-6 E @ NAUSET RD/WAMPUM LN	2.7	3 m	22 h 26 m	3,989	827,031
MA-28 S @ CHATHAM RD	2.1	11 m	2 d 19 h	9,156	744,091

Number of Crashes (All Modes)

The Cape Cod Commission has recently identified the region's Top 50 high crash locations. The data used for this endeavor, including crashes that occurred from 2018-2020, is the most recent available from the Massachusetts Department and Transportation (MassDOT) and local police departments from Barnstable County. Through the analysis of that data, a series of top crash location lists have been generated, including crash rank, crash rate and Equivalent Property Damage Only (EPDO). A future task will be to identify the top pedestrian and bicycle crash areas. The following table summarizes the top crash locations by rank that are located on either Route 28 or Route 6 within Barnstable County.

TABLE 6. Top Crash Locations (2018-2020)

Rank Crashes	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
2	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
4	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
6	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
9	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
12	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
14	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
17	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
18	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
20	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
22	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890

Rank Crashes	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
23	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
24	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
25	Barnstable	Route 28 at Bell Tower Mall	23	163	0.716	5.077
27	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
28	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Engine House Road	23	143	1.010	6.844
29	Barnstable	Route 28 (Falmouth Road) at Main Street	22	142	1.003	6.475
30	Barnstable	Route 28 (Falmouth Road) at Route 149	22	102	0.844	3.912
33	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
35	Eastham	Route 6 at Samoset Road/Depot Road	21	81	1.107	4.271
36	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
42	Barnstable	Route 28 (Iyannough Road) at Spring Street	19	99	0.912	4.750
44	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270

As seen in the above table out of the top 50 locations, approximately half of the locations were on Route 28. It should be noted that this top crash analysis is limited to intersection specific crashes and does not include the limited-access highway portion of Route 6.

Transit Usage

Ridership data is collected routinely by the mobile data computers linked to the fare boxes on the entire fixed route CCRTA system. The ridership on the demand response services (DART) is also recorded by the CCRTA. This data will be studied by the Cape Cod Commission in the future and development of detailed transit use and patterns of travel will be incorporated into the CMP.

The Sealine and H2O service routes generally follow the Route 28 corridor: Whereas the Flex service route generally follows the Route 6 corridor on the Outer Cape. A summary of transit usage from 2017 to 2022 by service route is summarized in Table 7.

TABLE 7. CCRTA Ridership Data (2017-2022)

SERVICE ROUTES	FY17	FY18	FY19	FY20	FY21	FY22
DART (Demand Response)	177,749	169,015	172,339	179,718	99,208	121,527
SeaLine	161,095	165,746	170,468	143,648	121,258	126,201
WHOOSH	17,753	14,073	13,628	21,563	5,245	4,780
Villager	48,077	45,524	42,900	28,473	18,190	22,600
Hyannis Loop	16,677	23,309	25,340	17,982	11,413	13,019
H20 Line	162,416	151,673	145,483	130,334	106,951	114,434
Provincetown/Truro Shuttle	87,726	82,933	82,056	134,641	28,863	34,527
Flex	89,255	87,346	82,385	85,532	71,580	86,274
Hyannis Shuttle	3,367	8,651	10,540	8,167	4,477	5,206
Bourne Line	13,457	10,928	12,826	13,093	12,481	17,228
Sandwich Line	24,944	23,961	24,545	20,454	12,964	16,939
CapeFLYER (Rail)	13,555	13,781	14,568	2,823	7,037	9,473
SmartDART	-	-	-	-	-	8,717

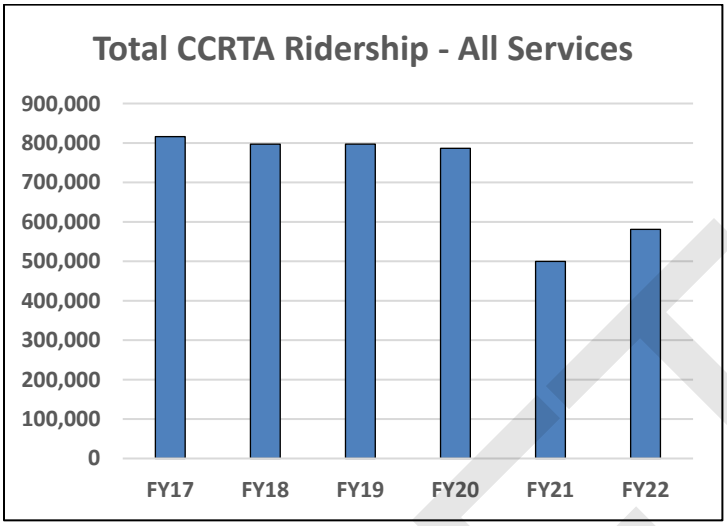

FIGURE 11. Total Ridership Across All CCRTA Services (FY17-FY22)

As seen in the above table, excluding the DART service, the Sealine, H20 and the Flex service routes are consistently the busiest transits lines and are serviced on the congested corridors of Route 28 and Route 6. Improvements focused on the Route 28 and Route 6 corridors to reduce congestion and improve pedestrian connections would help continue to grow transit ridership for these routes. The SmartDART service offered by the CCRTA was started in FY21, however data is only currently available from FY22. Figure 11 shows the total ridership across all the CCRTA services from FY17 to FY22. The large change in data from FY20 to FY21 is due to the Covid-19 Pandemic. This data is useful to monitor as it can help inform public policy decisions related to transportation infrastructure investments and planning for future pandemics or other crises that may impact transportation systems.

Park-and-Ride Usage

Data collected at the three Park-and-Ride locations are organized in Figures 13, 15 and 17 to show the capacity and average occupancy for each of the lots from 2014-2022. In addition, a recent aerial image from Google Earth from February 2023 is included as figures below for each lot and shows the parking lots at the Barnstable and Sagamore Park and Ride facilities. The data was collected in various samples during the summer months and shows inconsistent trends when comparing the data.

The results show that the Barnstable lot is regularly nearing capacity. During several observations, the Barnstable lot was observed to be over capacity with illegal vehicles parked. A MassDOT Highway project is in the preliminary design phase and includes the expansion of parking capacity at the existing park and ride facility on Route 132. The project is also anticipated to include electric vehicle parking spaces and upgrades to bus shelters. The Sagamore Lot has not been observed to

exceed capacity in the last 15 years except for in 2021. However, this may be a statistical anomaly due to the Covid-19 Pandemic. The average occupancy does show that the Harwich lot averages fewer than 50 percent capacity for each year despite the removal of commuter bus service.

FIGURE 12. Barnstable Park and Ride Lot On Route 132

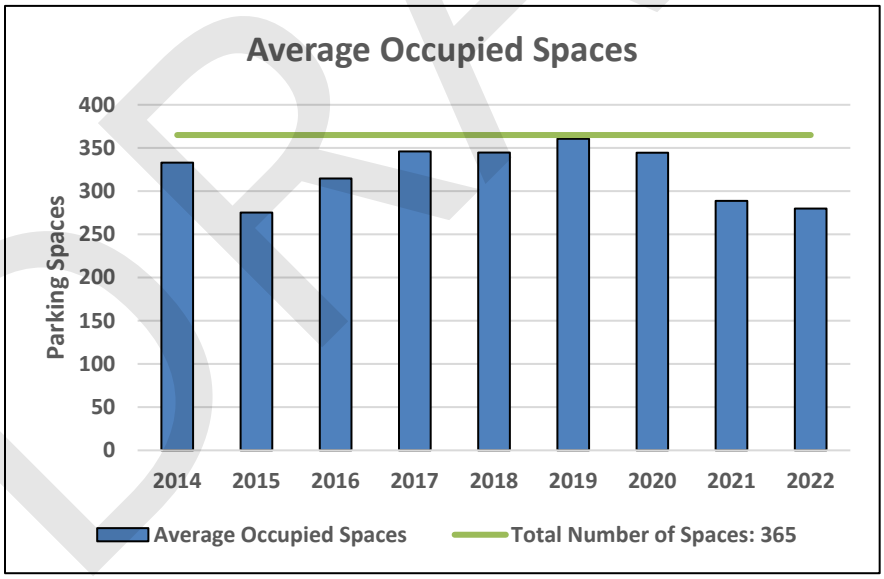

FIGURE 13. Barnstable Park and Ride usage

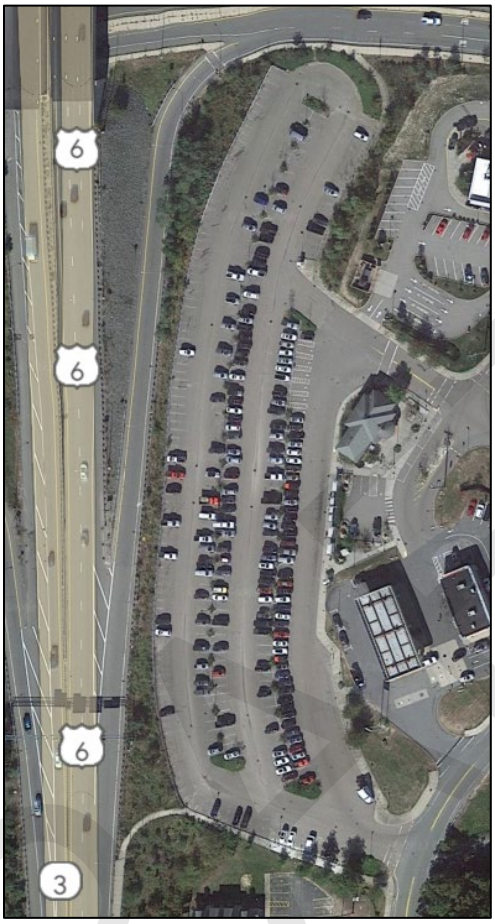

FIGURE 14. Sagamore Park and Ride Lot at the Sagamore Bridge

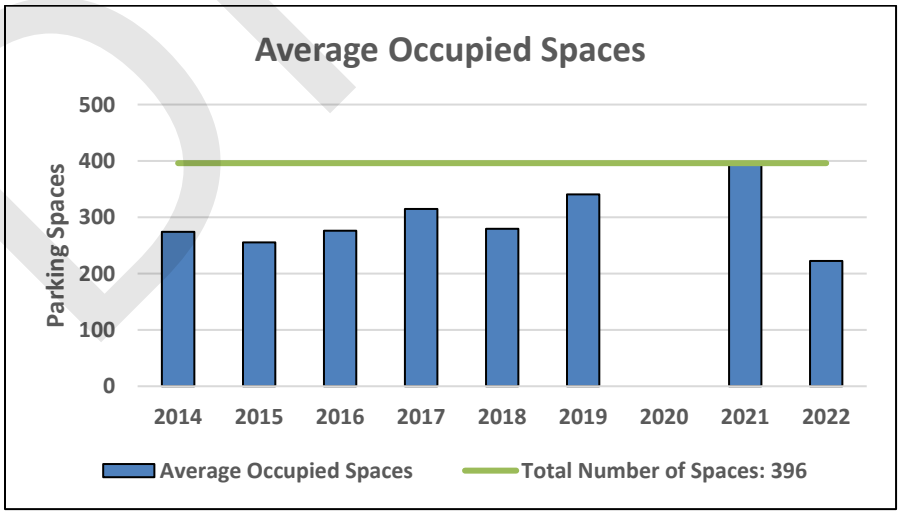

FIGURE 15. Sagamore Park and Ride Usage

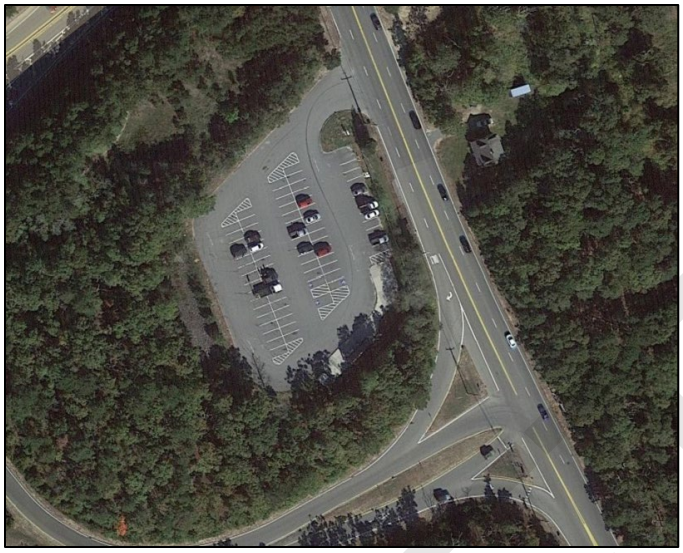

FIGURE 16. Harwich Park and Ride Lot On Route 124

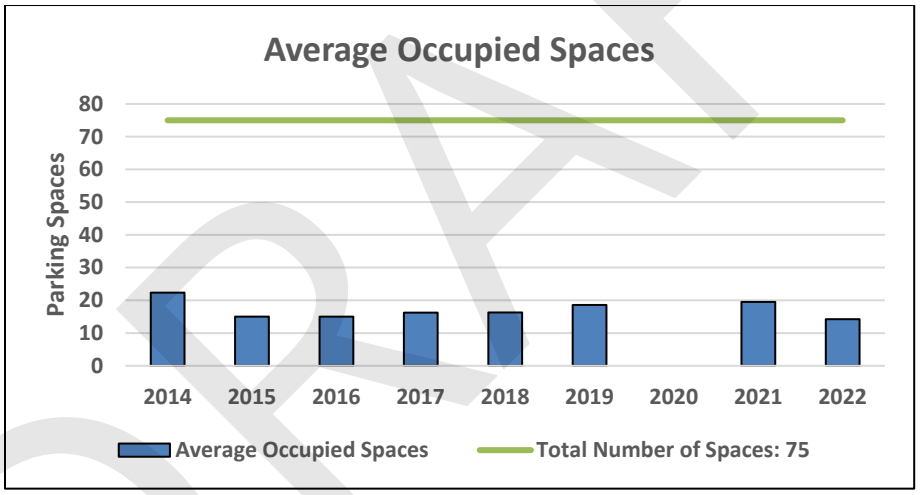

FIGURE 17. Harwich Park and Ride Usage

Walkability

To date, several healthy transportation studies have been performed related to pedestrian connectivity. The following figure summarizes the existing sidewalk network on Cape Cod. Based on this figure, approximately 47% of the Route 28 corridor does not currently have a sidewalk on it. Additional inventory efforts related to walkability on Route 28 and Route 6 were performed as part of data collection efforts in the summer of 2019. Additionally, a future study will help to identify gaps in the pedestrian network at high ridership stops that do not contain amenities consistent with the transit stop buildout.

FIGURE 18. Sidewalk Network

The following figure shows the results of ArcGIS data from Cape Cod on roads that are considered walkable in 2021. There are different levels of walkability, this map shows only shows if the roads are considered walkable. As can be seen, there are several gaps on the Outer Cape and gaps due to the major corridors in the region, Route 28 and Route 6.

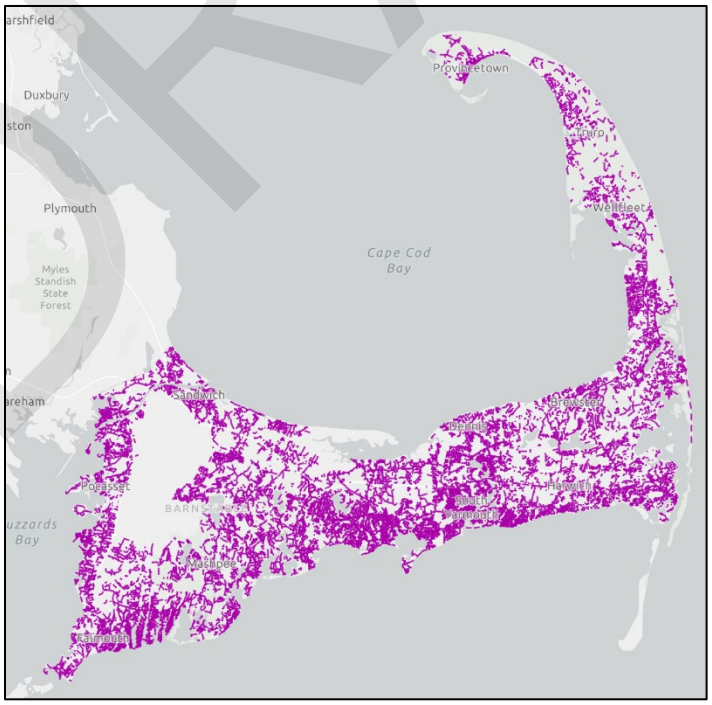

FIGURE 19. Walkable Roads on Cape Cod

Transportation Demand Management

Transportation Demand Management (TDM) measures are encouraged for private development projects on Cape Cod through a Development of Regional Impact (DRI) permit issued by the Cape Cod Commission. The current Regional Policy Plan (RPP) encourages all DRI projects at a minimum to implement best practices for TDM such as, carpool parking spaces, bicycle storage or posting of transit schedules. Larger sites are recommended to implement a site-specific TDM plan that could include a trip reduction monitoring program, subsidized transit passes or an on-site transportation. In addition, the RPP encourages growth to be focused on centers of activity and areas supported by adequate infrastructure to promote a multi-modal transportation system.

ANALYZE PROBLEMS AND NEEDS

Based on our data collection efforts previously summarized in the last section and based on previous and on-going studies that have been performed as part of the UPWP, the following problem areas have been identified for the Route 28 and Route 6 corridors:

- Park and Ride lot capacity exceeded (Barnstable)
- Cape Cod Canal Area bottleneck locations
- Route 28 and Route 6 bottleneck intersections
- Route 28 high crash locations
- Pedestrian gaps on Route 28 and Route 6 in the Outer Cape
- Bicycle multi-use path connectivity
- Increased transit service and expansion routes

IDENTIFICATION AND ASSESSMENT OF STRATEGIES

As part of the development of future regional documents such as the RTP and TIP, the following CMP strategies should be considered for the basis of future studies or have funding dedicated to address CMP strategies and problem areas. These seven strategies will aim to reduce congestion, improve safety, and increase multi-modal opportunities.

Congestion Management Strategies

- Management and expansion of park and rides
    - Identify areas for expansion at existing park and ride lots.
    - Recommend management upgrades for park and rides (fee structure).
    - Implement Canal study recommendation for a new park and ride lot in Sandwich.
    - Monitor expansion and improvement of the Route 132 Barnstable Park and Ride.
- Geometric improvements for certain bottleneck intersections

    - Improvements to allow for additional capacity or safety enhancements to reduce crashes and congestion in the Canal Area and other key location on the CMP network. Example may be additional turn lanes.
- Bicycle and pedestrian improvements
    - Improvements to pedestrian and bicycle infrastructure can help to encourage a higher proportion of people to walk or bike for their transportation needs, thus reducing automobile congestion.
    - Implement Vision 88.
    - Address missing gaps in sidewalk network.
    - ADA ramps/transition plans.
    - Safety enhancements (RRFBs, crosswalk striping signage).
    - Promote multi-use paths.
- Optimization of signal timings
    - Modify signal timings to allow for optimal flow through congested intersections.
    - Recommend additional timing plans for some seasonal congested intersections.
    - Recommend adaptive signal technology.
- Increased transit service (including rail and inter-city bus)
    - Promote for additional transit services including year-round commuter rail and bus expansion for routes and service times. Note: CCRTA recently modified the Sealine route to serve Falmouth Hospital and Falmouth District Court, which are major destinations that were previously unserved.
- Leverage transit technology
    - Recommend potential transit signal technological improvements as part of intersection redesign projects on main transit corridors to all transit vehicles for an improved performance. Examples could be giving transit signal priority, queue jumping, or on-time performance information reporting to customers via mobile devices.
- Access Management
    - Promote smart development with appropriate access management to minimize congestion points and improve safety.
    - Promote TDM measures to offset single occupancy vehicles to sites to reduce congestion.

PROGRAM AND IMPLEMENTATION STRATEGIES

The results of the CMP will include a generation of studies to address issues that exceed the criteria developed to define transportation congestion for the region. These studies will produce recommendations that will be included in the RTP and TIP processes to be considered for

construction or implementation. The table below summaries which improvement strategies could apply to the study area roadways.

TABLE 8. Potential Improvement Strategies for Congested Corridors on Cape Cod

IMPROVEMENT STRATEGIES	CORRIDOR		
	ROUTE 6 (MID-CAPE HIGHWAY) & CANAL AREA	ROUTE 6 (OUTER CAPE)	ROUTE 28
Management & Expansion of Park n Ride	X		
Geometric Improvements	X	X	X
Bicycle & Pedestrian	X	X	X
Signal Timing Optimization	X	X	X
Increased Transit Service	X	X	X
Leverage Transit Technology	X	X	X
Access Management		X	X

Recommendations for location specific actions/studies

Recommendations to the MPO to address issues that exceed the criteria developed to define transportation congestion for the region will generally come from studies conducted by the Cape Cod Commission transportation staff. Recommendations may also be developed by the towns and the CCRTA. All recommended projects and strategies will be evaluated by the Commission and the Cape Cod Joint Transportation Committee using the MassDOT evaluation criteria and with the RTP goals. Based on these evaluations, the CMP projects will be considered by the MPO for inclusion in the RTP and compete for funding within the TIP.

Recommendations for regional actions/studies

Some congestion problems will need to be addressed on a corridor-wide or system basis or require significant investments, such as the Canal Area improvements. Studies or remedial actions will be recommended to the MPO for their consideration and potential inclusion in the TIP or the UPWP. Projects with regional significance may become an initiative of the State Transportation Improvement Program (STIP). These proposed projects may require a more extensive evaluation regarding conformity with the Massachusetts State Implementation Plan (SIP). These projects may also become Transportation Control Measures (TCMs) and included as such in the SIP submitted to EPA.

EVALUATION OF STRATEGY EFFECTIVENESS

The CMP is an ongoing program that documents the region's mobility concerns. The CMP contains the most recent performance monitoring information for the regional transportation system. The information and general analysis of the system, using the criteria defined in the CMP and RTP processes, will provide the basis for the Cape Cod Commission Transportation staff and the Cape Cod Joint Transportation Committee to make recommendations. These recommendations will be made to the Cape Cod MPO as congestion reducing and mobility enhancing actions to be considered in the MPO planning and programming processes. The following evaluation will be used as part of the CMP to evaluate effectiveness.

- The UPWP performance measure task will be expanded to include additional analysis to support evaluation of multi-modal measures in the CMP.

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CAPE COD COMMISSION

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix H: Climate Change Adaptation and Mitigation

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2023

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Technical Appendix H: Climate Change Adaptation and Mitigation

To supplement the discussion provided in Chapter 4, this appendix provides additional information on the following:

- Low Lying Roads
- Transportation electrification elements of the Cape Cod Climate Action Plan

LOW LYING ROADS

Low lying roads are prone to flooding from the combined effects of hazards such as sea level rise, storm surge, and erosion. Cape Cod is especially vulnerable to coastal storms because of its unique geography and flooding is currently a regular event on several road segments during extreme high tides and storm events. As seas rise and storms intensify the impact to our coastlines and flooding occurrences will increase in frequency and depth.

Cape Cod Commission (Commission) staff are working with the towns of Barnstable, Bourne, Brewster, Dennis, Eastham, Orleans, Sandwich, Wellfleet, Truro, and Yarmouth to examine vulnerabilities in the roadway network and identify adaptation alternatives. With funding support from the U.S. Economic Development Administration and the Massachusetts Municipal Vulnerability Preparedness (MVP) program, the Commission has contracted with the Woods Hole Group to conduct a vulnerability assessment of roadway segments, bridges, and culverts due to flooding from the combined effects of sea level rise and storm surge. The project employs state of the art modeling and community engagement to identify and prioritize low lying roads to target for coastal resiliency action.

The project[1] began in September 2021 and will conclude in June 2023. Project elements for each town include:

- Vulnerability and Criticality Assessments: Coastal inundation projections and roadway vulnerability will be modeled for road segments in 2030, 2050, and 2070 planning horizons and a roadway criticality analysis will be applied to each road segment.

[1] https://capecodcommission.org/our-work/low-lying-roads-project/

- Roadway and Bridge Risk Assessment: Road segments and bridges that may be impacted during the three planning time horizons will be identified and prioritized for analysis by calculating risk scores.
- Map Viewer: Each town will have a GIS-based map viewer developed to present data and map layers for review. The map viewer will include a tool to capture public comment on vulnerable road segments identified, or other locations the town may want to consider for developing adaptation solutions.
- Public Workshop: A public workshop will be held for each town to review the outcomes of the vulnerability and risk assessments, and to present the criticality framework and top road segments projected to be vulnerable during the three planning time horizons.
- Road Segment Selection: Using the information gathered in the analyses and public comment, town staff will choose two road segments to further for conceptual adaptation design solutions.
- Roadway Design Solutions: Up to three conceptual road adaptation design solutions and estimated costs will be prepared for the prioritized road segments. These solutions, where applicable, will include a nature-based solution ("green"), a traditional engineering solution ("gray"), and a hybrid (nature-based with traditional engineering elements) solution.

Final conceptual designs will then be presented to town staff, who may use these deliverables to further project development. A second public workshop will be held to present the conceptual design solutions to those towns receiving MVP funding.

Process for Identifying Low Lying Roads

VULNERABILITY

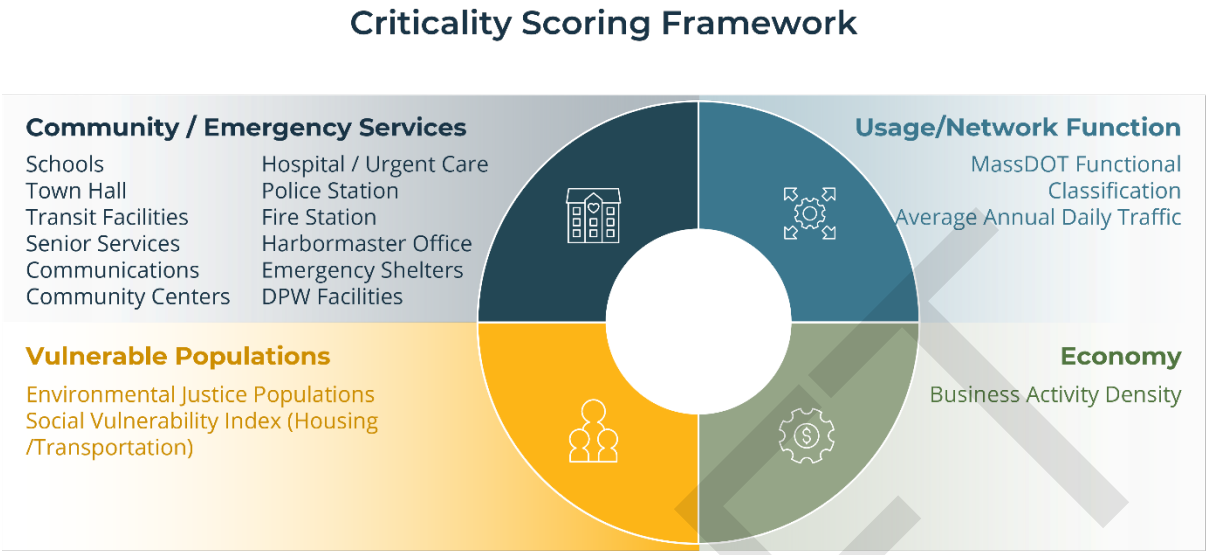
Roads are more or less likely to flood depending on a number of factors such as proximity to the coast and road elevation. Significant rain events may also result in inland road flooding but are not a focus of this project. The vulnerability of a road is determined by the probability or likelihood that it will flood on an annual basis. The terms vulnerability and probability are used interchangeably in this project. The probability of a road flooding annually is determined by the elevation of the road surface as compared to the elevation of the anticipated water surface during a storm event, under future time horizons.

CRITICALITY

Criticality is how important a road is to the community's transportation needs. The project team used regionally available data to score roads and road segments according to their criticality within a community. The scoring framework used to determine road criticality includes variables such as:

- Usage/Network Function - the type of road and average daily traffic
- Vulnerable Populations - environmental justice or social vulnerability communities
- Emergency/Community Services - access to critical, emergency, or community facilities

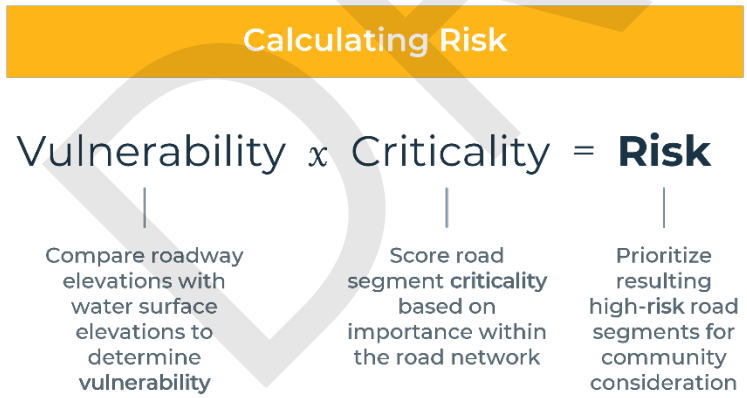
- Economy - business activity density

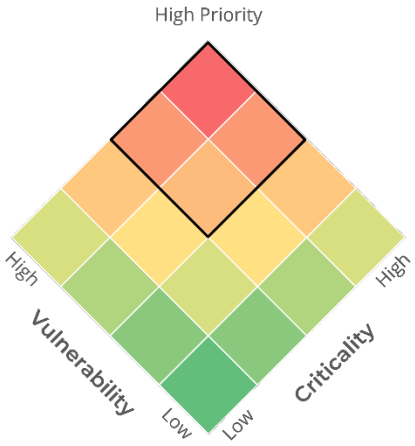


Adapted from Woods Hole Group

RISK

For this project risk is more than the probability of flooding. It is defined as criticality times vulnerability. The roads in a community that are both highly critical and have a high probability of flooding are ranked as high-risk roads or road segments that may require adaptation alternatives, as depicted in this visual.



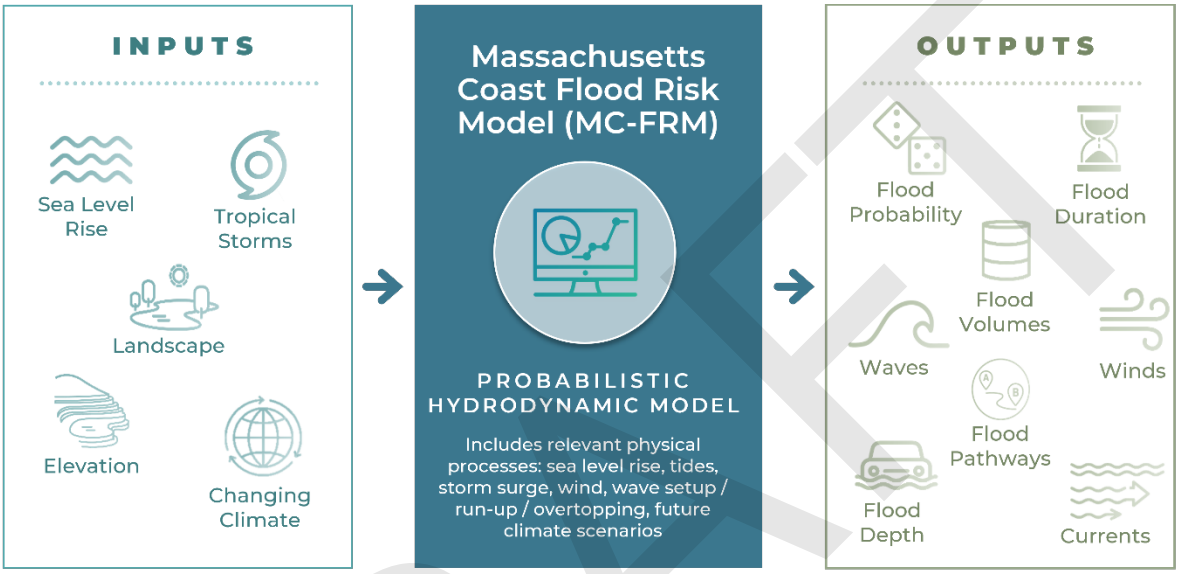


Adapted from Woods Hole Group

Model Introduction

The low lying roads project utilizes the Massachusetts Coast Flood Risk Model (MC-FRM), a state-of-the-art model that projects flooding under future time horizons. The model includes the dynamic

impacts of tides, waves, wave run-up and overtopping, storm surge, winds, and currents over a range of storm conditions to generate the probability of inundation. The MC-FRM generates hydrodynamically modeled projections for sea level rise and storm surge to determine projected changes in the likelihood of flooding under climate conditions for 2030, 2050, and 2070. The model uses inputs displayed below to create multiple outputs. Flood probability and flood depth are the primary outputs used in this assessment to evaluate roadways.



Results

The following section highlights model outputs, presenting examples for the town of Bourne.

The results of the model include assessments of high tide flooding, inundation probability, criticality, and risk for the entire town.

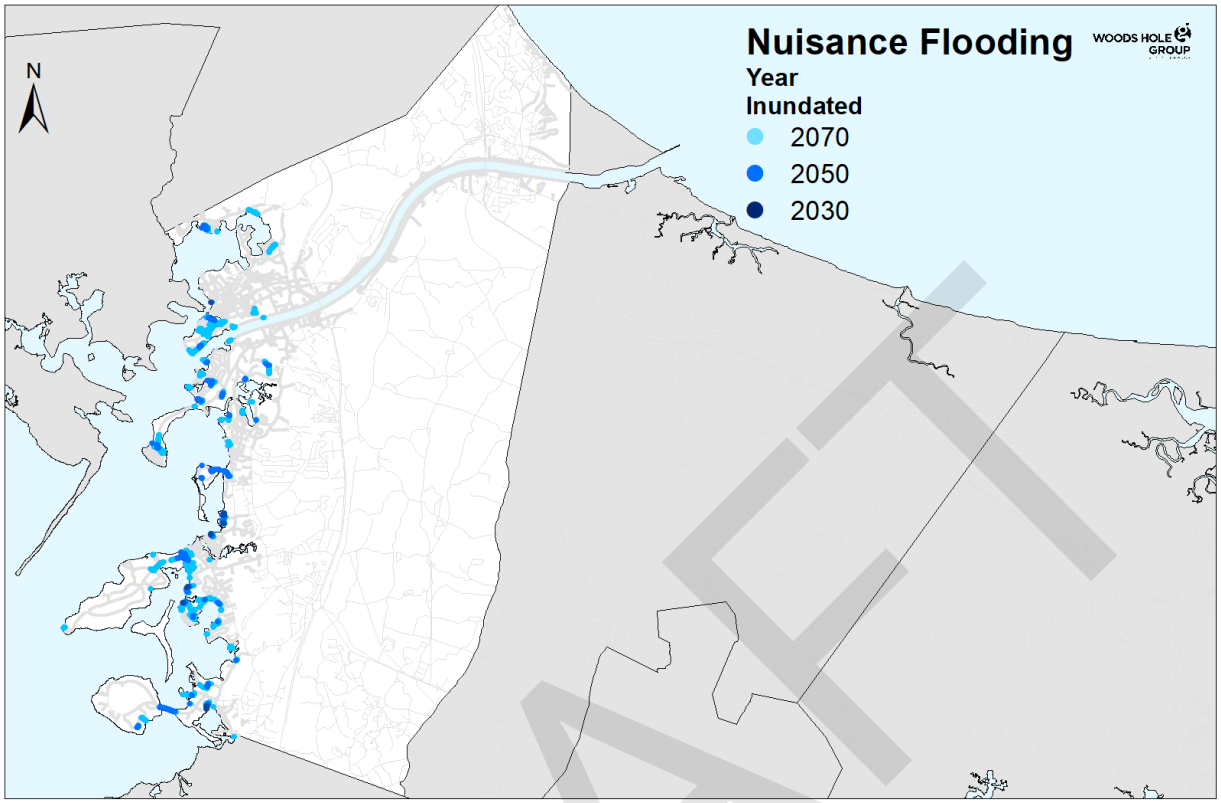


FIGURE A-1. Projected Low Lying Roads Nuisance (MHW) Flooding

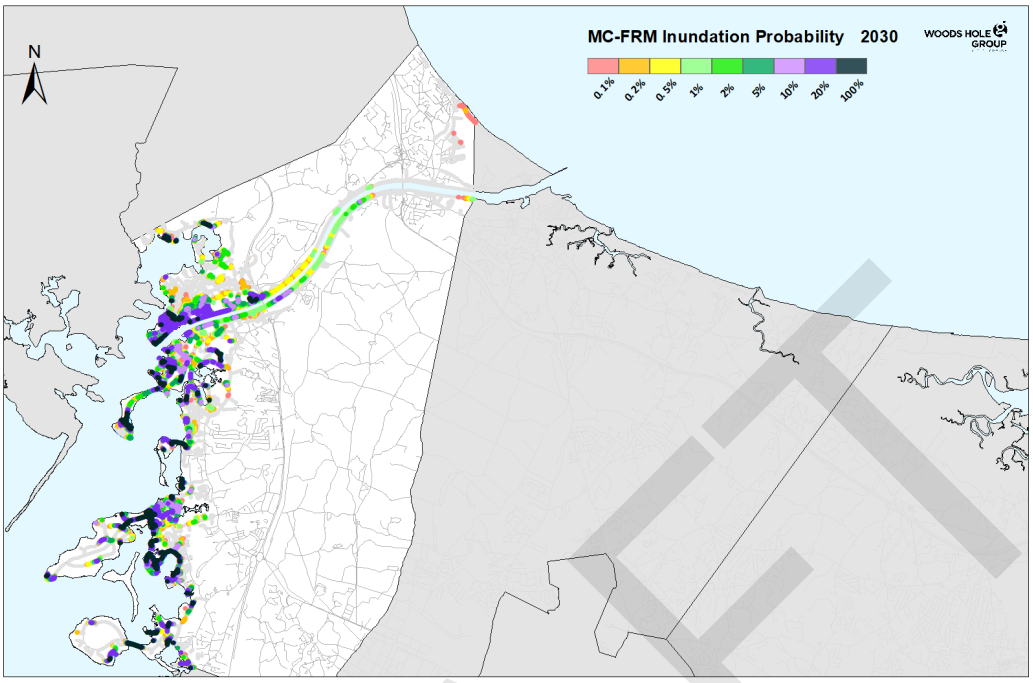


FIGURE A-2. Low Lying Roads Inundation Probability - 2030

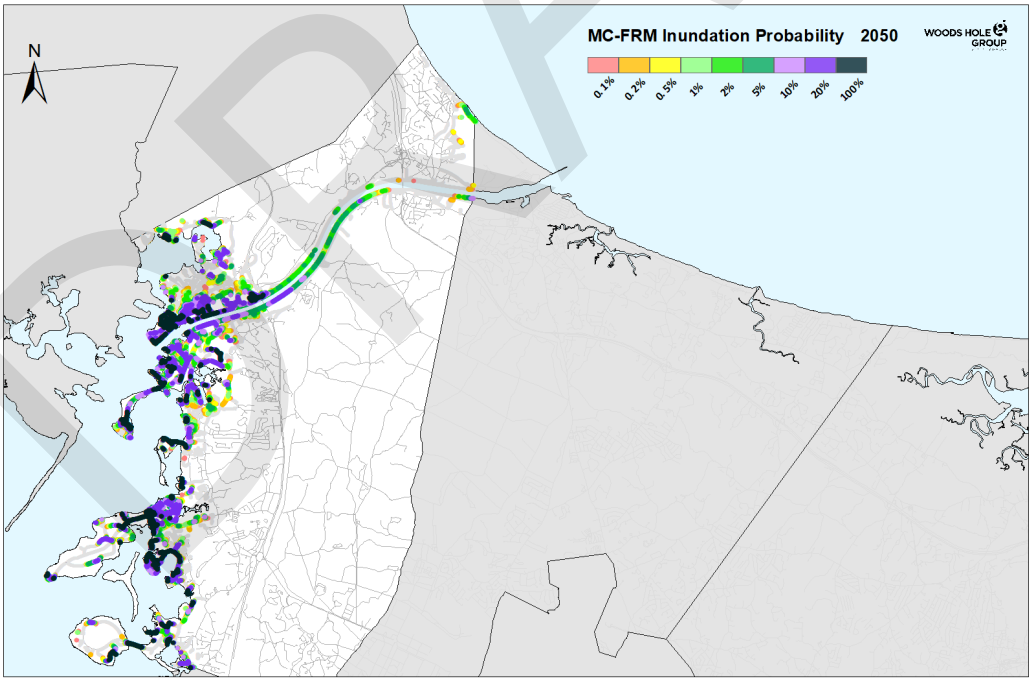


FIGURE A-3. Low Lying Roads Inundation Probability - 2050

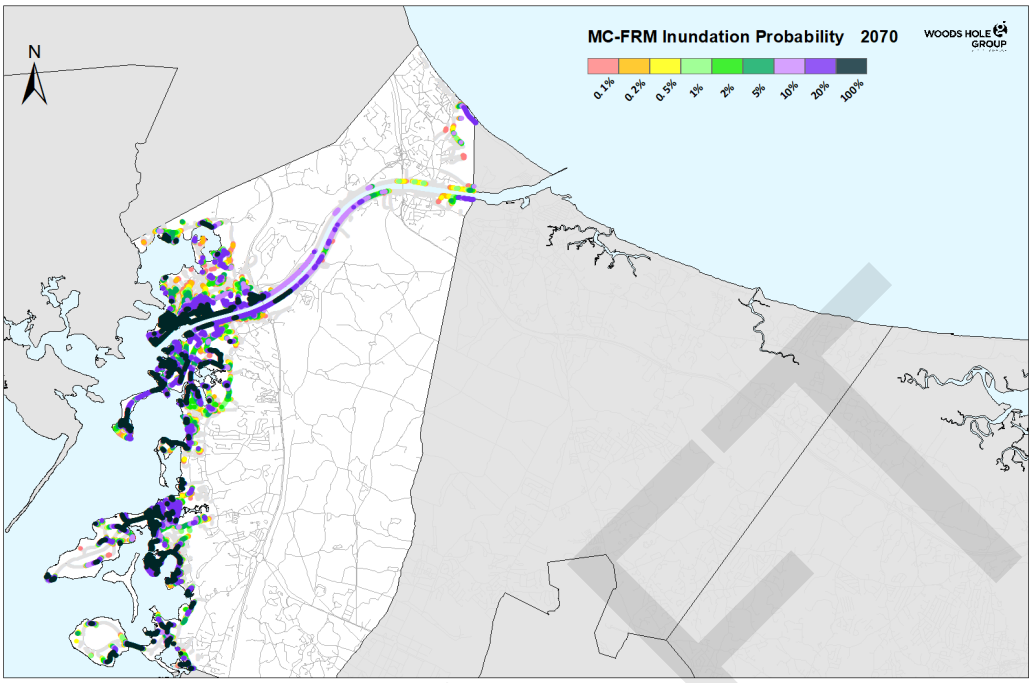


FIGURE A-4. Low Lying Roads Inundation Probability - 2070

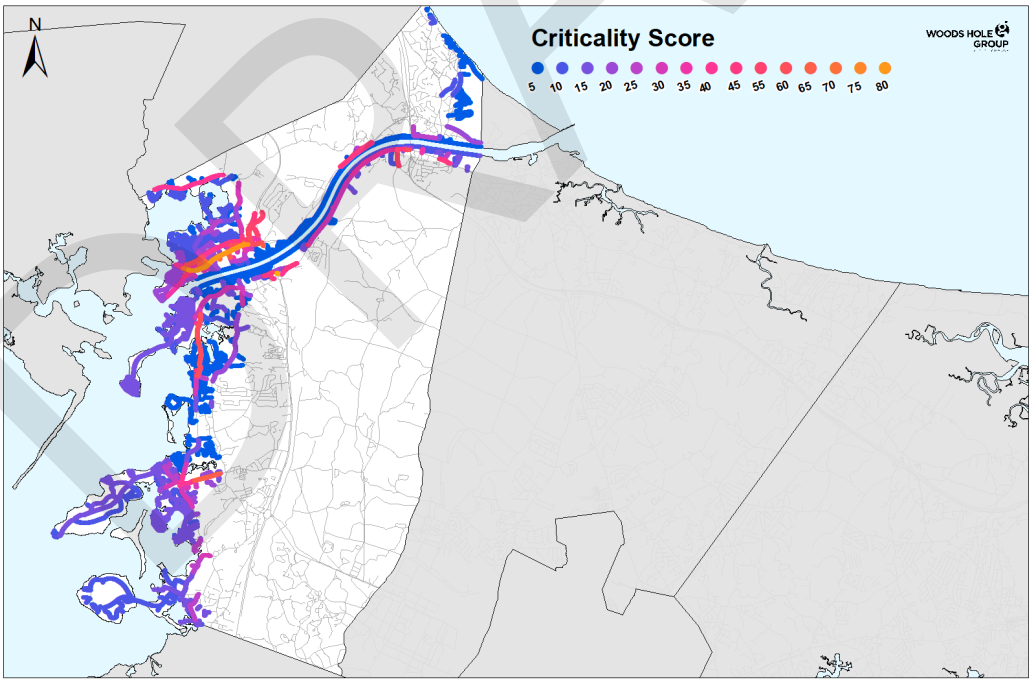


FIGURE A-5. Road Network Criticality Scoring

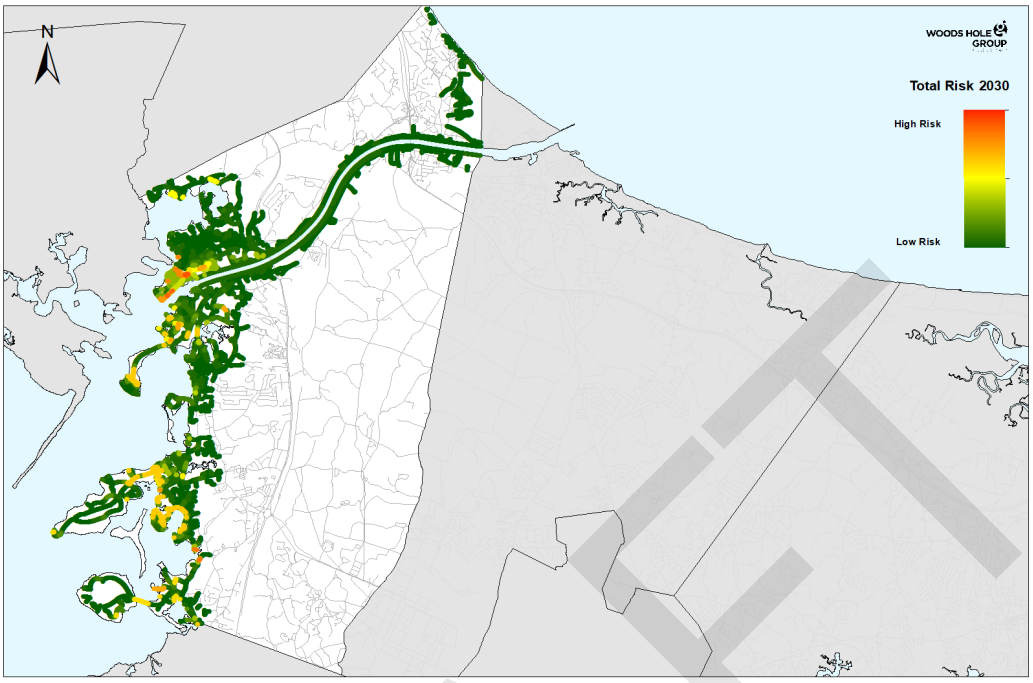


FIGURE A-6. Risk Results - 2030

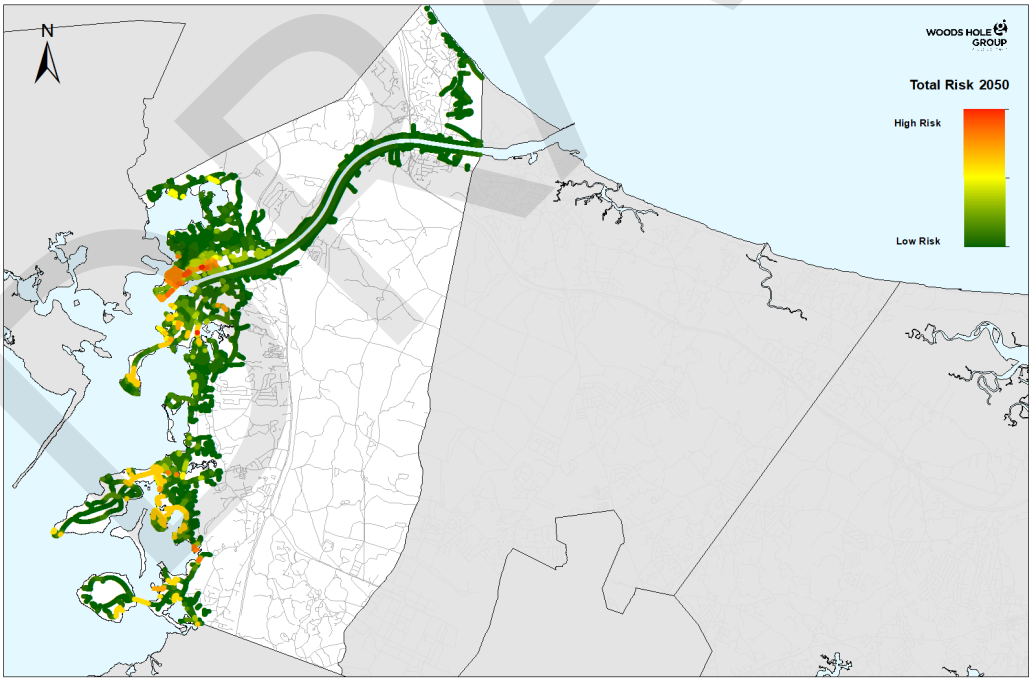


FIGURE A-7. Risk Results - 2050

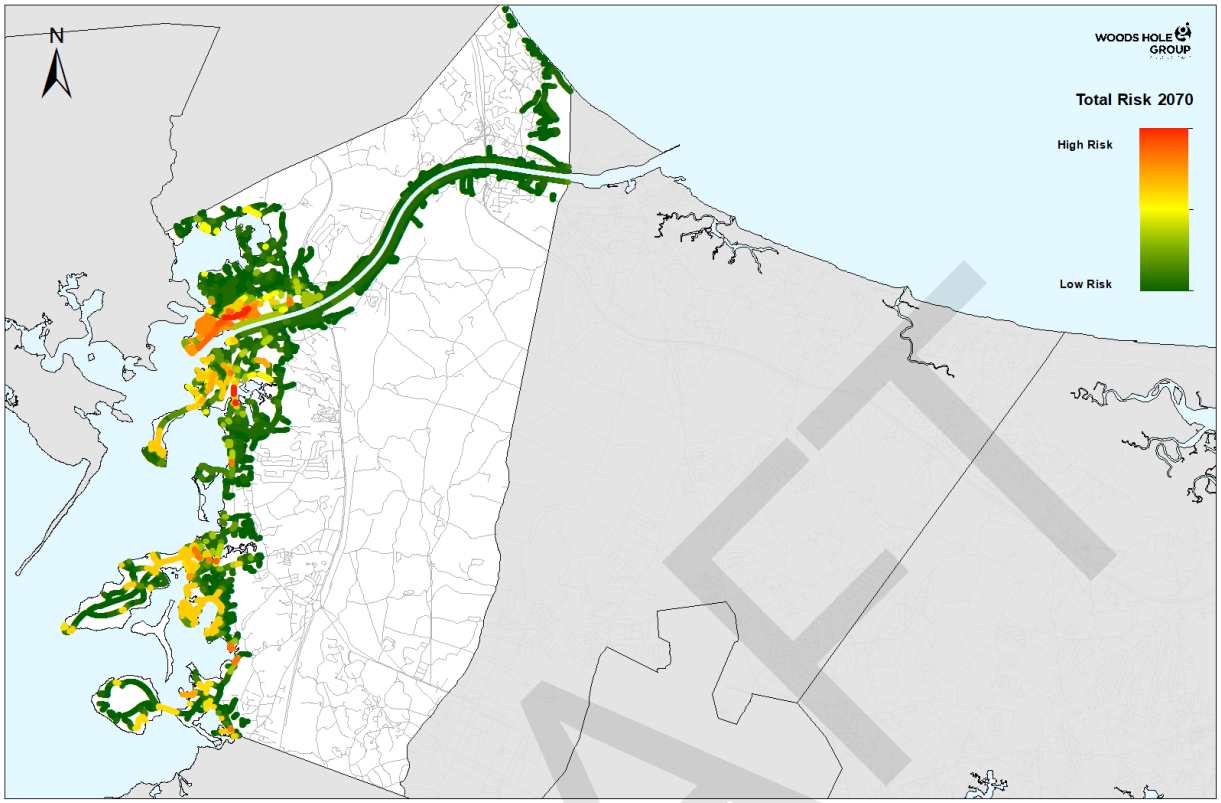


FIGURE A-8. Risk Results - 2070

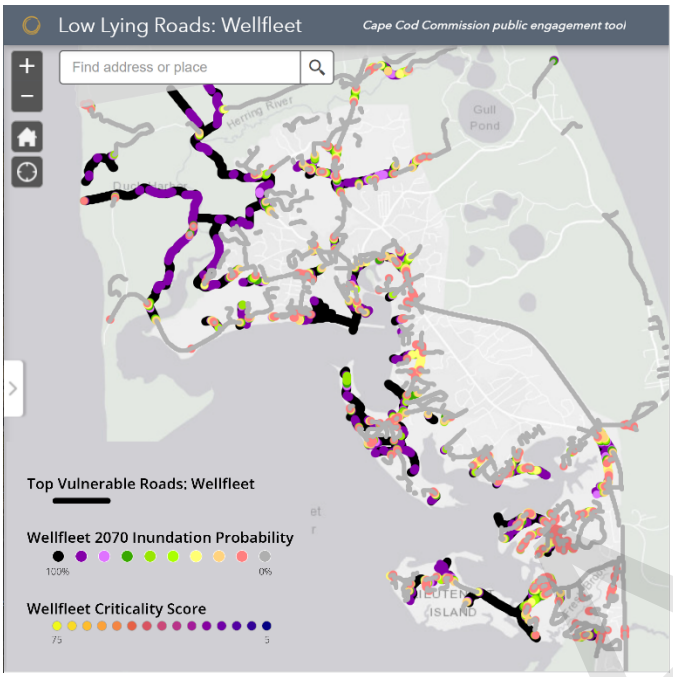
A list of top priority roads that have a high flood-risk is developed from these town-wide results. The list provides the road name, the length of road segment that will flood, and the probability of flooding under each time scenario: 2030, 2050, and 2070.

	Name	Length (ft)	Description	Segment Storm Probability (%)			Nuisance Length (ft)		
				2030	2050	2070	2030	2050	2070
A	Academy Dr, Taylor Rd and Wright Ln	4020	Main road leading Mass Maritime	10-100	20-100	100		260	2100
B	Red Brook Harbor Rd	440	Road backing Parkers Boat Yard	10-100	20-100	100		20	180
C	Harbor Pl	320	Road segment along Taylor Point Marina	100	100	100		220	320
D	Main St, Holt Rd and Canal St	3700	Long segment between Academy Dr and Smalley Rd	5-20	20-100	100			
E	Shore Rd (Back River)	720	Road and bridge crossing Back River	10-20	20-100	100			
F	Wings Neck Rd and North Shore Rd	4180	Leads to Wings Neck Island, isolated neighborhood	10-100	20-100	100		720	2720
G	Shore Rd (Pocasset River)	180	South of Pocasset River Bridge	10-20	20	100			
H	Cohasset Ave and Buzzards Bay Ave	400	E to W road between Buzzars Bay Bypass and Main St	5-10	20	100			
I	Shore Rd (Monument Beach)	180	Backing Monument Beach	10-20	20	100			
J	Megansett Rd	320	Road intersection leading to Amrita Island	2-20	10-100	100			
K	Circuit Ave and Bell Buoy Rd	3260	Backing Hen's Cove Beach, isolated neighborhood	0.2-100	2-100	5-100		200	1660
L	Mashnee Rd*	580 (5240)	Access to Mashnee Island, isolated neighborhood	0.5-100	2-100	10-100			1120
M	Monument Neck Rd and Presidents Rd	1120	Main access point to large neighborhoods	1-20	5-20	20-100			
N	Emmons Rd	1580	Road / bridge at Monument Beach, isolated neighborhood	5-100	20-100	20-100		1080	1280
O	Scraggy Neck Rd*	(1300)	Isolated neighborhood	5-100	10-100	20-100			1220

* = Private or partially private

FIGURE A-9. Summary of High Priority Road Segments

The model results have been compiled into an interactive map viewer displaying data used in the analysis and a public comment feature tool for stakeholders to provide feedback on areas of interest.



Map Viewer

LOW LYING ROADS

Customized by Town

Individual applications available for each of the 10 participating towns

Interactive Data Visuals

Explore the Criticality Score, along with Inundation Probability and Risk for 2030, 2050, and 2070

Public Comment Feature

Allows for public feedback within the map interface

Solutions

Conceptual adaptation design solutions will be developed for chosen high priority road segments. The project looks to identify nature -based solutions for each priority segment; however existing site conditions may constrain possible alternatives.

Green infrastructure, also known as nature-based solutions, are engineered designs that mimic or enhance natural processes. Green infrastructure has the potential to provide co-benefits, such as creating habitat or improving water quality. Examples include dune nourishment and enhanced marsh habitat.

Gray Infrastructure are also known as traditional engineering structures. Examples include bridges, seawalls, and roadway elevation.

Other approaches include realignment of roadways or managed retreat, which is the purposeful and coordinated movement of infrastructure (e.g., roads) away from the risk (e.g., flooding).

The spectrum of possible strategies ranges from "do nothing" to "coastal armoring." The most feasible solutions will consider site conditions and likely combine green and gray options.

Vulnerable road segments in Bourne selected to move forward with adaptation solutions were Circuit Avenue and Wings Neck Road. The following presents existing conditions and possible road adaptation design solutions for Circuit Avenue, highlighting a road cross-section (B) adjacent to the public beach at Hen Cove.

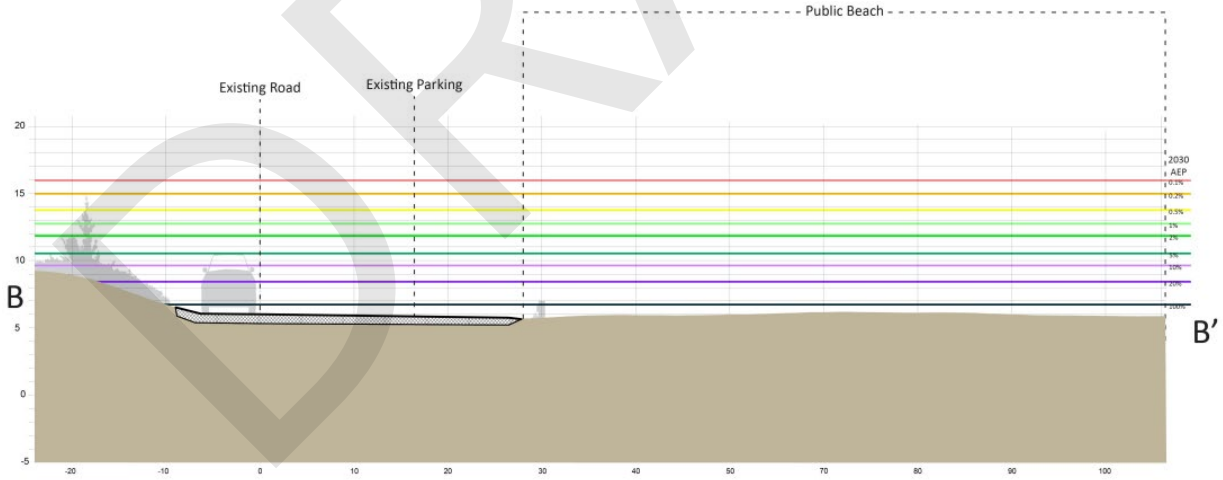


FIGURE A-10. Existing Conditions – Cross-Section

The colored, horizontal lines represent different flood probabilities for 2030 using the MC-FRM.

The gray alternative presents a conceptual design that would raise 2,452 linear feet of the road from a lowest elevation point of 3.8 feet NAVD88 to a lowest point of 9.5 feet NAVD88, and would include sheet piling to elevate portions of the road with traditional vegetated side slopes in other locations.

FIGURE A-11. Circuit Avenue Alternative 1 - Gray

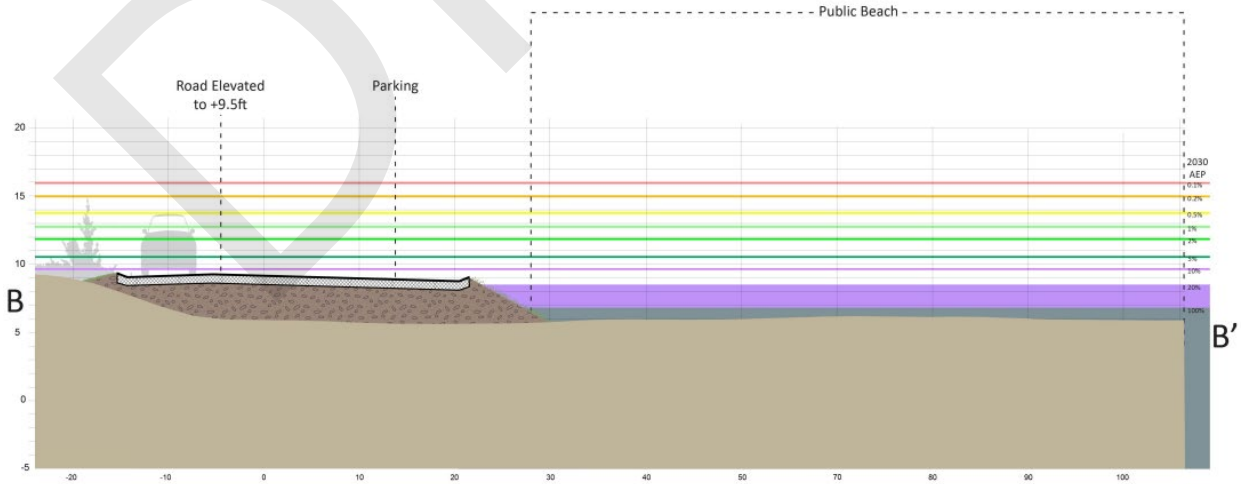


FIGURE A-12. Circuit Avenue Alternative 1 – Gray, Cross-Section

The hybrid alternative presents a conceptual design that would incorporate parapet walls to 8.6 feet NAVD88 to tie together high points along Circuit Avenue. A tide gate would be added to an existing culvert and raised sections of pavement would be added to side streets to prevent flanking. A dune would be constructed at the public beach with access provided by a wooden walkover structure.

FIGURE A-13. Circuit Avenue Alternative 2 - Hybrid

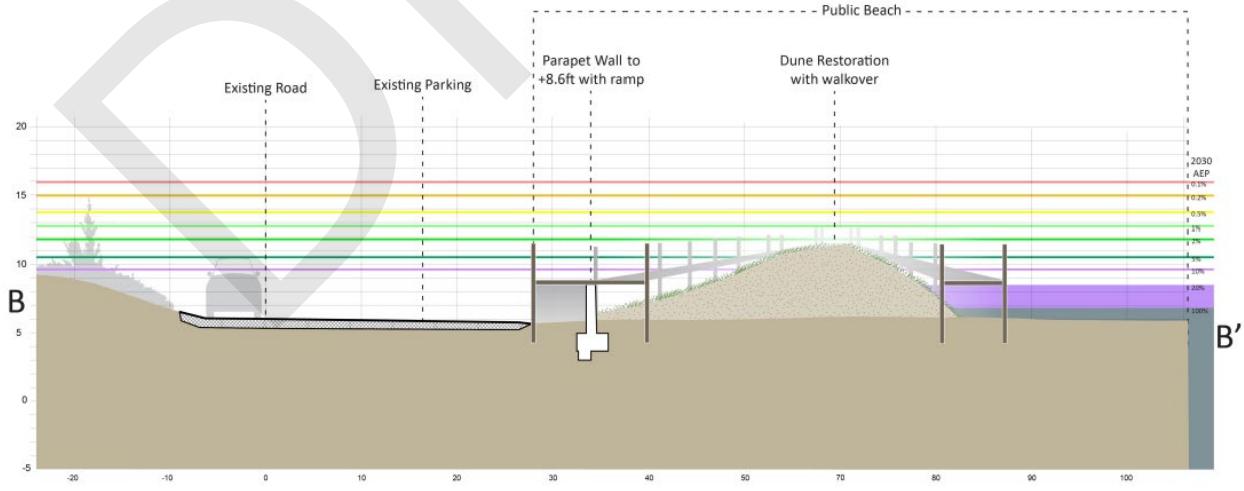


FIGURE A-14. Circuit Avenue Alternative 2 – Hybrid, Cross-Section

The green alternative presents a conceptual design that would include a combination of coastal bank and dune enhancements to protect the road to 6.9 feet NAVD88. A dune enhancement to 10 feet NAVD88 would protect the beach and parking lot from erosion. The existing culvert would be replaced and an operable tide gate would be installed.

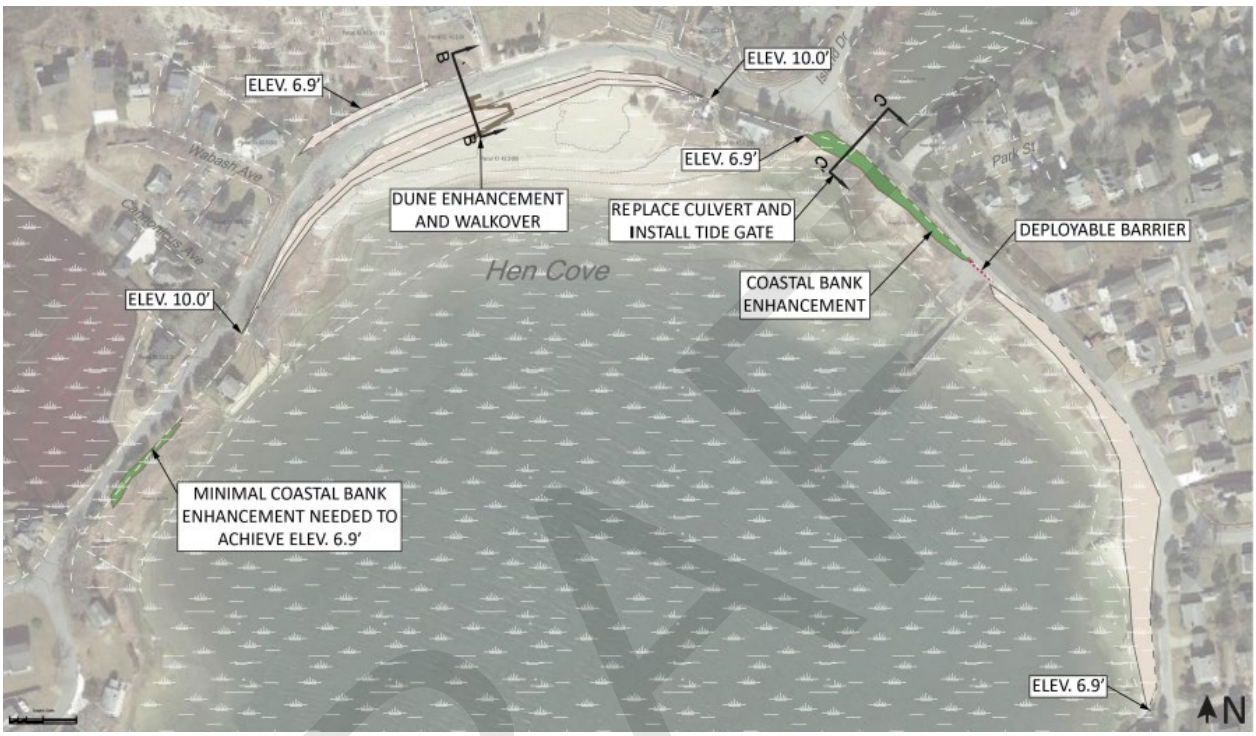


FIGURE A-15. Circuit Avenue Alternative 3 - Green

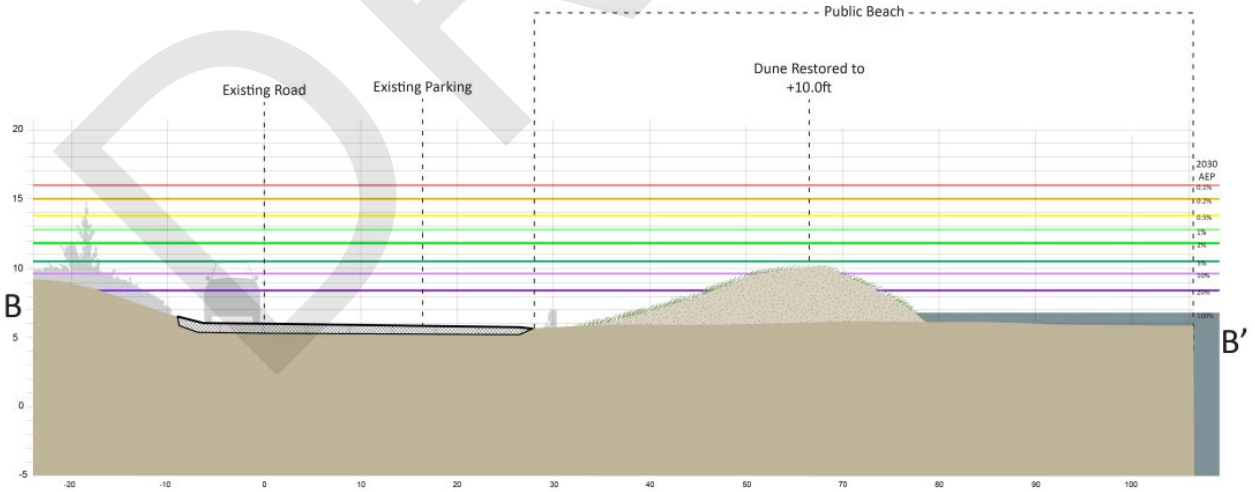


FIGURE A-16. Circuit Avenue Alternative 3 – Green, Cross-Section

A summary of alternatives can be used to compare considerations and tradeoffs of employing a particular solution.

CIRCUIT AVENUE, BOURNE
Summary of alternatives

	Description	Critical Elevation	Annual Exceedance Probability			Vulnerable to Tidal Flooding	Impacts to Wetlands	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 20 foot wide road with a public beach and a culvert.	3.8 feet	100%	100%	100%	2050	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	2452 linear feet of Town-owned road are elevated from a lowest point of 3.8 feet to a lowest point of 9.5 feet. Sheet pile is used to elevate the road at the cranberry bog and culvert crossing, and traditional vegetated side slopes are used at other locations.	9.5 feet	10%	20%	100%	N/A	N/A	Yes	$1,133,000
ALTERNATIVE 2: HYBRID	A parapet wall to 8.6 feet is installed to tie together high points along Circuit Ave. A tide flap is added to the culvert to prevent flanking. A dune is constructed at the public beach, and access is preserved with a wooden walkover.	8.6 feet	10%	20%	100%	N/A	Possible Positive	No	$1,386,000
ALTERNATIVE 3: GREEN	A combination of coastal bank and dune enhancements protect the road to 6.9 feet. Additional dune enhancements at the beach protect the parking lot and beach from erosion. The culvert is replaced and an operable tide gate is installed.	6.9 feet	20%	100%	100%	N/A	Positive	Yes	$1,108,000

*Installed material cost +20% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on RSMeans 2021 cost book and adjusted for inflation and region.

FIGURE A-17. Comparison of Alternatives

Each town can use these conceptual design solutions and comparison of alternatives to further a preferred option to additional design and permitting for roadway adaptation. The probability and risk analyses can be used to plan for and prioritize future road work over the projected planning horizons.

Additional funding through the MVP program was secured last fall to continue this work with the remaining Cape Cod communities: Chatham, Falmouth, Harwich, Mashpee, and Provincetown. Modeling and analysis are underway for these towns, and workshops will be scheduled in the spring of 2023. Work under this second MVP Action grant will conclude in June 2024.

CAPE COD CLIMATE ACTION PLAN

Climate change is transforming Cape Cod. Though rising seas and changes to the coastline may be the most dramatic evidence of climate change, it is impacting every facet of Cape Cod's natural, built, and community systems. Climate action is necessary to slow the effects of climate change and improve the region's resilience to its impacts.

In 2021, the Cape Cod Commission developed the Cape Cod Climate Action Plan[2] (CAP), which provides a way forward for the region to mitigate and adapt to our changing climate and aligns with the Commonwealth's goal of reaching net-zero emissions by 2050. The CAP is the result of an intensive effort, coordinated by the Cape Cod Commission, to engage the Cape Cod community, identify paths toward climate resiliency, and further develop partnerships necessary to implement climate actions.

The Climate Action Plan identifies strategies and actions that can aid in reducing greenhouse gas emissions (GHG) and enhance local resiliency to climate threats. The identified strategies and actions will require significant changes in how we build, rebuild, work, travel, plan for and implement our infrastructural investments.

The Cape's transportation hub for intra- and inter-regional transportation, as well as the region's main hospital and supporting infrastructure, along with regional businesses, road infrastructure, and hundreds of local critical facilities are located within areas vulnerable to flooding, sea level rise and extreme weather events.

Regional GHG Emissions

Cape Cod's 2017 GHG emissions were estimated to equal 3,564,875 $MTCO_2e$, approximately 4-5% of Massachusetts state emissions. Transportation is the highest local contributing sector of emissions, accounting for 55.5% of total Cape Cod emissions. The second highest contributing sector locally is stationary energy use, which is responsible for 39% of total inventory emissions. The remaining 5% of emissions come from the waste (3%), industrial processes (1.9%), and agriculture (0.4%) sectors.

[2] More information is available at www.capecodcommission.org/climate

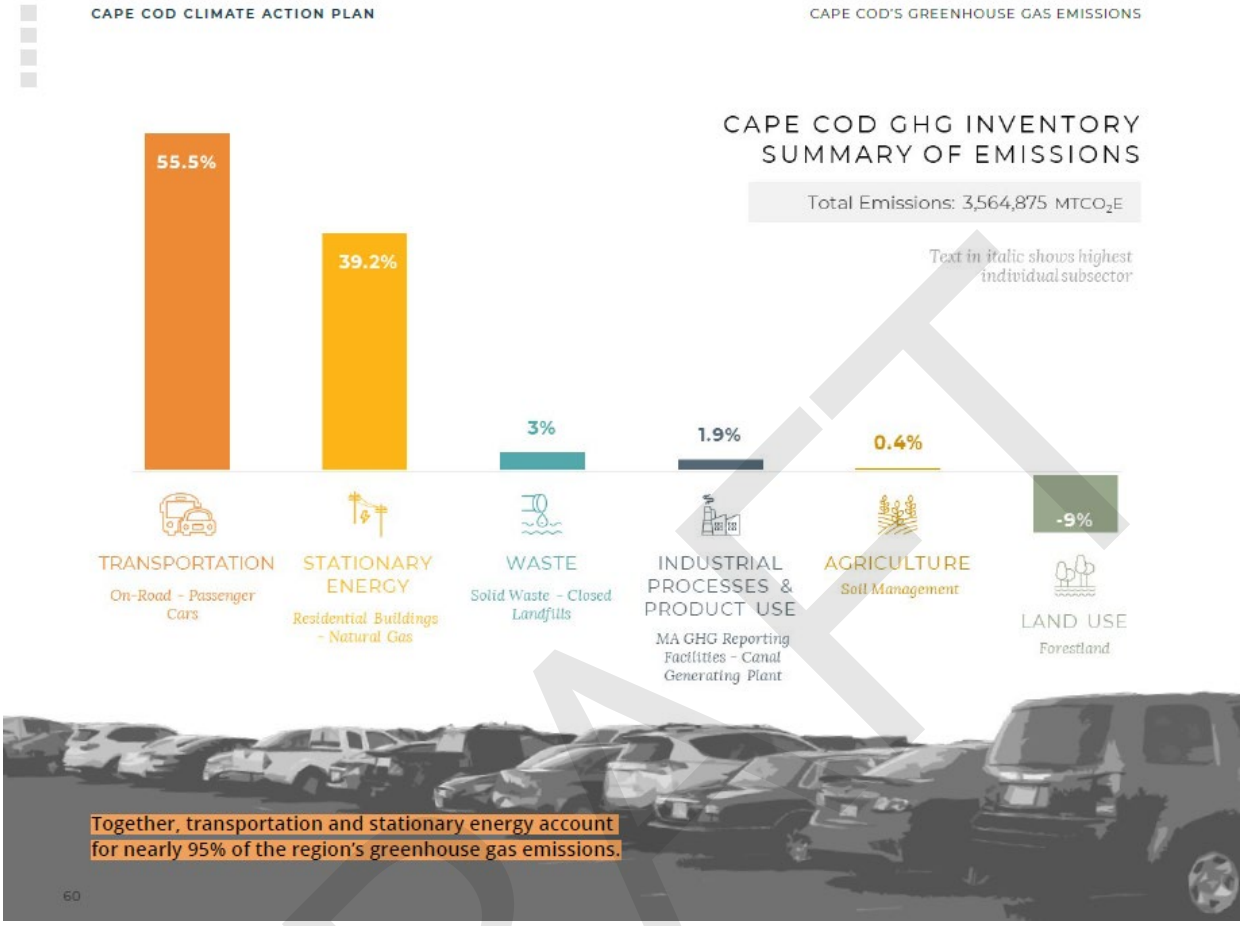


FIGURE A-18. Summary of Cape Cod Greenhouse Gas Emissions

Transportation accounts for 55.5% of GHG emissions for the region, compared with 45.7% of state emissions. On-road vehicles account for 43% of the region's emissions and nearly 80% of transportation emissions.

Future GHG Emissions Scenarios

Future GHG emissions scenarios were developed by Eastern Research Group and Synapse Energy Economics as part of the CAP to help better understand how the region could contribute to GHG emissions reductions in support of the Commonwealth's GHG emissions reductions goals to reduce GHG emissions to 50% below 1990 levels by 2030 and to 85% below 1990 levels by 2050.

The future emissions scenarios provide context for the extent of actions necessary within each modeled sector to contribute to achievement of the Commonwealth's goals. For each of the scenarios, Synapse modeled several key metrics, which will help the region understand the

necessary magnitude of change—and progress toward it—to play its part in achieving the Commonwealth's GHG emissions reduction targets.

All decarbonization scenarios require significant growth in the share of new, light-duty electric vehicle (EV) sales. Even an aggressive energy efficiency scenario (SER2), with reduced vehicle miles traveled (VMT) relative to the other decarbonization cases, requires 63% of new vehicle sales to be EVs by 2030. An increased year-round population scenario (SER3) requires 85% by 2030. The aggressive electrification scenario (SER1) and the carbon neutral scenario (CEN) each require 93% of new sales to be EVs by 2030. By 2050, all decarbonization scenarios require 100% of new vehicle sales to be EVs.

To accommodate about 214,000 light-duty EVs on the road by 2050 (as required to reach 2050 emissions goals in the SER1 scenario), 8,800 public charging stations will need to be installed, which is nearly 4,000 more (at an additional cost of around $10 million) than would be needed in a sustained policy case.

Strategies for Climate Action

With input from stakeholders during the CAP development process, the Commission created a Climate Actions Database, which presents strategies, actions, and steps to achieve the goals of the CAP. One priority strategy identified is to accelerate the electrification of the transportation system.

Actions within this strategy include:

- Encourage investments in EV charging infrastructure – To accelerate the adoption of EVs, additional investment in charging infrastructure is required. Residential and commercial developments and redevelopments should be designed and built with EVs in mind. While the majority of EV charging may take place at home there is a clear need for public charging stations, particularly for a region where a significant proportion of motorists on the roadway are visitors. This will require action from both the public and private sectors.
- Support programs that incentivize EV adoption – With lower operating and maintenance costs, the lifetime cost of owning an EV could be less than a gas-powered vehicle. Unfortunately, the higher upfront cost of EVs still presents a barrier to ownership for many. While advances in technology are expected to ultimately make the EV the most economical choice, in the near- and medium-term, rebates and other incentives can help to promote EV adoption. These incentives are particularly important to ensure equitable access to EVs. Additionally, the local availability of dealers and repair facilities for EVs will be important for large-scale adoption.
- Explore opportunities for electrification of public transit and fleet vehicles and vessels – As technology advances, EV options will become more feasible for public transit vehicles, municipal vehicles, school buses, police vehicles, delivery vehicles, and various marine vessels. Feasibility

studies could help inform decision-makers of the current opportunities, barriers, costs, and grant options for electrification.

Implementation and Measuring Performance

The strategies and actions identified through the Climate Action Plan process require implementation by the region as a whole. Partnerships within government, and with and between nongovernmental organizations, researchers, and the business community, will be critical for success. Partnerships must be forged and strengthened to advance the implementation of many actions. Implementation will require all those who live, work, and visit Cape Cod to advance climate action.

In addition to partnerships, the region must focus on those actions which will begin to have significant impacts on reducing GHG emissions from the sectors with the biggest contributions, such as transportation, and those which will help improve the resilience of the region's natural and built systems.

Measuring progress towards meeting the goals of the Climate Action Plan will require both long-term tracking of regional performance measures and shorter-term tracking of the implementation of specific strategies and actions. One measure within the CAP of reduced emissions from the transportation sector is the percent of vehicles powered by electricity, including:

- Percent of new vehicle purchases that are EVs
- Number of EVs
- Number of EVs in municipal fleets
- Number of EV charging stations

Measuring performance of transportation electrification over time is needed to show progress towards electrification goals.

CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix I: Stormwater Management

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Technical Appendix I: Stormwater Management

Stormwater runoff is caused by precipitation from rain and snowmelt events which flow over land or impervious surfaces and is unable to percolate into the ground. In natural systems, precipitation may be directly infiltrated subsurface, stored in natural depressions, or reintroduced to the atmosphere through evapotranspiration. However, development such as buildings, roads, sidewalks, and paved driveways increases impervious surface area and alters natural hydrology. The increase in impervious cover that accompanies development results in two main issues related to stormwater: 1) greater volume and peak flows of runoff and 2) transportation of contaminants into water bodies.

In natural ecosystems, runoff is infiltrated through the ground into groundwater and discharged to freshwater streams, ponds, lakes, rivers and marine estuaries. Flooding is less significant in natural systems because greater volumes of stormwater are able to infiltrate through the soil, passing it from the surface to the groundwater. In urbanized areas, dense impervious cover reduces the amount of infiltration that can occur. The increase in stormwater runoff volume results in increased ponding, flooding, and hydroplaning potential on roadways, which makes roadways unsafe for travel.

Stormwater runoff flushes pollutants and debris from impervious surfaces and discharges them to local waterways. Common pollutants found in stormwater runoff include oil; grease and metals from vehicular traffic; salts and other deicing agents used to maintain safe roadway operation under winter weather conditions; pesticides and fertilizers from landscaping activities; sediments from various activities; altered water temperatures and litter. When conveyed by stormwater runoff these pollutants impair waterways, degrade natural habitat, pollute groundwater, increase flooding, cause erosion of streambeds or siltation of waterways, and decrease the amount of water recharged to aquifers. Transported by stormwater runoff, pollutants find their way into the ground and surface waters throughout Cape Cod. These waters with increased pollutant loads ultimately discharge to coastal embayments.

STORMWATER MANAGEMENT CHALLENGES ON CAPE COD

What makes Cape Cod a unique area for stormwater management is the combination of highly porous native soils left by the retreating glaciers and shallow groundwater levels, which are especially prevalent in coastal communities. Well-drained soils readily infiltrate runoff, providing excellent volume reduction of stormwater. However, the combination of

highly permeable soils and a high water table results in rapid infiltration of contaminated stormwater runoff in to the groundwater. Because groundwater on Cape Cod travels towards nutrient-sensitive coastal embayments, the quality of stormwater runoff is a concern.

Where most efforts to manage stormwater focus on moving the volume of water off roadways, stormwater management on Cape Cod also requires addressing the quality of stormwater that infiltrates to the Cape's groundwater (drinking water) resources and the Cape's coastal estuaries.

Stormwater and Drinking Water Protection

Drinking water on Cape Cod is provided by the groundwater, a sole source aquifer, and because of the hydrogeology of Cape Cod, the aquifer is sensitive to stormwater runoff. Areas of land that receive precipitation to recharge drinking water wells are called Wellhead Protection Areas (WPAs). Stormwater management is particularly important in these areas because contaminated stormwater runoff can potentially contaminate drinking water supply. Because of this threat, WPAs have specific regulations in place to protect the Cape's drinking water supply. Potential Water Supply Areas (PWSAs) have also been identified on Cape Cod to ensure consideration and possible protection of suitable land for drinking water wells. WPAs and PWSAs are mapped water resources areas in the Cape Cod Commission's Regional Policy Plan (RPP) and have specific regulatory review standards.

TMDLS and Impaired Watersheds on Cape Cod

The allowable load of a particular contaminant that changes a healthy system to a deteriorating system is defined as a critical threshold, which under the federal Clean Water Act is referred to as a Total Maximum Daily Load (TMDL). TMDLs determine the maximum allowable load of a pollutant to a water body that still enables that water body to meet state water quality standards. Establishing a TMDL includes identifying and quantifying sources of the pollutant of concern (from both point and non-point sources), taking into consideration a margin of safety, seasonal variations, and several other factors. Communities are required to restore impaired surface water bodies where a TMDL is determined. TMDLs are determined for specific pollutants such as nitrogen, phosphorous, and pathogens.

NITROGEN

In marine and coastal embayments, nitrogen generally acts as the limiting nutrient. Due to the Cape's unique geology, very little nitrogen is removed from groundwater by natural processes, so increased nitrogen loading from development has a particularly significant effect on the nitrogen-limited coastal embayments of Cape Cod. When an excess of nitrogen is introduced to an embayment, changes in the natural ecology will occur. A common result from excess nitrogen loading is eutrophication, which is the overgrowth of

certain plant species (e.g. algae), often leading to the loss of species diversity and community richness, and overall habitat degradation. In some severe cases eutrophication creates anoxic environments resulting in fish kills, loss of eel grass, and aesthetically unpleasant conditions.

Nitrogen sources include septic systems and other water treatment facilities, fertilizer, stormwater, atmospheric nitrogen, sediment nitrogen, and natural background.

As of 2022, the Massachusetts Estuaries Project has studied 40 Cape Cod embayments. Of the 40 studied embayments, 36 are considered "impaired" and have a nitrogen TMDL that have been approved by the Massachusetts Department of Environmental Protection (MassDEP) and the U.S. Environmental Protection Agency (EPA). Though the majority of nitrogen reaching the coastal embayments originates from septic systems, a reasonable percentage of all controllable nitrogen sources originate from impervious surfaces (i.e., stormwater). The Waste Load Allocation (WLA) calculations in the Nitrogen TMDLs consider runoff from the entire impervious area within a 200-foot buffer zone around all waterbodies.

PHOSPHORUS

There are other nutrients that have detrimental effects on water resources besides nitrogen. Phosphorus is generally the limiting nutrient in fresh bodies of water. Phosphorus does not travel as readily through soils as nitrogen, because it binds to iron or aluminum oxides and hydroxides present in soil. However, once these binding sites are full, phosphorus will travel through the soil and into groundwater and freshwater ponds. Although there aren't any TMDLs on Cape Cod for phosphorus, excess amounts of phosphorus are entering freshwater bodies and causing impairment. Like nitrogen, excess amounts of phosphorus loading causes eutrophication in ponds and lakes. Leading to impaired water quality, fish kills, and loss of habitat.

FIGURE 1. Stormwater Runoff Nitrogen Load to Impaired Embayments

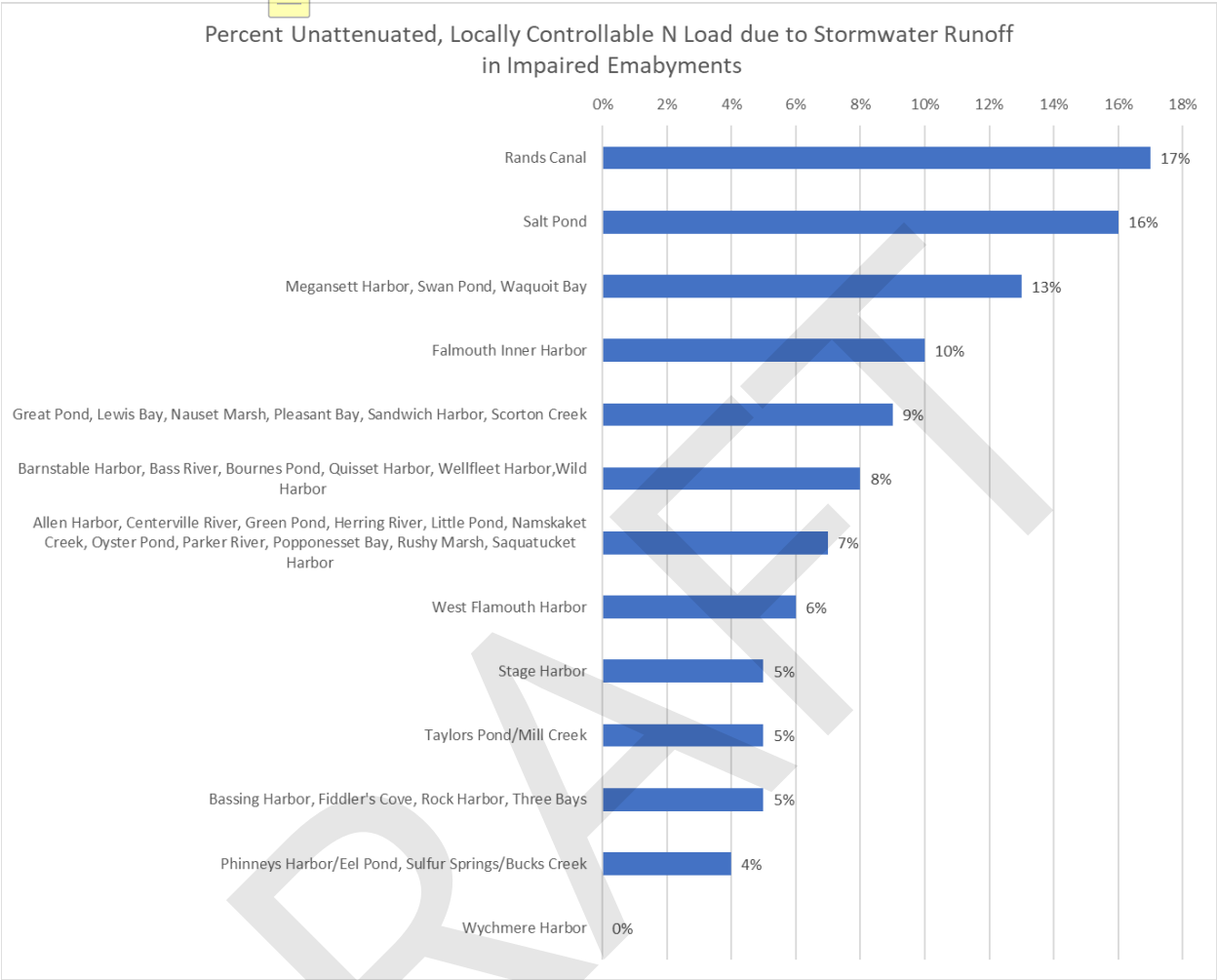
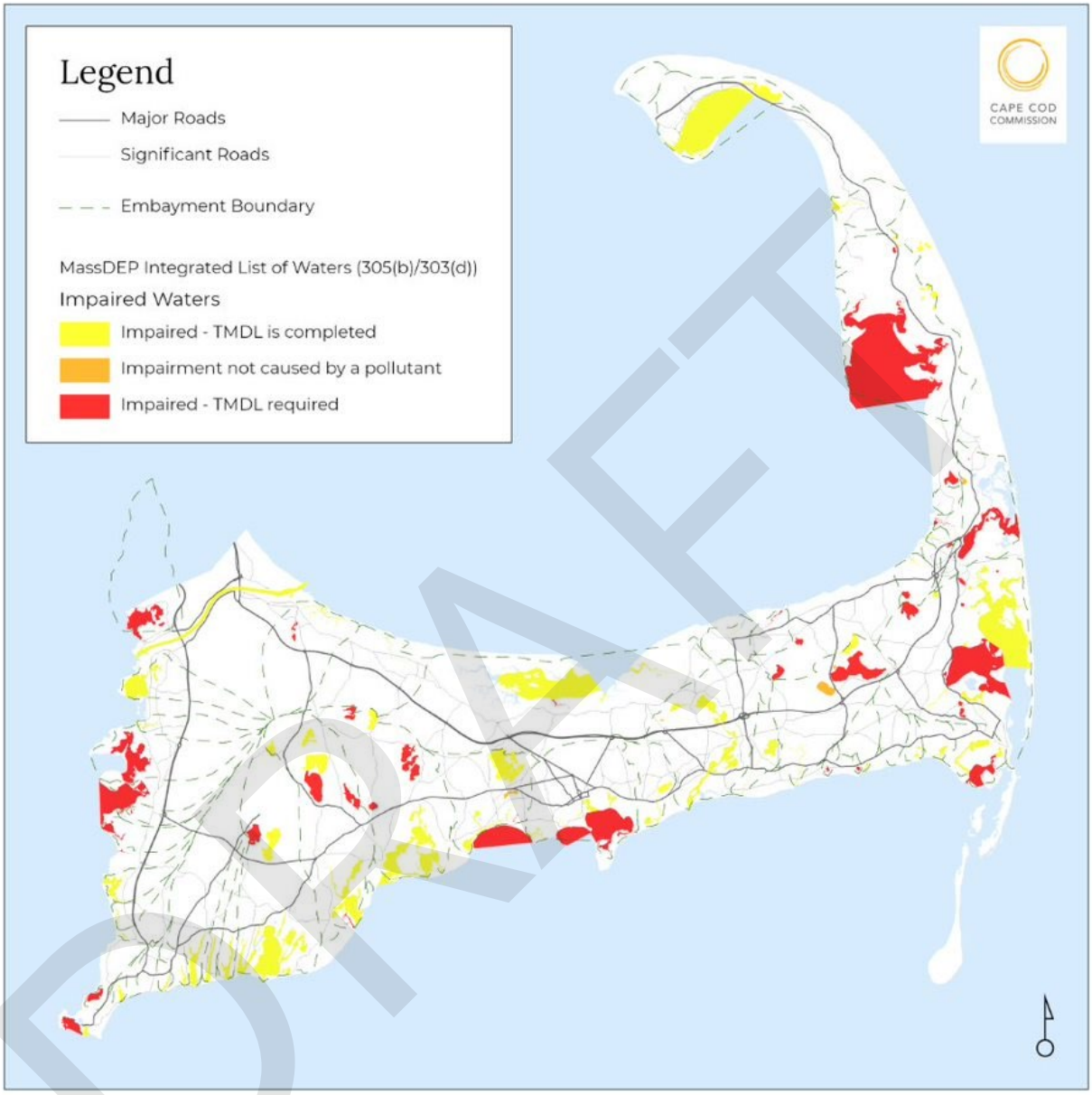


FIGURE 2. Impaired Waters (DRAFT)



BACTERIA

Pathogens can pose a risk to human health by causing gastrointestinal illness through exposure via ingestion, contact with recreational waters, and consumption of filter-feeding shellfish. Waterborne pathogens enter surface waters from a variety of sources including sewage, the feces of warm-blooded wildlife, pets, geese, gulls, and illicit discharges of boat wastes. Areas of elevated bacteria levels in Cape Cod watersheds are believed to be primarily from boat wastes, pets, wildlife, birds, stormwater, and failing septic systems. Eighty Five percent of Cape Cod's watershed populations (residences and businesses) have individual septic systems for disposal of human waste. Septic system failures or poorly

performing systems play an important part in the bacterial contamination throughout the Cape.

Pathogen TMDLs were developed for all Cape Cod Watersheds using fecal coliform as an indicator bacterium for shellfish areas, enterococci for bathing in marine waters, and E. *coli* for fresh waters. Understanding sources of bacteria is essential when selecting appropriate stormwater management strategies.

Pathogen TMDLs exist for 86 pathogen-impaired water body segments on Cape Cod, defined through the following TMDL documents:

- Final Pathogen TMDL Report for the Cape Cod Watershed (49 segments) - 2009
- Addendum to Final Cape Cod Pathogen TMDL Report (17 segments) – 2012
- Final Pathogen TMDL for Buzzards Bay Watershed (14 segments) - 2009
- Final Pathogen TMDL for Three Bays Watershed, Barnstable, MA (4 segments) - 2009
- Bacteria TMDL for Muddy Creek - 2005
- Bacteria TMDL for Frost Fish Creek, Chatham, MA – 2005

The WLA calculation for the pathogen TMDL assumes a 200-ft buffer zone around embayments as the contributing area for stormwater. According to the Cape Cod Watershed TMDL, data indicate that in general, two to three orders of magnitude (i.e., greater than 90%) reductions in stormwater fecal coliform loading will be necessary, especially in developed areas.

HYDROLOGIC RESPONSE UNITS

To analyze the runoff potential, and specifically the amount of phosphorus load from stormwater runoff, Commission staff utilized work done to develop the EPA Opti-Tool (Tool). The Tool is designed to assist in the planning and optimizing of stormwater management practices to provide the greatest benefit for achieving water resource goals, while balancing costs. Output from the Tool helps users determine the best stormwater management practices across changing and developing landscapes. The Tool is based on extensive research and modeling and incorporates inputs that are regionally representative of stormwater data, precipitation data from Boston Logan Airport, and annual average load export rates from major land uses.

One of the main inputs to the Tool is hydrologic response units (HRUs). HRUs represent areas in our communities of similar physical characteristics that respond similarly to precipitation and weather events. The units in the hydrologic response units are newly defined categories comprised of land use, land cover, and soil type. These characteristics assess the potential of an area to generate stormwater runoff and estimate potential pollutant loading. Land use plays a lesser role in terms of generating runoff but is necessary

for determining the amount and type of pollutants likely to be present in the runoff. When considered together in newly categorized HRUs, runoff, phosphorus, and nitrogen load values can be calculated.

Calculating runoff impacts consistently across towns or regions is important for monitoring current and potential impacts from stormwater and pollutant loads. Commission staff developed a standard for HRUs to ensure that each town in Barnstable County will have the same data and comparable stormwater impact calculations.

Hydrologic Response Unit data inputs for this analysis include:

- Land use describes how people modify land, representing the economic and cultural activities and the built environment in a given place. Land use definitions or districts divide properties into different categories (residential, commercial, agricultural). This information was obtained from MassGIS 2016 Land Use. Classifying land use within an area is an important step in identifying areas that are more vulnerable to stormwater runoff and pollution.

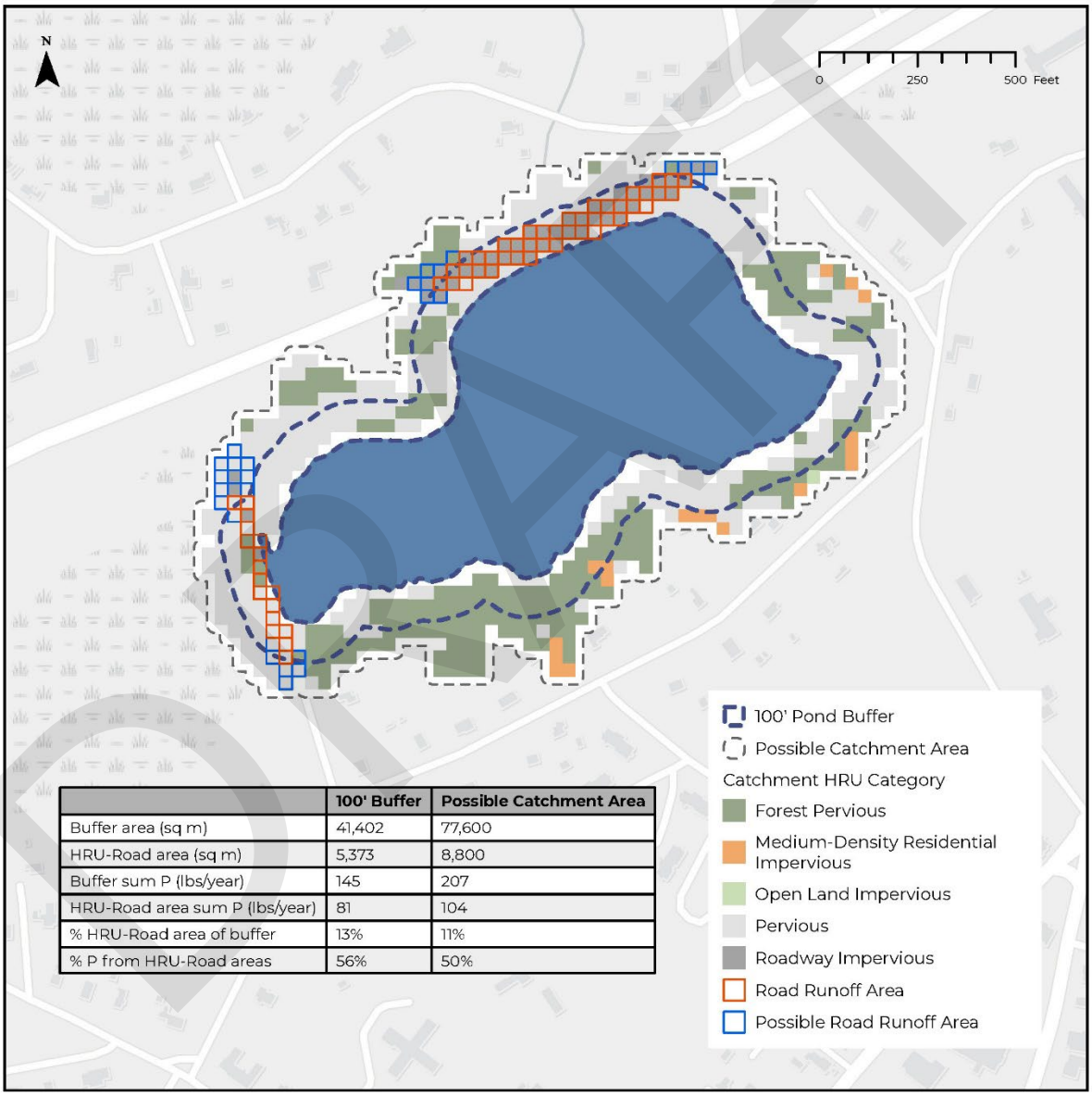
- Land cover indicates the physical land type (grass, bare ground, asphalt) and was also obtained from MassGIS 2016 Land Use.

- Soil type refers to the makeup and characteristics of the soil, and specifically for this purpose, the hydrologic soil group. The soil data were obtained from USDA NRCS Soil Survey Geographic (SSURGO) Database.

An adjustment made by Commission staff to the HRU was a designation of an area as impervious or pervious. Impervious and pervious surfaces have a large impact on rain and runoff infiltration. Nonporous materials, such as roads, roofs, and parking lots, significantly obstruct infiltration of water. The impervious or pervious designations were determined using a 30% threshold. In a 10x10 meter grid cell, if more than 30% of the cell's area was impervious, then the entire cell was determined to be impervious. If 70% or more of the grid cell has pervious surfaces, the entire cell was designated to be pervious. For reference, a 10x10 meter grid cell is about the size of a two-car garage.

To estimate which road segments may contribute runoff into a 100-foot pond buffer, a possible catchment area was delineated. Elevation information was used to define a contribution area to a pond buffer which included distance traveled on downhill slopes (-90° to 0° movement allowed) and forward aspects (180° movement allowed). The same parameters were used to calculate distance traveled from roads. Areas where travel distance "from" roads and "to" ponds intersected indicated possible road runoff areas that were not already captured within a 100-foot pond buffer. Surface water flow characteristics were not included in the catchment delineation.

Figure 3 illustrates the analysis described above and includes a pond, its 100-foot buffer, and a "possible catchment area" that includes the area that is connected by slope and direction to the pond buffer. The various HRU categories within the 100-foot buffer and catchment area are shown. HRUs that overlap roads in the 100-foot buffer are highlighted as "road runoff" areas, with "possible road runoff" areas additionally included where travel distance from roads falls within the catchment area.



	100' Buffer	Possible Catchment Area
Buffer area (sq m)	41,402	77,600
HRU-Road area (sq m)	5,373	8,800
Buffer sum P (lbs/year)	145	207
HRU-Road area sum P (lbs/year)	81	104
% HRU-Road area of buffer	13%	11%
% P from HRU-Road areas	56%	50%

FIGURE 3. Example pond and 100-foot buffer showing HRUs and phosphorus contribution to the pond from roads and other land use acivities.

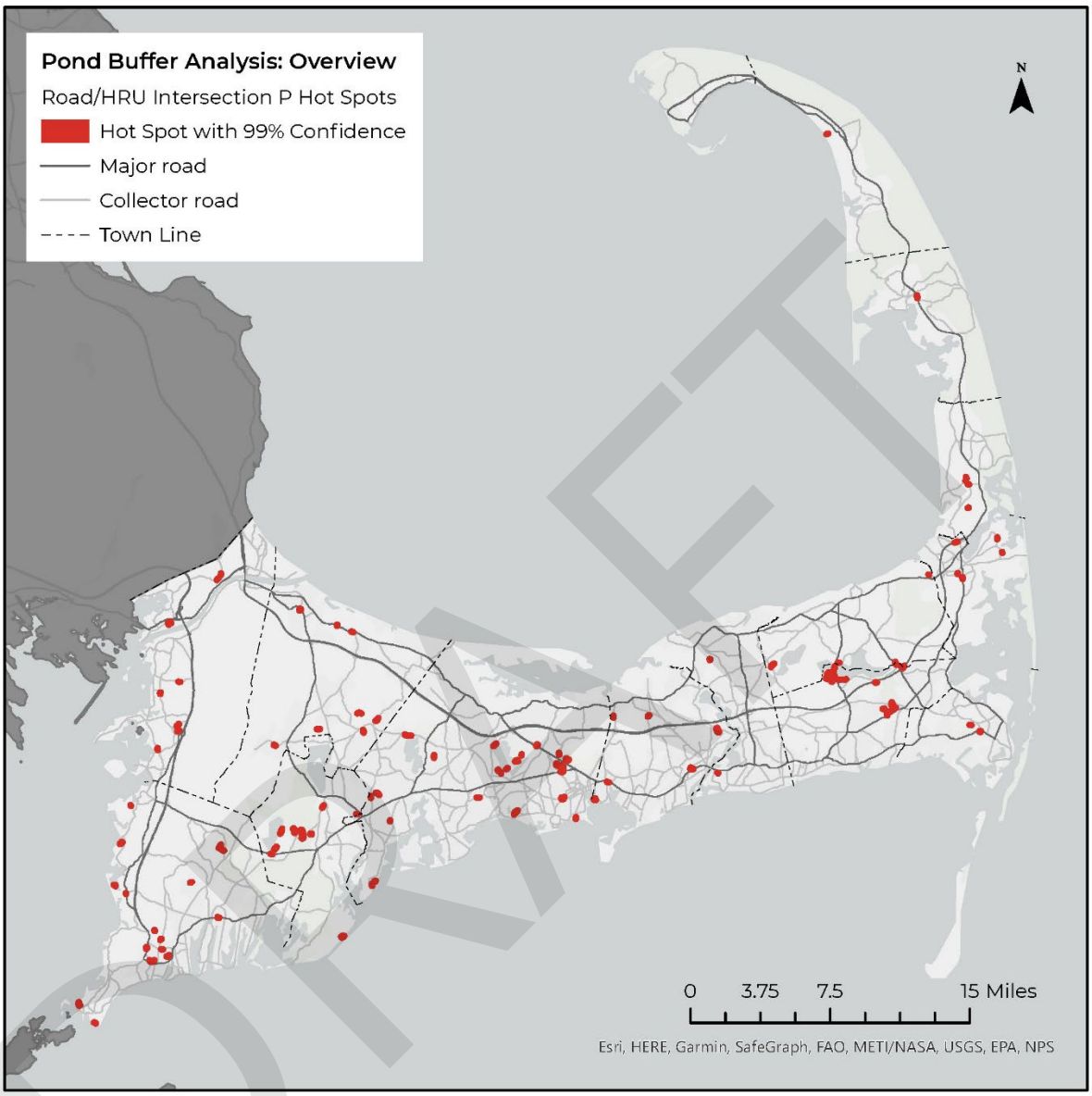


FIGURE 4. Cape-wide pond buffer analysis of road and HRU intersection indicating phosphorus loading hotspots.

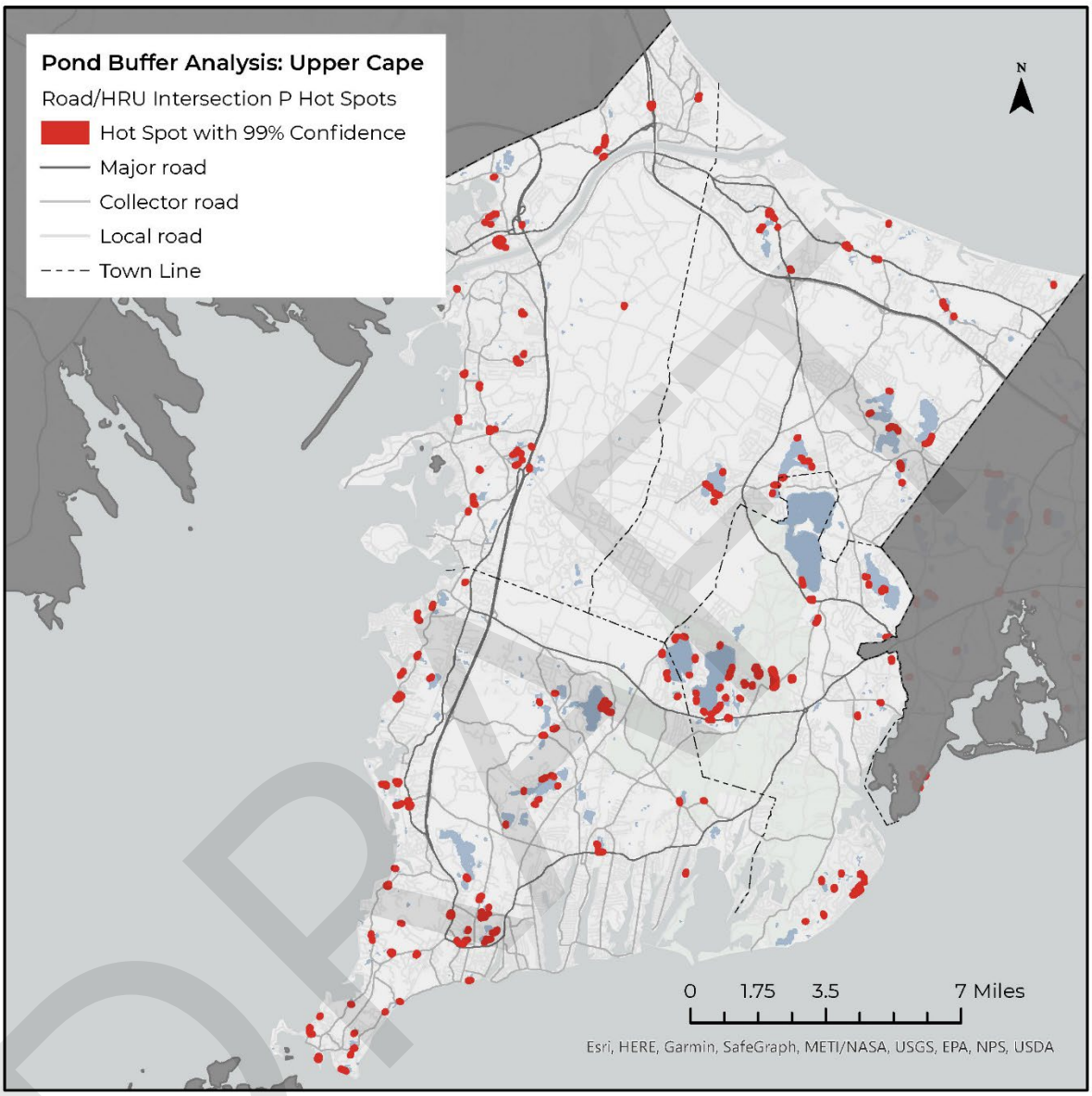


FIGURE 5. Pond buffer analysis of road and HRU intersection for upper Cape indicating phosphorus loading hotspots.

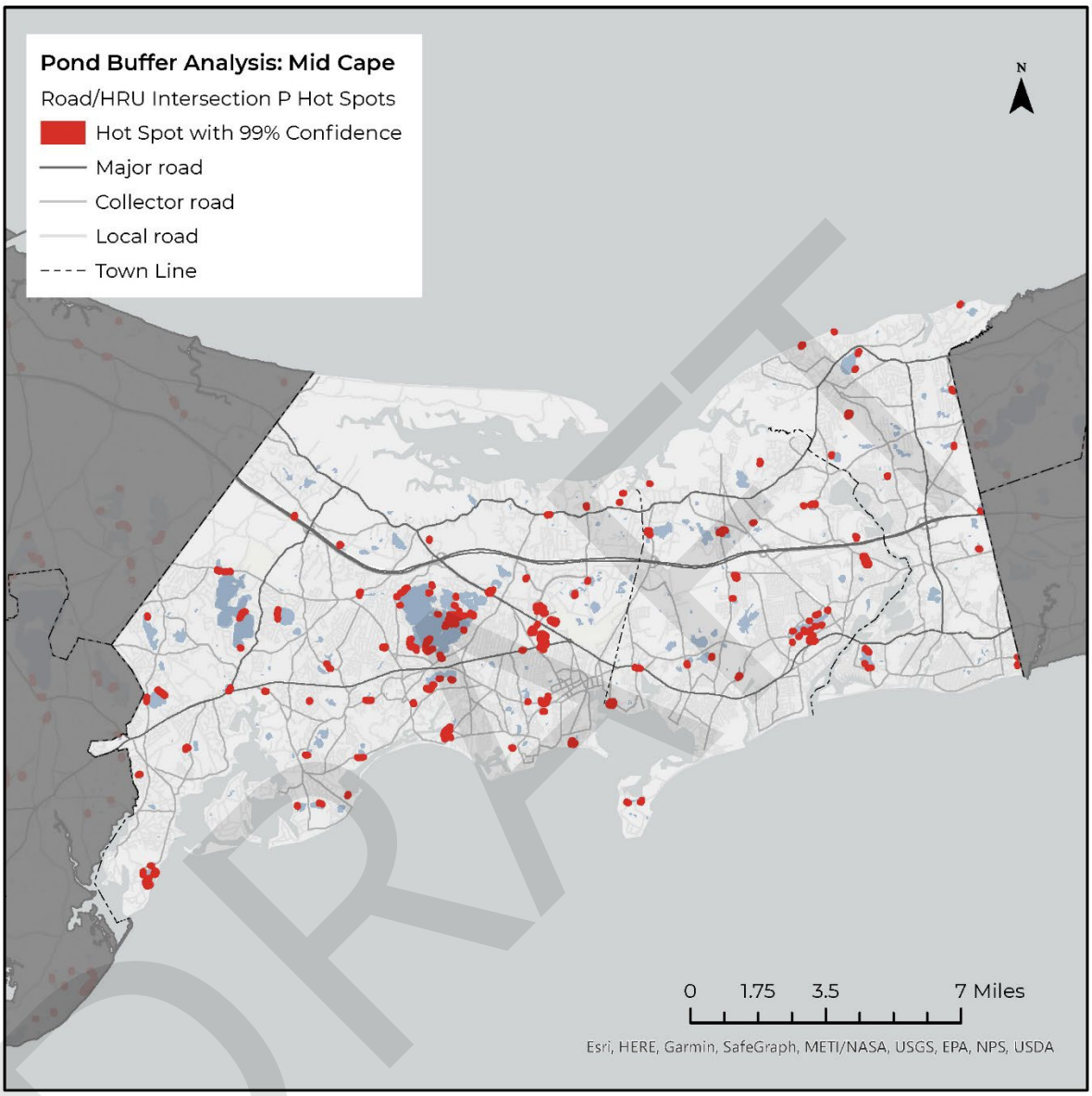


FIGURE 6. Pond buffer analysis of road and HRU intersection for mid Cape indicating phosphorus loading hotspots.

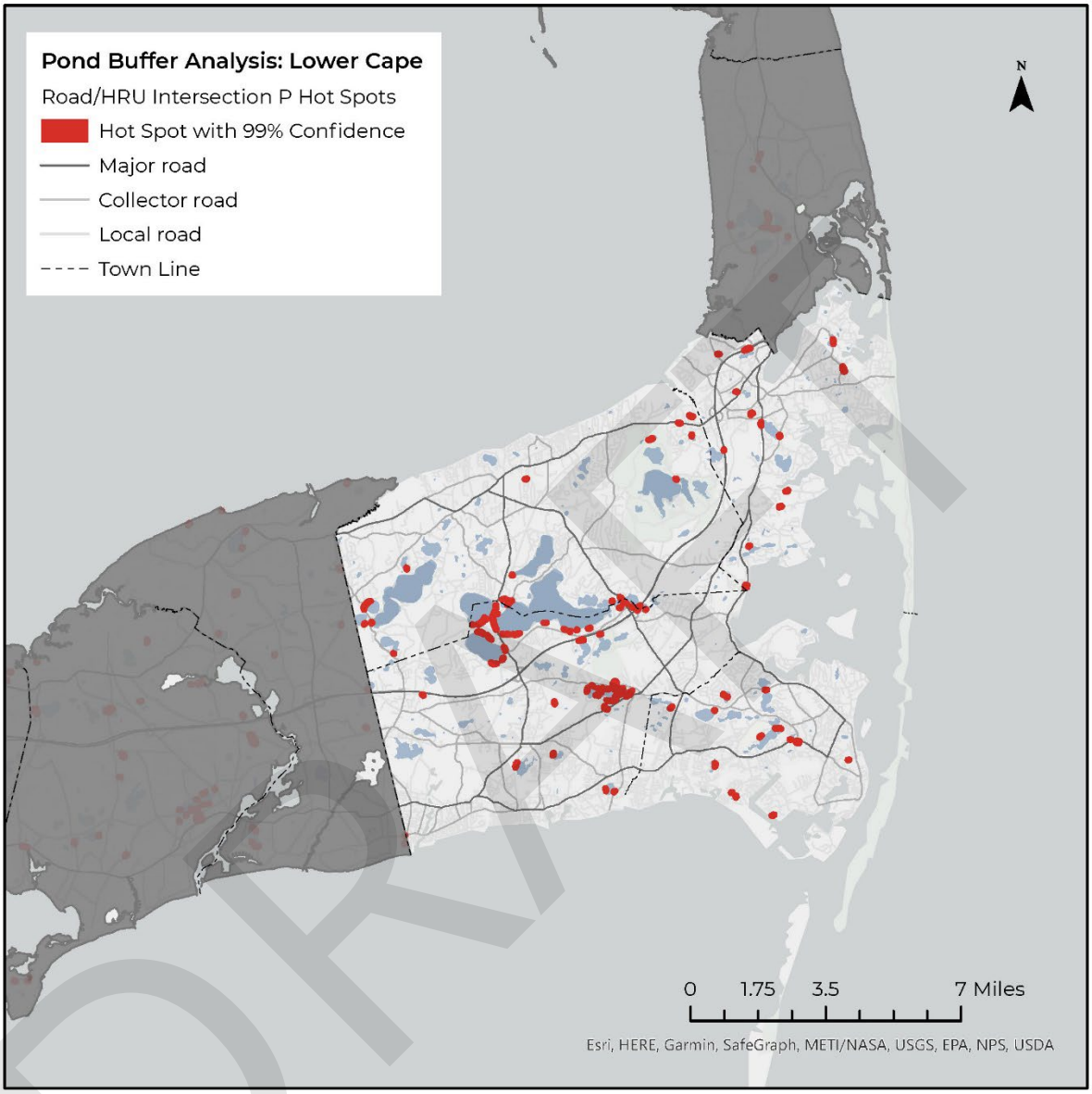


FIGURE 7. Pond buffer analysis of road and HRU intersection for lower Cape indicating phosphorus loading hotspots.

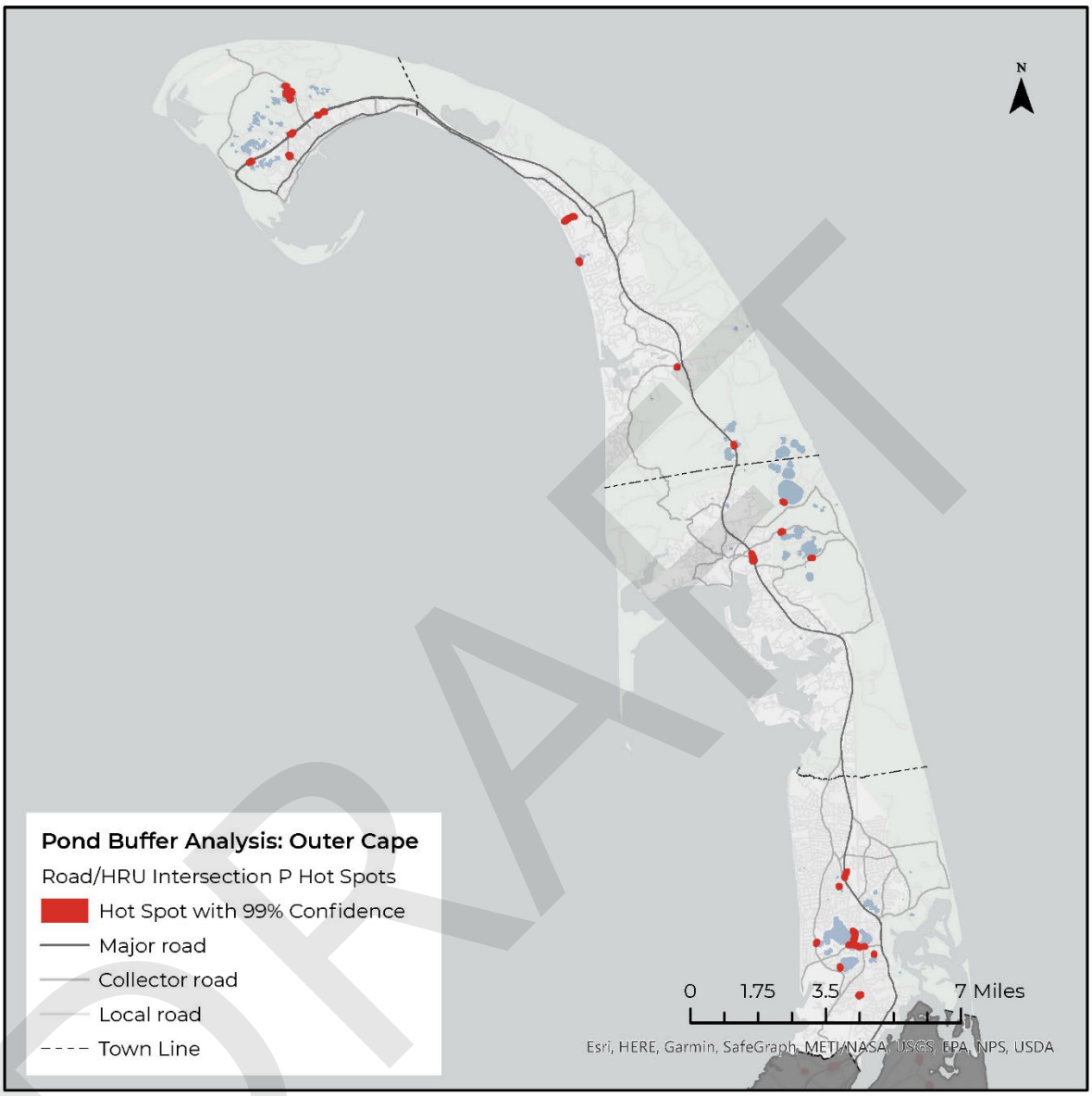


FIGURE 8. Pond buffer analysis of road and HRU intersection for outer Cape indicating phosphorus loading hotspots.

Stormwater Runoff and Sensitive Resource Areas

The map (Figure 9), below, identifies resource areas (and buffers around those areas) that can be sensitive to pollutants in stormwater runoff. These identified areas are where Nitrogen, Phosphorous, and/or Pathogens should be mitigated in stormwater runoff to protect sensitive resources areas on the Cape. Existing roadway retrofits and future roadway development should consider treatment of these pollutants in the identified areas.

Because different resource areas are sensitive to different kinds of pollutants, Table 1, below, outlines the resource areas mapped and their associated pollutants of concern. Buffer distances around resource areas were chosen by considering where stormwater runoff from roads may impact sensitive natural habitats and are derived from TMDL considerations and the RPP. In general, buffers are required to protect surface water bodies from sedimentation, erosion, and pollution; they are also needed to maintain wildlife habitat. In WLA calculations used for both the Nitrogen and Pathogen TMDLs on Cape Cod, a 200-foot buffer was considered as the contributing area for stormwater runoff. The RPP designates buffer distances around Sensitive Natural Resource Areas (SNRA), where development should be located outside of these buffer zones. Buffers include a 300-foot buffer around ponds, a 350-foot buffer around certified vernal pools, and a 200-foot buffer around rivers.

FIGURE 9. Stormwater Treatment Areas and the Pollutant(s) to be Treated (DRAFT)

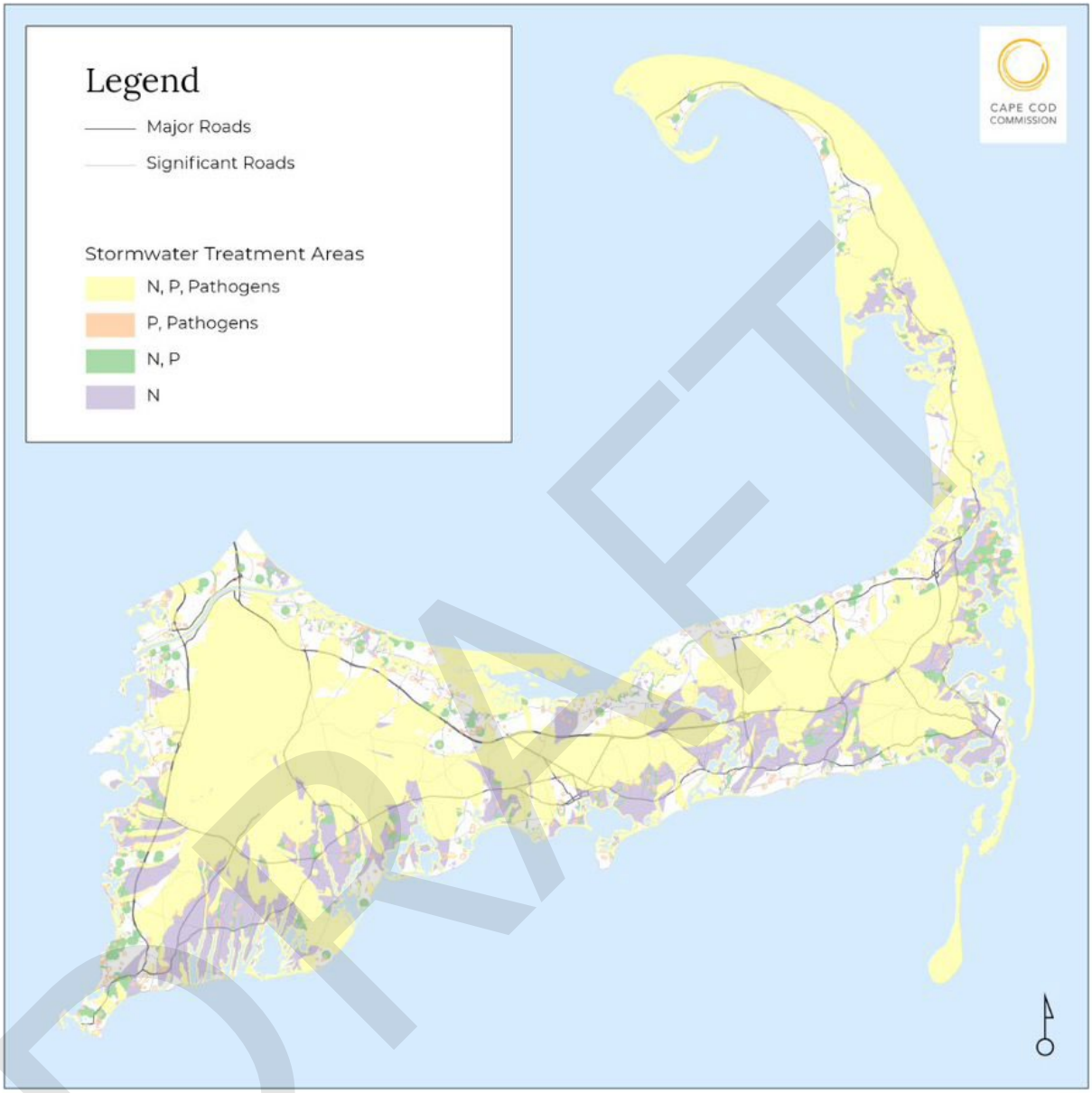


TABLE 1. Sensitive Resource Areas and Associated Pollutants of Concern

SENSITIVE RESOURCE AREA	NOTES	POLLUTANTS TO REDUCE
Watersheds requiring N removal	Indicates to what level watersheds must reduce current nitrogen loading	N
Impaired Waters	Impaired for pollutants (nutrients, metals, pesticides, solids, and pathogens) or impaired for pollution (e.g., low flow, habitat alteration, non-	P, N, Pathogens

	native species infestations). "Impaired" defined by Section 305 (b) and 303 (d) of the CWA.	
Impaired Waters Buffer	300-foot buffer around impaired waters	P, N, Pathogens
Outstanding Resource Waters	Considered a "Critical Area" according to MA Stormwater Standards. Stormwater discharges to Outstanding Resource Waters shall be removed (and set back from the receiving water or wetland) and receive the highest and best practical method of treatment	N, P, Pathogens
WPAs & IWPAs	Considered a: "Critical Area" according to MA Stormwater Standards. Water Resource Area in the RPP which have additional considerations for maintenance of water quality "Significant Natural Resource Area" according to RPP	N, P, Pathogens
Coldwater Fisheries	200 foot buffer. Overall sensitive habitat that requires maintenance of cold temps and high dissolved oxygen.	P, N, Pathogens
National Heritage and Endangered Species Program (NHESP) Certified Vernal Pool buffers	350 foot buffer required per RPP. Considered a SNRA (per RPP). EPA recommends managing a 1000 foot radius area beyond the edge of a vernal pool basin as vernal pool upland habitat.	P, N
Ponds Buffer	300 feet	P, Pathogens
River Buffer	200 feet	P, N
MassDEP Wetland Areas	Considered a SNRA (per RPP).	N
NHESP Priority Habitats	Considered a SNRA (per RPP).	P, N, Pathogens
Freshwater Recharge Area	Considered a Water Resource Area in the RPP with additional considerations related to phosphorus loading	P, N, Pathogens
Potential Public Water Supply Area	Considered a SNRA (per RPP).	P, N, Pathogens

Climate Change Considerations in Stormwater Management

Recent storm records and predictions for storm activity in the coming years suggest that roadways in New England will trend towards more extreme events. Accordingly,

Massachusetts transportation infrastructure should be designed to accommodate higher intensity storm events. The Massachusetts Climate Change Adaptation Report also cites evidence that by 2050, annual precipitation in Massachusetts may increase by 8%, with a winter increase of 16% (accompanied by a decrease in snow days and an increase in winter rain precipitation). These climate predictions suggest that future planning for stormwater management should consider increased volumes of water (and stormwater runoff) on Massachusetts roadways.

Climate Change Consideration for Low Lying Roads

Low lying roads are areas prone to flooding from the combined effects of hazards such as sea level rise, storm surge, and erosion. Cape Cod is especially vulnerable to multiple hazards including erosion, coastal storm flooding, and sea level rise, because of its unique geography and roadways that travel through ever-changing environments. Flooding is currently a regular event on several road segments during extreme high tides and storm events. As seas rise and storms intensify the impact to our coastlines and flooding occurrences will increase in frequency and depth.

Roads are more or less likely to flood depending on a number of factors such as proximity to the coast and road elevation. Significant rain events may also result in inland road flooding but are not a focus of this project. The vulnerability of a road is determined by the probability or likelihood that it will flood on an annual basis. The probability of a road flooding annually is determined by the elevation of the road surface as compared to the elevation of the anticipated water surface during a storm event, under future time horizons.

Regionally available data was used to score roads and road segments according to their criticality within a community. Criticality is how important a road is to the community's transportation needs. The scoring framework used to determine road criticality includes variables such as:

1. Usage/Network function - the type of road and average daily traffic

2. Vulnerable populations - environmental justice or social vulnerability communities,

3. Emergency/Community Services - access to critical, emergency, or community facilities

4. Economy - business activity density

The roads in a community that are both highly critical and have a high probability of flooding are ranked as high-risk roads or road segments that may require adaptation alternatives, including elevation or relocation of a road segment. Relocation, also known as

managed retreat, is the process of strategically relocating roads or a road segment out of the path of coastal hazards.

Cape Cod communities are identifying vulnerable roads utilizing the Massachusetts Coast Flood Risk Model (MC-FRM), a state-of-the-art model that projects flooding under future time horizons. The model includes the dynamic impacts of tides, waves, wave run-up and overtopping, storm surge, winds, and currents over a range of storm conditions to generate the probability of inundation. The MC-FRM generates hydrodynamically modeled projections for sea level rise and storm surge to determine projected changes in the likelihood of flooding under climate conditions for 2030, 2050, and 2070. The model uses inputs, such as sea level rise, tropical storms, landscape, elevation, and climate change, to create multiple outputs. Flood probability and flood depth are the primary outputs used in this assessment to evaluate roadways.

DESIGN CRITERIA FOR MANAGING STORMWATER VOLUME

First Flush

The Water Quality Volume (WQV) represents the runoff generated by a design depth of rainfall from a given drainage area. This provides a minimum quantity (ft^3) of water to capture and treat for the constituents of concern. To capture the full volume of each rain event would be costly and require large, dedicated portions of land. In its essence, the goal of stormwater management is twofold and includes treating contaminated runoff and minimizing flooding issues for the majority of storm events. The WQV calculation ensures that water quality treatment is provided for the most contaminated runoff, or the "first flush," of each event. The first flush typically includes the most polluted runoff of an event as it re-suspends contaminants that have been gathering on impervious surfaces during dry periods. Therefore, guaranteeing the capture and treatment of this initial runoff stream is the most important consideration from a water quality standpoint.

As defined by the Massachusetts Stormwater Design Handbook, the required WQV for the below land use types equals 1.0 inch of runoff times the total impervious area.

- from a land use with a higher potential pollutant load
- within an area with a rapid infiltration rate (greater than 2.4 inches per hour)
- within a Zone II or Interim Wellhead Protection Areas (IWPAs)
- near or to the following critical areas:
  - Outstanding Resource Waters
  - Special Resource Waters
  - bathing beaches

- shellfish growing areas
- cold-water fisheries.

The remaining land use types not listed here require a design depth of 0.5", but 1" is currently a recommended practice and will likely be the standard in the near future.

For the purposes of this report the WQV is calculated following Equation 1 and is defined below.

Equation 1: WQV Calculation

WQV = P * Rv * I * A

Where:

P = precipitation (in.)

Rv = unitless volumetric runoff coefficient

I = percent impervious cover draining to structure

A = contributing drainage area to BMP (acre)

Greater Design Flood Frequency

As discussed in the 2011 Massachusetts Climate Change Adaptation Report, addressing the resiliency and adaptability of infrastructure in the face of global climate change is of paramount concern. A 2010 study from the University of New Hampshire discussing trends in precipitation in the Northeastern United States indicates "that the occurrences of extreme precipitation events, and the intensity of rainfall, are increasing." The study shows that annual precipitation has increased since the late 1940's with the largest increases occurring in recent years. Researchers with the University of Massachusetts Boston Environmental, Earth and Ocean Science Department analyzed trends in precipitation from 1954 to 2008. Findings in the study strongly suggest the need for updating design storm estimates in Maine, New Hampshire and Massachusetts.

The table below, Figure 10, is an excerpt from Chapter 8 of the Mass Highway Design Manual, 2006 Edition and shows the recommended design flood frequencies for drainage systems by highway functional class. With trends showing an increase in event intensity and frequency, consideration should be taken to use greater design flood frequency values in areas of increased hydroplaning risk. It is becoming increasing common, and generally

recommended, to the 2015 NOAA Atlas 14 or the regularly updated Northeast Regional Climate Center estimates.

FIGURE 10. Recommended Design Flood Frequency (excerpt from MassHighway Design Manual)

Highway Functional Class	Urban/Rural	Type of Installation: Cross Culverts	Type of Installation: Storm Drain System[2]	Type of Installation: Open Channels[3]
Interstate/Freeway/Expressway	Both	50-yr	10-yr[4]	50-yr
Arterial	Urban	50-yr	10-yr[4]	50-yr
	Rural	50-yr	10-yr[4]	50-yr
Collectors/Local	Urban	25-yr[5]	5-yr	25-yr[5]
	Rural	10 or 25-yr	2 or 5-yr	10 or 25-yr

1. The values in the table are typical ranges. The selected value for a project is based on an assessment of the likely damage of a given flow and the costs of the drainage facility.
2. This includes pavement drainage design.
3. This includes any culverts which pass under intersecting roads, driveways, or median crossings.
4. Use a 50-yr frequency at underpasses or depressed sections where ponded water can only be removed through the storm drain system.
5. The selected frequency depends on the anticipated watershed development and potential property damage.

Source: HEC #1, March, 1969. Design of Highway Pavements, pp. 12-5 to 12-6. Note: HEC #12 — Revised, March, 1984.

Note: 100-year requirements must be checked if the proposed highway is in an established regulatory floodway or floodplain, or resource area is defined by the April, 1983 revisions to Ch. 131 MGL, Section 40. See Section 10.1.2.

Pavement Cross Slope and Expanded Shoulder

Providing adequate cross slope on a roadway surface and expanding the road shoulder are effective ways to manage runoff. Assuming shoulders are properly sloped to drain away from pavement, both help convey (?) runoff from driving lanes. Because adjusting roadway cross slopes is expensive and results in significant disruption to vehicular travel, such an approach would be considered only if a segment of roadway was already slated for reconstruction and resources like historic character and critical vegetation would not be damaged with inclusion of an expanded shoulder.

Minimize Drainage Path Lengths

Long downhill grades where water is channelized through raised shoulders or berms increase stormwater velocity and quantity until release points are reached, such as a curb cut or a curve transition where concentrated flow turns to sheet flow across the roadway. As drainage path lengths increase, the effects of channelization are compounded. By minimizing drainage path lengths through frequent curb cuts; runoff velocity, volume, and associated ponding are minimized. Catch basins, while a useful management tool for overall runoff reduction, should not be relied upon to minimize drainage path lengths. Due

to improper placement, clogging and infrequent maintenance, catch basins are often unable to capture design volumes on busy roadways.

Curbing and Berming

Curbing is primarily used at the outside edge of pavement to contain surface runoff within the roadway and away from adjacent properties. Secondary and tertiary benefits of curbing include the roadside delineation, prevention of slope erosion, , and pedestrian sidewalk protection.

In many instances, preventing runoff from exiting the road surface is an important goal when large quantities of runoff have the potential to affect adjacent property owners and protected natural resources. However, curbing and berming may be unnecessary in areas where there are sufficient median and adjacent rights of way to capture roadway runoff. Where there is sufficient land area to capture roadway runoff excess curbing and berming may be an unnecessary preventative measure and counterproductive when attempting to minimize the potential for hydroplaning. Intermittent or complete removal of curbing and berms in applicable areas will reduce runoff build up and minimize drainage path lengths.

When combined with a properly designed cross slope, the complete removal of curbing and berms will promote country drainage and have minimal risk for slope erosion. Where curbing and berming must remain, drainage pathways should still be minimized by frequent curb cuts. Curb cuts capturing runoff from large drainage areas and long drainage path lengths must account for the increased energy and velocity of runoff to prevent erosion. This may be accomplished through a variety of energy dissipaters such as vegetated filter strips, riprap aprons and riprap outlet basins. Curb cuts capturing runoff within nitrogen sensitive watersheds could utilize specific stormwater controls that address nutrient reduction. The targeted controls should be placed down gradient of energy dissipaters to accept a more controlled flow.

DESIGN CRITERIA FOR WATER QUALITY

Pollutants in stormwater fall into two groups: suspended solids and dissolved pollutants. Particle sizes greater than 0.45 micron are considered suspended solids. Pretreatment devices, such as a sediment forebay or oil grit separator, are ordinarily designed to remove suspended solids that have larger particle sizes. Dissolved solids, however, are removed by treatment practices that rely on settling (e.g. extended dry detention basins and wet basins) or filtration (e.g. sand filters and filtering bioretention areas).

If stormwater runoff will affect surface water that is subject to a TMDL, proponents must design, construct, operate and maintain a stormwater management system that is

consistent with the TMDL. Currently, there are TMDLs for both nitrogen and bacteria on Cape Cod.

Treating Nitrogen

There are a growing number of stormwater management technologies which effectively remove nitrogen from stormwater. Stormwater best management practices (BMPs) equipped with vegetation can remove nitrogen through nutrient uptake, while other BMPs create an anoxic, or oxygen free, environment for denitrifying bacteria to convert nitrogen in stormwater to inert nitrogen gas. BMPs that can effectively remove nitrogen include bioretention systems, tree box filters, sub-surface constructed wetlands and retention ponds. Nitrogen removal efficiencies of chosen BMPs can be found in Table 4 (page 31).

Treating Phosphorus

Although there are no TMDLs on Cape Cod for phosphorus, this nutrient impacts the water quality of fresh bodies of water, such as ponds and wetlands. In situations where the siting of a BMP is near a freshwater body, consider BMPs that capture and remove phosphorus, such as retention ponds or bioretention systems. Total phosphorus removal efficiencies for the listed BMPs can be found in Table 4.

Treating Bacteria

In shellfish growing areas and public swimming beaches, bacterial contamination is of concern. Therefore, designers should evaluate BMPs for their ability to capture bacteria or limit their growth. BMP technologies that retain water under conditions that promote bacteria growth (such as enclosed spaces that can become "septic" during extended no flow periods) should be avoided in these areas. For example, identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. Only segments that remain impaired during wet weather should be evaluated for stormwater BMP implementation opportunities. Bacterial removal efficiencies for some chosen BMPs can be found in Table 4.

Environmentally Sensitive Roadway Design

Low impact development (LID) techniques are innovative stormwater management systems that are modeled after natural hydrologic features. Environmentally sensitive roadway design involves incorporating LID techniques to prevent the generation of stormwater and non-point source pollution by reducing impervious surfaces, disconnecting flow paths, treating stormwater at its source, maximizing open space, minimizing disturbance, protecting natural features and processes, and/or enhancing wildlife habitat.

BEST MANAGEMENT PRACTICES FOR ROADWAYS

Stormwater control measures (SCM) are best practies to limit untreated, polluted stormwater runoff from reaching waterbodies. SCMs can be categorized in to two categories: structural and non-structural SCMs. Structural SCMs are physical interventions in the landscape, while non-structural SCMs are administrative measures/requirements, such as trainings and operating procedures.

Structural SCMs

Structural SCMs are physical interventions for stormwater management that can be used alone or together to convey, treat, and/or infiltrate stormwater runoff. Structural SCMs can be classified in one or several of the following categories:

- Pretreatment
- Treatment
- Conveyance
- Infiltration
- Other

PRETREATMENT

Pretreatment SCMs are typically the first SCMs in a treatment train and typically remove coarse sediments that can clog other SCMs. The settling process generates sediment that must be routinely removed. Maintenance is especially critical for pretreatment SCMs, because they receive stormwater containing the greatest concentrations of suspended solids during the first flush. Pretreatment SCMs can be configured as on-line or off-line devices. On-line systems are designed to treat the entire WQV. Off-line practices are typically designed to receive a specified discharge rate or volume. A flow diversion structure or flow splitter is used to divert the design flow to the off-line practice. Examples of pretreatment SCMs include:

- Deep Sump Catch Basins
- Oil Grit Separators
- Proprietary Separators
- Sediment Forebays
- Vegetated Filter Strips

TREATMENT

Stormwater Treatment Basins provide peak rate attenuation by detaining stormwater and settling out suspended solids. The basins that are most effective at removing pollutants

have either a permanent pool of water or a combination of a permanent pool and extended detention, and some elements of a shallow marsh. Stormwater basins include:

- Extended Dry Basins (Detention Ponds)
- Wet Basins (Retention Ponds)

Constructed stormwater wetlands are designed to maximize the removal of pollutants from stormwater runoff through wetland vegetation uptake, retention and settling. Gravel wetlands, however, remove pollutants by filtering stormwater through a gravel substrate.

- Constructed Stormwater Wetland
- Gravel Wetland

Other filtration SCMs include:

- Filtering Bioretention Areas and Rain Gardens
- Proprietary Media Filter
- Sand Filters/Organic Filters
- Tree box Filter

CONVEYANCE

These SCMs collect and transport stormwater, usually to other SCMs for treatment and/or infiltration. Conveyance SCMs may also treat runoff through infiltration, filtration, or temporary storage. For example, a vegetated swale functions both as a runoff conveyance channel and the vegetation prevents erosion, filters sediment, and provides some nutrient uptake benefits.

- Drainage Channels
- Grass Channels
- Water Quality Swales
  - Dry
  - Wet

INFILTRATION

Infiltration techniques reduce the amount of surface flow and direct the water back into the ground.

- Exfiltrating Bioretention Areas and Rain Gardens
- Dry Wells
- Infiltration Basins
- Infiltration Trenches
- Leaching Catch Basins

- Subsurface Structures

OTHER

- Dry Detention Basins
- Green Roofs
- Porous Pavement
- Rain Barrels and Cisterns

SCM accessories are devices that enable SCMs to operate as designed. SCM accessories include the following:

- Check Dams
- Level Spreaders
- Outlet Structures
- Catch Basin Inserts

TREATMENT TRAINS

A SCM "treatment train" incorporates several stormwater treatment mechanisms in sequence, like railcars in a train, to enhance the treatment of runoff. A series, rather than using a single method of treatment, improves the levels and reliability of pollutant removal. The effective life of a SCM can be extended by combining it with pretreatment SCMs, such as a vegetated filter strip or sediment forebay, to remove sediment prior to treatment in the downstream "units." Sequencing SCMs can also reduce the potential for re-suspension of settled sediments by reducing flow energy levels or providing longer flow paths for runoff.

Examples of treatment trains:

- A sediment forebay discharging to a wet basin flowing into a constructed stormwater wetland
- A water quality swale flowing into a wet basin or a constructed stormwater wetland
- An oil grit separator connected to a sand or organic filter
- A sediment forebay discharging to an extended dry detention basin connected to a sand filter
- A water quality swale discharging to a vegetated filter strip connected to an infiltration trench

Non-Structural SCMs

Non-structural SCMs are policies, educational approaches, and housekeeping efforts that can help mitigate stormwater runoff. Because nonstructural practices can reduce stormwater pollutant loads and quantities, the size and expense of structural SCMs can be

reduced, thereby affording substantial cost savings. Below are two non-structural SCMs that can be used to reduce the amount of contaminants in roadway stormwater runoff.

STREET SWEEPING

Street sweeping programs have the capacity to be effective in removing pollutants, primarily total suspended solids (TSS), from stormwater.

Three factors that can have an influence on the effectiveness of a street sweeping program are:

(1) Access - Studies have shown that up to 95% of the solids on a paved surface accumulate within 40 inches of the curb, regardless of land use. Those responsible for stormwater maintenance have the ability to impose parking regulations during street sweeping occurrences so that sweepers can get as close to curbs as possible.

(2) Type of sweeper - There are three types of sweepers: Mechanical, Regenerative Air, and Vacuum Filter. Each has a different ability to remove TSS.

- Mechanical: use brooms or rotary brushes to scour the pavement. They are not effective at removing TSS (0% to 20% TSS removal).
- Regenerative Air: blow air from a closed-loop system onto the road or parking surface, causing debris, including fine particles, to rise and be vacuumed. Regenerative air sweepers may blow particulates off the vacuumed portion of the roadway or parking lot, where they can be collected by stormwater runoff when it rains.
- Vacuum filter: there are two types, wet and dry. The dry type uses a broom in combination with the vacuum. The wet type uses water for dust suppression. Research indicates vacuum sweepers are highly effective in removing TSS.

Regardless of the type chosen, the efficiency of street sweeping is increased when sweepers are operated in tandem.

(3) Frequency of sweeping - TSS removal efficiency is determined based on annual loading rates. If a road were swept only once a year with a sweeper that is 100% efficient, it would remove only a small fraction of the annual TSS load. Many studies and reports suggest that optimum pollutant removal occurs when surfaces are swept every two weeks.

TABLE 2. TSS Removal Credits for Street Sweeping

TSS REMOVAL RATE	HIGH EFFICIENCY VACUUM SWEEPER – FREQUENCY OF SWEEPING	REGENERATIVE AIR SWEEPER – FREQUENCY OF SWEEPING	MECHANICAL SWEEPER (ROTARY BROOM)
10%	Monthly Average, with	Every 2 Weeks Average, with	Weekly Average, with

	sweeping scheduled primarily in spring and fall.	sweeping scheduled primarily in spring and fall.	sweeping scheduled primarily in spring and fall.
5%	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Monthly Average, with sweeping scheduled primarily in spring and fall.
0%	Less than above	Less than above	Less than above

It has been found that street sweeping programs may NOT be effective due to the following:

- The period immediately following winter snowmelt, when road sand and other accumulated sediment and debris is washed off, is frequently missed by street sweeping programs.
- Larger particles of street dirt may prevent smaller particles from being collected.
- The entire width of roadway may not be swept.
- Sweepers may be driven too quickly to achieve maximum efficiency.
- Land surfaces along the paved surfaces may not be entirely stabilized.

Successful street sweeping programs should consider factors such as whether road and parking lot shoulders are stabilized, the speed at which the sweepers will need to be driven (safety factor such as along a highway), whether access is available to the curb (whether vehicles parked along the curb line will preclude sweeping of the curb line), the type of sweepers, and whether the sweepers will be operated in tandem. Municipalities or private developers that are planning to purchase a new street sweeper should consider vacuum sweepers, because they are the most consistently effective.

ROAD SALTING

The application and storage of deicing materials, most commonly salts such as sodium chloride, can lead to water quality problems for surrounding areas. Salts, gravel, sand, and other materials are applied to highways and roads to reduce the amount of ice or to provide added traction during winter storm events. Salts lower the melting point of ice, allowing roadways to stay free of ice buildup during cold winters. Sand and gravel increase traction on the road, making travel safer.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and may be toxic to aquatic life. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

To prevent increased pollutant concentrations in stormwater discharges, the amount of road salt applied should be reduced. Calibration devices for spreaders in trucks aid maintenance workers in the proper application of road salts, so the amount of salt applied

could be varied to reflect site-specific characteristics such as road width and design, traffic concentration, and proximity to surface waters. Alternative materials, such as sand or gravel, calcium chloride, and calcium magnesium acetate may be used in especially sensitive areas.

SCMs for Cape Roadways

The following SCMs are discussed in more detail, as they are suitable for construction on

the Cape considering the Cape's permeable soils and more rural, semi-urban landscape.

- Porous pavement (other)
- Leaching Catch Basins (infiltration)/ Infiltration Basins (infiltration)
- Sub-surface Sediment Chambers (pretreatment + infiltration)
- Retention Pond (treatment)
- Bioretention (treatment)
- Advanced Bioretention (treatment)
- Water Quality Swales (conveyance, treatment, infiltration)
- Constructed Stormwater Wetlands (treatment)

POROUS PAVEMENT

FIGURE 11. Porous Pavement adjacent to traditional impervious asphalt pavement (foreground)

(Source: Virginia Asphalt Association)

Porous pavement, also known as pervious, permeable, or open-graded asphalt, is a standard hot-mix asphalt with reduced sand or fines allowing stormwater to infiltrate through a permeable surface. The reduced fines provide air pockets in the pavement creating interconnected void space allowing stormwater to flow through the pavement and into a sand and crushed stone aggregate bedding layer base supporting the pavement. The sub-base provides storage and runoff treatment without requiring additional land area to do so. Porous pavement over an aggregate storage bed will reduce stormwater runoff volume, and pollutants. When properly constructed, porous pavement is a viable alternative to traditional pavement especially in areas where green space and/or additional land area to capture and treat stormwater is limited. Porous pavement may also be incorporated into sidewalks and bike lanes to further reduce site runoff.

Porous pavement has been shown to remove high levels of TSS and petroleum hydrocarbons. When designed correctly, porous pavements may also reduce bacteria contamination.

LEACHING CATCH BASINS/INFILTRATION BASINS

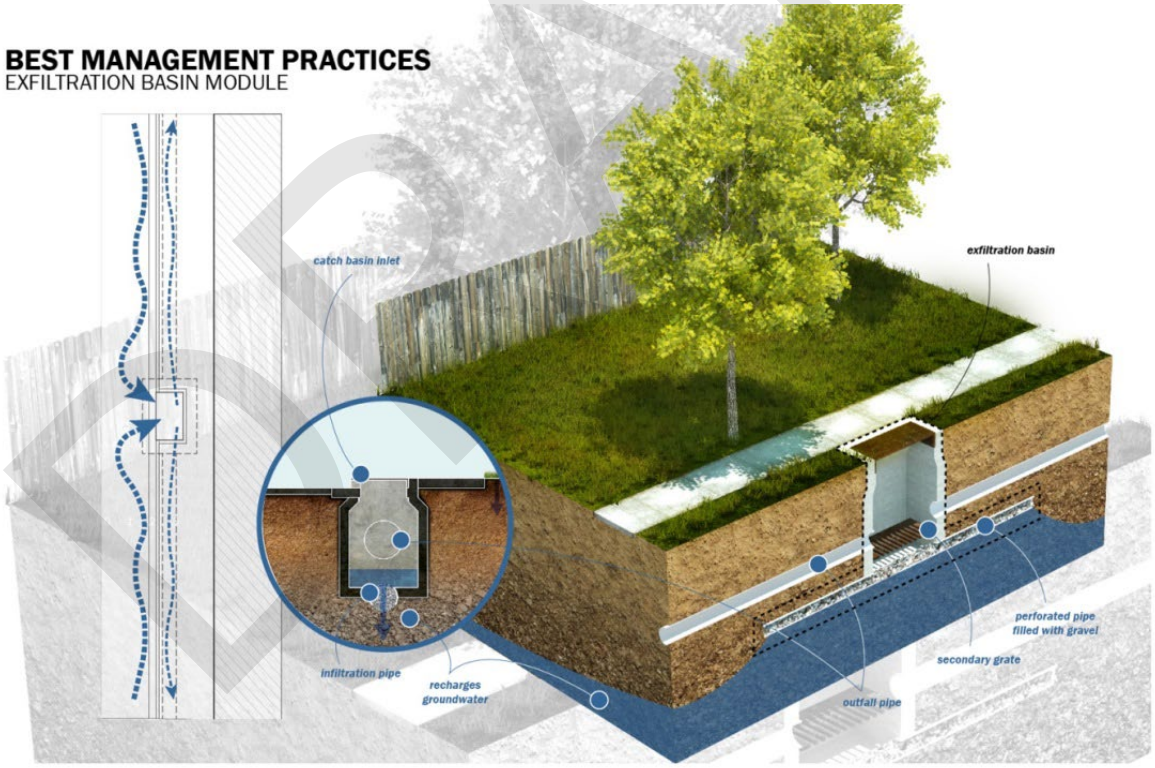


FIGURE 12. Leaching Catch Basin

(Source: Waggonner and Ball Architects)

A leaching catch basin is similar to a traditional catch basin with the added ability to permit the infiltration of captured runoff. Leaching basins are often installed in series with a deep sump catch basin that provides pretreatment. Because of this pretreatment, the catch basin/leaching basin combination is preferable to the leaching catch basin as a higher removal of TSS may be achieved while also extending the life and minimizing maintenance on the leaching catch basin. Leaching catch basins and leaching basins should only be used in areas with highly permeable soils, making these basins a popular stormwater control throughout the Cape.

Leaching catch basins, in series with pre-treatment catch basins, achieve excellent TSS removal in addition to constituents that sorb to fine particulates including petroleum hydrocarbons and metals.

SUB-SURFACE SEDIMENT CHAMBERS/UNDERGROUND SAND FILTERS

FIGURE 13. Sub-surface Treatment Chambers

(Source: Lindsay Cook, Cape Cod Conservation District Intern)

Sub-surface sediment chambers function similarly to surface sedimentation systems. Sediment trapping systems remove pollutants (mainly particulates) from stormwater runoff through a pretreatment sedimentation area followed by an outflow mechanism returning treated flow to a stormwater conveyance system.

In a treatment train, the outflow from the sedimentation area can be followed by an infiltration bed containing filter media (typically sand, soil, gravel or a combination of media).

This infiltration bed removes fines and the pollutants sorbed, or attached, to these particulates. Various contaminants including, but not limited to metals, petroleum hydrocarbons and bacteria may sorb to fines allowing infiltration systems to achieve removal efficiencies in these categories though the physical process of filtration.

WET BASINS

FIGURE 14. Wet Basin

(Source: U.S. EPA)

Wet Basins (formerly retention ponds), or "wet ponds," are a widely used conventional stormwater management tool. They are designed to retain a permanent pool of runoff allowing for continuous water quality treatment. Unlike detention basins, or dry basins, which detain runoff only for a limited period of time, retention ponds may be retrofitted from a flood control measure to a water quality treatment system through the installation of additional outlets. As retention ponds contain an active aquatic ecosystem frequent maintenance is required to prevent the buildup and export of contaminants.

Limitations include standing water increasing the risk of drowning and creating mosquito habitat. Retention ponds also may contain excess nutrients that, without proper maintenance, may lead to harmful algal blooms.

Retention ponds remove TSS, petroleum hydrocarbons, nitrogen (with proper maintenance), metals and in some cases bacteria.

BIORETENTION

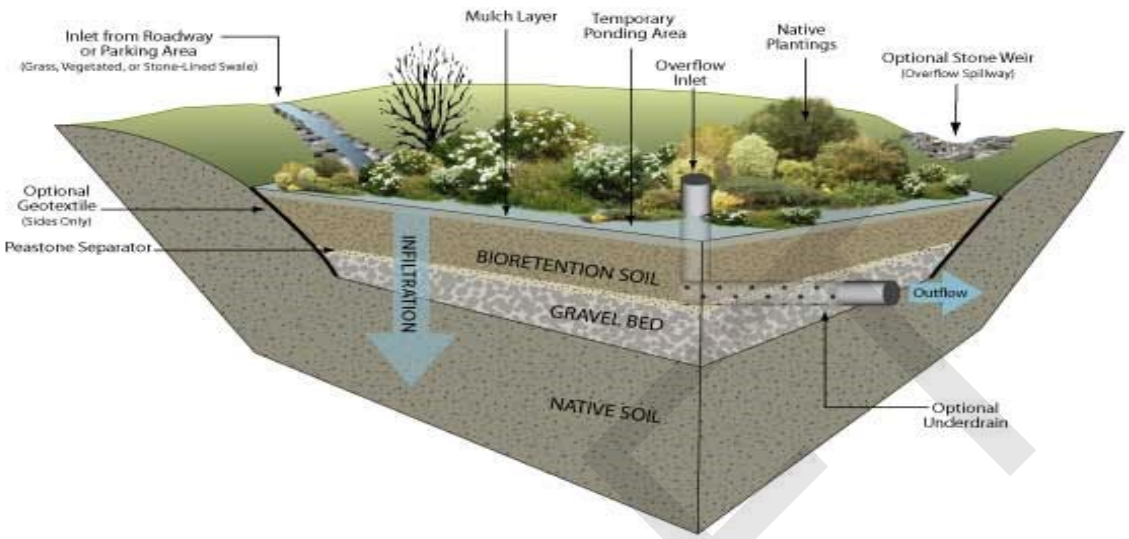


FIGURE 15. Bioretention

(Source: Douglas County Environmental Services)

Bioretention is a method that uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Stormwater ponds in shallow depressions underlain by a sandy engineered soil media through which most of the runoff passes.

Bioretention systems can easily be incorporated into the landscape to address and maintain many of the natural hydrologic functions. Pollutants within these systems are removed through both chemical and physical means within the bioretention soil mix. Bioretention systems also encourage biological treatment of nutrients, such as nitrogen, through nutrient uptake by vegetation within the system. Bioretention tends to work best in sandy soils, such as are present in many areas of Cape Cod.

Properly designed bioretention systems achieve excellent removal efficiencies for a wide range of pollutants including TSS, petroleum hydrocarbons, nitrogen, metals, phosphorus and bacteria. Typical removal efficiencies are shown in Table 4.

ADVANCED BIORETENTION

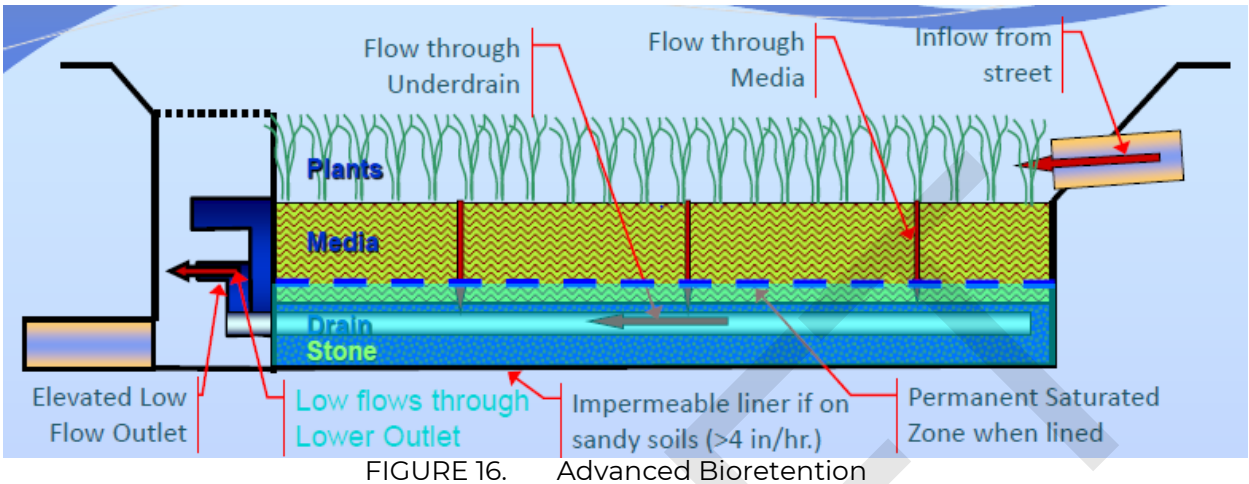


FIGURE 16. Advanced Bioretention

(Source: Washington Stormwater Center)

Advanced bioretention systems provide additional treatment through increased travel and residence time of stormwater. As runoff infiltrates vertically through the soil media, an impermeable liner intercepts and redirects the flow horizontally. This horizontal flow increases contact between runoff, bioretention soil media and root vegetation thereby attaining a reduction in nutrients and various other contaminants greater than traditional bioretention systems. Advanced systems are often lined at the bottom of excavation preventing infiltration and rerouting water once again on a horizontal flow path prior to discharge.

Other modifications to bioretention systems aimed at improving performance include adding supplements to the soil media. Additives such as activated charcoal, sawdust and shredded paper have been shown to improve removal of certain constituents from stormwater runoff. Another approach employs modifications to the configuration of the bioretention system to retain a portion of the accumulated stormwater. This internal water storage design has been shown to reduce soluble nitrogen levels by inducing an anaerobic condition within the bioretention facility itself. Research advances in bioretention system design are continuing to emerge, with promising new methods of increasing pollutant removal.

WATER QUALITY SWALES

FIGURE 17. Water Quality Swales

(Source: Washington Stormwater Center)

Water quality swales are vegetated channels providing conveyance, water quality treatment, and flow attenuation of stormwater runoff. Water Quality Swales provide pollutant removal through vegetative filtering, sedimentation, biological uptake, and infiltration into the underlying soil media. Both wet and dry water quality swales can be implemented with the appropriate type being dependent upon site soils, topography, and drainage characteristics. Water quality swale stormwater practices work best with well-drained soils that encourage infiltration as part of the water quality treatment approach. Recommended cross section of water quality swales includes a ¾ - 1" stone sub base covered with Type A native soils and vegetation.

A variety of shrubs, grasses, and ground covers are acceptable vegetation in both sun and shade conditions for the above mentioned stormwater technologies. Vegetation should be designed to maximize pollutant removal and contribute to native ecological systems and selected based on its tolerance to flooding and its ability to survive with little or no fertilizers and pesticides. This vegetation should be native, as it is adapted to the local climate and grows well without fertilizer..

Roadside water quality swales paired with country drainage provide increased water quality benefits, mimic the natural landscape, are highly compatible with LID design, have minimal impact on wildlife and reduce driving hazards by keeping stormwater flows off the roadway surface.

Water quality swales achieve adequate removal efficiencies for TSS, petroleum hydrocarbons, and metals. Typical removal efficiencies are shown in Table 4.

CONSTRUCTED STORMWATER WETLANDS

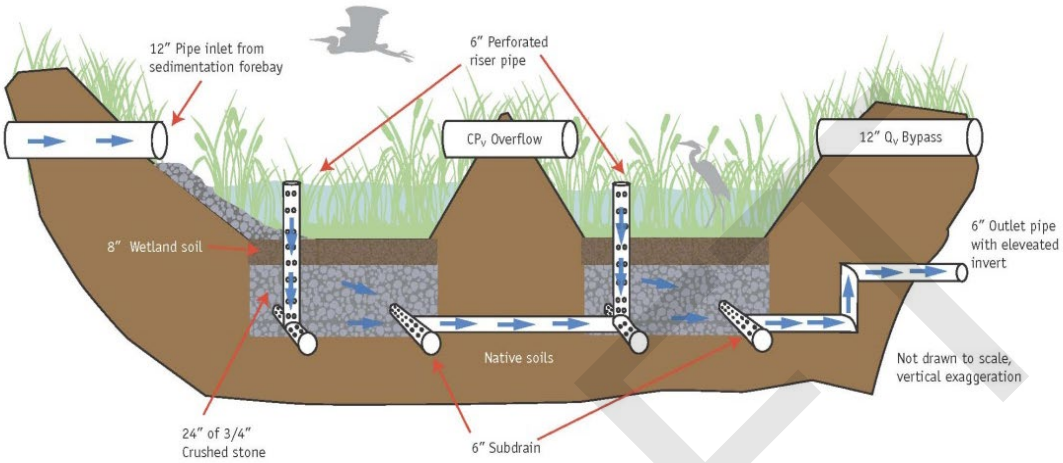


FIGURE 18. Constructed Stormwater Wetlands

(Source: University of New Hampshire Stormwater Center)

Constructed wetlands are intended to simulate the functions of natural wetlands by utilizing vegetation, soils, and microbial activity. Constructed wetlands are typically separated into surface flow wetlands and subsurface flow wetlands (or gravel wetlands). These wetland systems have the ability to treat wastewater from a range of pollutant sources, utilize few to no chemicals, have a lower carbon footprint, and may be less expensive in both capital costs and operation and maintenance than conventional treatment options.

The subsurface gravel wetland is designed as a series of horizontal flow-through treatment cells, preceded by a sedimentation basin. It is designed to attenuate peak flows and provide subsurface anaerobic treatment. The subdrains distribute the incoming flow, which then passes through the gravel substrate, and then to the opposite subdrains, into the adjacent cell, and then exits the treatment system. In the event of a high intensity event, the WQV is stored above the wetlands, and drains into the perforated riser on one end of the wetland, and into the substrate. Biological treatment occurs through plant uptake and soil microorganism activities. This is followed by physical-chemical treatment within the soil including filtering and absorption with organic matter and mineral complexes. Sub-surface gravel wetlands consistently achieve the highest removal efficiencies of any stormwater management system for a wide range of pollutants including TSS, petroleum hydrocarbons, nitrogen, metals, phosphorus, and bacteria. Typical removal efficiencies are shown in Table 4.

MAINTENANCE OF PREFERRED SCMS

It is important to note that these systems may require different maintenance and ongoing care regimes than what has been traditionally provided for stormwater management and landscape systems in the past. However, many of these systems do not require more time or cost intensive care than typical regimes; the care is just a different type of maintenance practice and these learning hurdles need to be overcome. For example, weekly mowing of traditional grass strips between roadways and sidewalks is both cost and time and fossil fuel resource intensive. In lieu of mown grass strips, Water Quality Swales could instead be constructed to provide contaminant removal benefits in addition to desired green aesthetics. Water Quality Swales may require less overall mowing than traditional grass strips, however, trash may need to be removed in monthly intervals. Overall, the amount of maintenance may be the same or less, but the ongoing care practices are different than what road maintenance crews may be used to. Introduction of preferred SCMs should be accompanied by an educational program that explains the necessary maintenance practices and educates maintenance personnel to ensure long-term maintenance adjustment to provide functional systems.

Below, a typical maintenance summary is provided for the vegetated systems described in the previous section.

Year 1 & 2 - Establishment

Just like any landscape installation, correct moisture levels following construction are essential to plant survival. The first ninety (90) days after planting are the critical time for watering. Young plants require heavy watering to establish. This is the same maintenance as required for traditional roadway edges such as mown grass strips. It is recommended to plant native species as they are adapted to grow in our local climate and generally require less water and less fertilizer than non-native plants.

The plants in a vegetated stormwater system need to be monitored to make sure they become established. It is suggested that this be specified as part of the original construction contract. A two year maintenance period is suggested to be added onto the construction contract to ensure plant survival. Monitoring points should be set up to photograph and document progress of re-vegetation at 3 month intervals. The maintenance contractor would monitor and water the plants, be responsible for replacing any plants that have died, and would control weeds when needed.

Throughout the establishment phase it may be necessary to review individual species tolerance. Some planted species may need to be replaced with species that are performing well. A small allowance should be left in the project budget to adjust the species as needed during the 2 year establishment phase if needed.

During the 2 year establishment phase, it is suggested that the following maintenance procedures be put in place as part of the original construction contract:

First 90 days, Bi-Weekly:

1. Weed

2. Water as needed

3. Check for and fix erosion

4. Inspect for good general appearance of area/gardens, remove trash as needed

Rest of 2-year Establishment Period, Monthly:

1. Regularly inspect for signs of erosion, obstructions, and unhealthy vegetation.

2. Remove weeds and invasive plants.

3. Remove any trash that has washed into the vegetation areas or the inlet channels or pipes.

4. Check the facility within a few days after a rainstorm to observe drainage and infiltration.

Rest of 2-year Establishment Period Seasonally (Spring and Fall):

1. Replace mulch and finish surfaces where needed

2. Plant/replant as needed. Adjust replacement species if required.

3. Scratch surface to prevent "crust"

4. Check pH; adjust as needed (pH should be as close to neutral as possible)

Once the vegetated systems are established during the maintenance contract, the ongoing maintenance required can be less than a typical mown area. The key is that it is a different kind of maintenance that needs to be performed by trained personnel.

Ongoing Maintenance After Establishment Phase

The below seasonal maintenance schedule reflects the maintenance needed after the two year establishment period. Bi-weekly mowing would NOT be required unless grass species are specified as part of a mown Water Quality Swale. Water Quality Swales may require bi-

weekly mowing (just like regular grass) in addition to the schedule noted below. Other than the necessary sediment and debris removal 4x per year, the maintenance required would be the same as a mown lawn strip.

TABLE 3. Recommended Time Frames for Typical Maintenance of Vegetated SCMs

	JAN	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Post Establishment:												
Remove sediment, leaves, debris and weeds		X			X			X			X	
Pruning/Cutback		X									X	

Table 3. Typical Maintenance of Vegetated Stormwater SCMs

Activity	Time of Year	Frequency
Inspect & remove trash	Year round	Monthly
Mulch	Spring	Annually
Remove dead vegetation	Fall or Spring	Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace entire media & all vegetation	Late Spring / early Summer	As needed*

* Paying careful attention to pretreatment and operation & maintenance can extend the life of the soil media.

TABLE 4. Comparison of Selected SCMs

SCM	SOURCE	COST/METRIC*	% POLLUTANT REMOVAL						MAINTENANCE NOTES
			TSS	N	P	METALS	ORGANIC C	OTHER % REMOVAL	
Sub surface sediment chambers/Underground sand filters	The Water Research Foundation (2018)	$0.02 to $3,392.28 / sq. ft	70%	46% (TKN)	33% (Total P)	45%	48%	76% Fecal Coliform	Routine inspections (after major storms) that include trash and debris removal. Lifespan 3-5 yrs. before corrective maintenance red: removal and replacement of top layers of sand, gravel, or filter fabric.
	NPREPD (2007)		86%	32% (Total N)	59% (Total P)	37% Cu; 87% Zn		37% Bacteria	
Retention pond (Wet Detention Ponds)	The Water Research Foundation(2018)	$ 1.28-$42.0/cubic ft.	50-90%	40-80% (soluble nutrients)	30-90% (Total P)	40-80%	20-40%	40-90% Pathogens (source: MA Stormwater Handbook)	Routine inspections (after major storms) that include trash and debris removal. Maintenance includes repairs to embankment, sediment removal, and control of algae, insects, and odors.
	NPREPD (2007)		80%	31% (Total N)	52% (Total P)	57%(Cu); 64% (Zn)		70% Bacteria	
Bioretention	The Water	$1.26-$607.46/sq. ft.	90%	68-80% (TKN)	70-83% (Total P)	93-98%	90%	90% Bacteria	Biannual inspection of trees and shrubs, pruning and weeding, alkaline

	Research Foundation (2018)	(capitol cost)							application.
	NPREPD (2007)		59%	46% (Total N)	5% (Total P)	81%Cu ;79%Zn			
Water Quality Swales	The Water Research Foundation (2018)	$30.86 - $1,537.77/ linear ft. (capital cost)	81%	38% (Nitrate)	9% (Total P)	42 - 71%	67%	62% Hydrocarbons	Periodic mowing, weed control, watering, reseeding of bare areas, mulch and fertilizer application, clearing of debris and sediment. Inspect four times per year. Indefinite lifespan, if properly maintained.
	NPREPD (2007)		81%	39% (Nitrate&Nitrite)	24% (Total P)	65% Cu; 71%Zn			
Porous Pavement	The Water Research Foundation (2018)	$2.07 to $40.28 / sq. ft. (capitol cost)	94%	43% (Nutrients)		76-93%	N/A	N/A	Vacuum sweeping and high-pressure hosing at least four times a year. Annual inspections. Longer lifespan than regular pavement: 30 yr. lifespan in Northern climates due to reduced freeze/thaw stress.
	NPREPD (2007)		89%	42% (Total N)	65% (Total P)	86% Cu; 66%Zn			

Constructed Stormwater Wetlands	EPA (1999)	$26,000 - $55,000 per acre (construction cost)	67%	28% (Total N)	49% (Total P)	36 - 62%	34%	77% Bacteria; 87% Hydrocarbons	Replanting, sediment removal, plant harvesting. Biannual inspections for first few years, annual inspections thereafter. >20 yr. lifespan
	NPREPD (2007)		72%	24% (Total N)	48% (Total P)	47% Cu; 42%Zn		78% Bacteria	

*The Water Research Foundation, International Stormwater BMP Database: 2020 Summary Statistics

REGULATIONS AND PERMIT CONDITIONS

Massachusetts Stormwater Management Standards

Many transportation projects in Massachusetts require adherence to MassDEP's Massachusetts Stormwater Management Standards. Specifically, the standards apply to transportation projects that require either a Massachusetts wetlands permit and/or require a Water Quality Certification. Through the State's Water Quality Certification, the general permit for municipal separate storm sewer systems (MS4) requires compliance with the Stormwater Management Standards. As an MS4 permit operator, the Massachusetts Department of Transportation (MassDOT) must abide by the Massachusetts Stormwater Management Standards.

The Massachusetts Stormwater Standards are comprised of 10 standards that:

1. Prohibit untreated stormwater discharges
2. Ensure peak discharge rates do not increase with development
3. Encourage infiltration by ensuring annual recharge does not decrease with development
4. Require stormwater management systems are designed to remove 80% of the average annual post-construction load of TSS.
    a. A long-term pollution prevention plan is implemented and maintained
    b. SCMs are sized to capture required volume (per Massachusetts Stormwater Handbook)
    c. Pretreatment is provided (per Massachusetts Stormwater Handbook)
5. Eliminate or reduce stormwater discharges to the maximum extent practicable (MEP) for land uses with higher potential pollutant loads.
6. Require the use of the specific source control and pollution prevention measures for discharges in Zone IIs, IWPAs, and near/to "critical areas" (defined below).
7. Require a redevelopment project to meet some of the Stormwater Management Standards and improve existing conditions. Existing stormwater discharges shall comply with Standard 1 only to the MEP.
8. Develop and implement a construction period erosion, sedimentation, and pollution prevention plan.

9. Develop and implement a long-term operation and maintenance to ensure that stormwater management systems function as designed.

10. Prohibit all illicit discharges to the stormwater management system.

Demonstrating compliance with the Stormwater Management Standards to the MEP requires:

1. Making all reasonable efforts to meet each of the Standards

2. Conducting a complete evaluation of possible stormwater management measures (e.g. LID techniques that minimize land disturbance and impervious surfaces, SCMs, pollution prevention, erosion and sedimentation control, and proper operation and maintenance of stormwater SCMs)

3. That if full compliance with the Standards cannot be achieved, they are implementing the highest practicable level of stormwater management.

CRITICAL AREAS

According to Standard 6, specific source controls and pollution prevention measures are required for "critical areas," as defined in MassDEP's Stormwater Management Handbook. MassDOT needs to identify discharges to the following resources areas as a priority and indicate in their stormwater management plan how stormwater controls will be implemented. The "Critical areas" defined in MassDEP's Stormwater Management Handbook, with associated references to the Code of Massachusetts Regulations (CMR), are as follows:

- Outstanding Resources Waters (314 CMR 4.00)
- Special Resources Waters (314 CMR 4.00)
- Recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs and IWPAs for groundwater sources and Zone As for surface water sources)
- Bathing beaches (105 CMR 445.000)
- Cold-water fisheries (310 CMR 10.04 and 314 CMR 9.02)
- Shellfish growing areas (310 CMR 10.04 and 314 CMR 9.02)

Designers of roadway improvements should recognize the special nature of "Critical Areas" (especially surface water drinking water reservoirs and other ORWs). In general, roadway improvements in these areas warrant additional efforts to protect water quality than may apply in other less sensitive areas.

Certain SCM design considerations are important to ensuring adequate performance in critical resource areas. The MassDEP Stormwater Management Policy uses TSS removal as an indicator for SCM performance. In some critical areas, however, TSS may not be the only parameter (or even the primary parameter) of concern. For example:

In shellfish growing areas and public swimming beaches, bacterial contamination is of concern. Therefore, designers should evaluate SCMs for their ability to capture bacteria or limit their growth. SCM technologies that retain water under conditions that promote bacteria growth (such as enclosed spaces that can become "septic" during extended no flow periods) should be avoided in these areas.

In cold water fisheries, water temperature is a critical parameter. Therefore, if a SCM discharges directly to temperature sensitive waters, the SCM should not retain water in such a manner that raises its temperature (as may occur in a shallow wet pond, for instance). Alternatively, SCMs can sometimes be designed to account for the temperature effects; for example, in a deeper wet pond, water can be discharged from lower levels of the pond or re-introduced to the downstream resource area through groundwater recharge.

MASSHIGHWAY STORMWATER HANDBOOK

MassDEP and MassHighway collaborated on the MassHighway Stormwater Handbook, which provides guidance on developing stormwater management strategies for highway projects in order to comply with the Massachusetts Stormwater Management Standards. The handbook describes how to determine whether the MassDEP Stormwater Management Policy applies to a particular project and how standards may apply to projects. The handbook also addresses design strategies that may facilitate compliance, and source control measures for controlling stormwater pollutant loads from stormwater runoff. Also provided is a process for screening and selecting SCMs for roadway improvement projects that meet the objectives of the MassDEP Stormwater Management Policy. The handbook is primarily intended for roadway designers, public works personnel, and other persons involved in the design, permitting, review, and implementation of highway and bridge improvement projects in Massachusetts.

MassDOT MS4 Permit

Phase II of EPA's National Pollutant Discharge Elimination System (NPDES) program applies to both roadway construction and existing roadways. Construction projects exceeding one acre of soil disturbance require filing a Notice of Intent with EPA under the NPDES Construction General Permit. NPDES Phase II Rule also applies to MassHighway, as it considers MassDOT to be an operator of an MS4. MassDOT currently holds an EPA NPDES Phase II Small MS4 General Permit (Permit #: MA043025), with a new MassDOT MS4 permit to be issued in the near future. The current MS4 general permit requires MassDOT to:

- Develop and implement a stormwater management program to reduce discharge of pollutants to the MEP.
- Develop measurable goals for the implementation of the stormwater management program and report on its progress on meeting those goals.
- Implement 6 "minimum control measures":
  - Public education and outreach

- Public involvement and education
- Illicit discharge detection and elimination
- Construction site runoff control program
- Post-Construction stormwater management
- Pollution prevention and good housekeeping in municipal operations.

MASSDOT'S STORMWATER MANAGEMENT PLAN

In MassDOT's *NPDES Stormwater Management Plan for MassHighway Owned and Operated Highways*, MassDOT explains how SCMs and associated goals are addressing each of the six minimum control measures laid forth in the MS4 permit. MassDOT's MS4 Permit also requires MassDOT to evaluate its discharges that fall within a watershed of a 303(d) listed water body. When a discharge drains to a listed waterbody for which a TMDL has been developed, the MS4 Permit requires MassDOT to comply with additional requirements. Discharges to impaired and TMDL watersheds are being addressed by MassDOT's Impaired Waters Program and MassDOT's TMDL Watershed Review Program, respectively.

IMPAIRED WATERS PROGRAM

MassDOT addresses stormwater runoff from its roadways draining to impaired water bodies as part of compliance with the NPDES Phase II Small MS4 General Permit. Starting in June 2010, MassDOT committed to assess all impaired water body segments that receive (or potentially receive) stormwater runoff from MassDOT roadways located in urban areas within five years. "Impaired" water body segments are those listed as Category 4a or 5 in MassDEP's Integrated List of Waters (referred to as the 303(d) list). MassDOT completed assessments of the 684 impaired water bodies identified including all 303(d) waters whose sub-basins contain some portion of MassDOT's urbanized area roadways. MassDOT expanded the water bodies list to encompass additional urban areas identified in the 2010 census, impaired waters listed on the 2012 final 303(d) list, and MassDOT property acquired (e.g., Mass Turnpike) since the enforcement as part of their good-faith commitment to improve stormwater runoff quality from their highways. In total, MassDOT assessed 826 waterbodies in five years, and continues to evolve the IWP as it moves towards a watershed-based approach for achieving water quality goals, Phase 2 of the IWP. To date, MassDOT has constructed 966 various treatment SCMs, addressing 103 waterbodies, and providing more than 626 acres of effective impervious cover reduction.

Phase 2 of the IWP, which is under development, will move away from tracking by impaired water to tracking by watershed. This approach will align with the water quality treatment goals of EPA as outlined in the 2016 MS4 Permit, which focus on stormwater improvements at the watershed scale and prioritizing TMDL watersheds. Additionally, the

goal is to also align with anticipated changes to MassDEP's Stormwater Handbook, where offsite mitigation will be required to meet treatment goals for some projects. By tracking at a watershed-level, MassDOT can plan ahead for the anticipated TS4 Permit which is expected to resemble the 2016 MS4 Permit in terms of watershed improvement goals.

TMDL WATERSHED REVIEW

MassDOT will assess TMDL reports wherever a TMDL has been approved for a water body into which MassDOT's urbanized roadways discharges stormwater.

MassDOT has conducted an initial review of these 41 final TMDL reports to determine whether the TMDL WLA, SCM recommendations, or other performance requirements for stormwater discharges that are applicable to MassDOT.

The assessment includes identifying TMDL Waters to which MassDOT's urbanized roadways may potentially discharge stormwater, conducting a site survey of discharge points and drainage infrastructure, calculating loading from MassDOT Stormwater as it compares to the WLA, assessing whether the WLA is being met through existing stormwater control measures or if additional control measures may be necessary, and finally selecting, designing, and implementing SCMs.

PRIORITIZATION OF SCM INSTALLATION

MassDOT has developed a SCM Summary Matrix, comparing SCMs as they perform in regard to managing peak flows, recharge, TSS removal, pollutant loadings, and soil infiltration capacity, as well as other parameters such as drainage area, clearance to bedrock, clearance to high water table, setback requirements, land area, slope, and maintenance sensitivity.

MassHighway's policy is to give "critical" waters (which includes Class A waters and Zone I WPAs) higher priority in terms of implementing stormwater SCMs.

MASSDOT EFFORTS RELATED TO CAPE COD TMDLS

MassDOT reports on its stormwater related activities in annual reports under the 2003 NPDES Phase II Small MS4 General Permit (available at NPDES Phase II Small MS4 General Permit - EPA Permit Number MA043025 - MassDOT Permit Year 19 Annual Report). As of the most recent report (Permit Year 19, April 2021-March 2022) MassDOT advanced their stormwater program through continued implementation of the Impaired Waters Program (IWP), educating staff, conducting public outreach at seminars, performing good housekeeping measures including Stormwater Control Measure (SCM) inspections, and starting a pilot program to map MassDOT drainage infrastructure. Construction of a stormwater SCM to address the Herring River nitrogen TMDL was scheduled for Fall 2017 (couldn't find a date of completion), and other TMDL related projects may be planned in concert with future construction activities. Table 5, adapted from a table in the Permit Year 15 Annual Report (April 2017-March 2018), shows MassDOT stormwater work that has been completed or is planned in TMDL watersheds.

TABLE 5. MassDOT Actions in Cape Cod TMDL Watersheds

BASIN/ TMDL NAME	POLLUTANT	MASSDOT ACTIONS COMPLETED	TO DO
Buzzards Bay/Final TMDL of Total Phosphorus for White Island Pond	Phosphorus	MassDOT does not include any relevant BMP recommendations.	No action planned
Allen, Wychmere & Saquatucket Harbors	Nitrogen	TMDL states that runoff from impervious surfaces is a negligible source of nitrogen load to the embayments when compared to other sources. The TMDL suggests that compliance with MS4 permit requirements will contribute to the goal of reducing the nitrogen load for Allen, Wychmere, and Saquatucket Harbors watersheds	MassDOT will continue to comply with its Stormwater Management Plan under the NPDES MS4 Permit
Final Pathogen TMDL Report for the Cape Cod Watershed	Pathogens	.	
Final Pathogen TMDL for the Three Bays Watershed	Pathogens	MassDOT should determine the Route 28 roadway drainage area discharging to the Marstons Mills River and install best management structures and/or operational practices to the maximum extent practicable and at a minimum, be designed to meet the water quality standard for bacteria in SA waters. Given this is a waterway with an approved TMDL, the MHD must meet the requirements of EPA's NPDES General Permit for Stormwater Discharges from Small MS4s (Phase II0, Part ID(1-4), as it pertains to approved TMDLs. Infiltration structures and devices that have been	MassDOT has completed the statewide review of TMDL watersheds for the need for additional BMPs to meet the TMDL recommendations. If additional BMPs were identified, they have been or will be included in future construction projects. . MassDOT has completed the statewide review of TMDL watersheds for additional BMPs were identified, they have been or will be included in future construction projects

BASIN/ TMDL NAME	POLLUTANT	MASSDOT ACTIONS COMPLETED	TO DO
		installed to control the road runoff from Route 28 into the Martsons Mills River should be inspected to determine their performance and condition. MassDOT should also continue to identify and implement to the maximum extent practicable best management practices so that the water quality standard for bacteria in SA waters is met.	
Final TMDL Report of Bacteria for Frost Fish Creek, Chatham	Bacteria	MassDOT has completed the statewide review of TMDL watersheds for additional BMPs were identified, they have been or will be included in future construction projects.	Determine the Route 28 roadway drainage discharging to Frost Fish Creek and install best management structures and/or operational practices to the maximum extent practicable with a goal of meeting the water quality standard for bacteria in SA waters.
Final TMDL Report of Bacteria for Muddy Creek, Chatham	Bacteria	The Route 28 culvert, through which Muddy Creek flows has been replaced through a project funded by Massachusetts Department of Environmental Restoration. The new roadway crossing eliminated the tidal restriction and included leaching basins to treat stormwater discharge before entering Muddy Creek. This project has implemented all improvements feasible to improve water quality of Muddy Creek as it relates to Route 28.	Statewide review of TMDL watersheds for the need for additional BMPs to meet the TMDL recommendations has been completed. If additional BMPs were identified, they have been or will be included in future construction projects.
Herring River	Nitrogen	TMDL states that runoff from impervious surfaces is a negligible source of nitrogen load to the river when compared to other sources. The TMDL suggests that compliance with MS4 permit requirements will contribute to the goal of reducing the nitrogen load for the Herring River Estuarine System.	MassDOT will continue to comply with its Stormwater Management Plan under the NPDES MS4 Permit. MassDOT has designed and is planning to construct a stormwater BMP (water quality swale) to treat direct discharges to the Herring River from Route 6 at the Route 6 / Herring River crossing. Construction is scheduled to begin in the Fall of 2017.
Final Nutrient TMDL for	Total Nitrogen	No relevant BMP recommendation included	

BASIN/ TMDL NAME	POLLUTANT	MASSDOT ACTIONS COMPLETED	TO DO
Centerville River/East Bay			
Final Nitrogen TMDL for Little Pond	Total Nitrogen	No relevant BMP recommendation included	
Final Nitrogen TMDL for Oyster Pond	Total Nitrogen	No relevant BMP recommendation included	
Final Nitrogen TMDL for Phinneys Harbor	Total Nitrogen	No relevant BMP recommendation included	
Final Nitrogen TMDL for Pleasant Bay System	Total Nitrogen	No relevant BMP recommendation included	
Final Nitrogen TMDL Report for Five Sub-Embayments of Popponesset Bay	Total Nitrogen	No relevant BMP recommendation included	
Final Nitrogen TMDL Report for the Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in	Total Nitrogen	No relevant BMP recommendation included	

BASIN/ TMDL NAME	POLLUTANT	MASSDOT ACTIONS COMPLETED	TO DO
the Waquoit Bay System			
Final Nitrogen TMDL Report for the Three Bays System	Total Nitrogen		
Final Nitrogen TMDL for West Falmouth Harbor	Total Nitrogen		
Final Nitrogen TMDL Report for Five Chatham Embayments (Stage Harbor, Sulphur Springs, Taylors Pond, Bassing Harbor and Muddy Creek)	Total Nitrogen		
Final TMDLs of Nitrogen for Great, Green, and Bournes Pond Embayment Systems	Total Nitrogen		

BASIN/ TMDL NAME	POLLUTANT	MASSDOT ACTIONS COMPLETED	TO DO
Final Lagoon Pond TMDL	Total Nitrogen	No BMP recommendation included	

Coordinating Transportation Stormwater Infrastructure with the 208 Plan

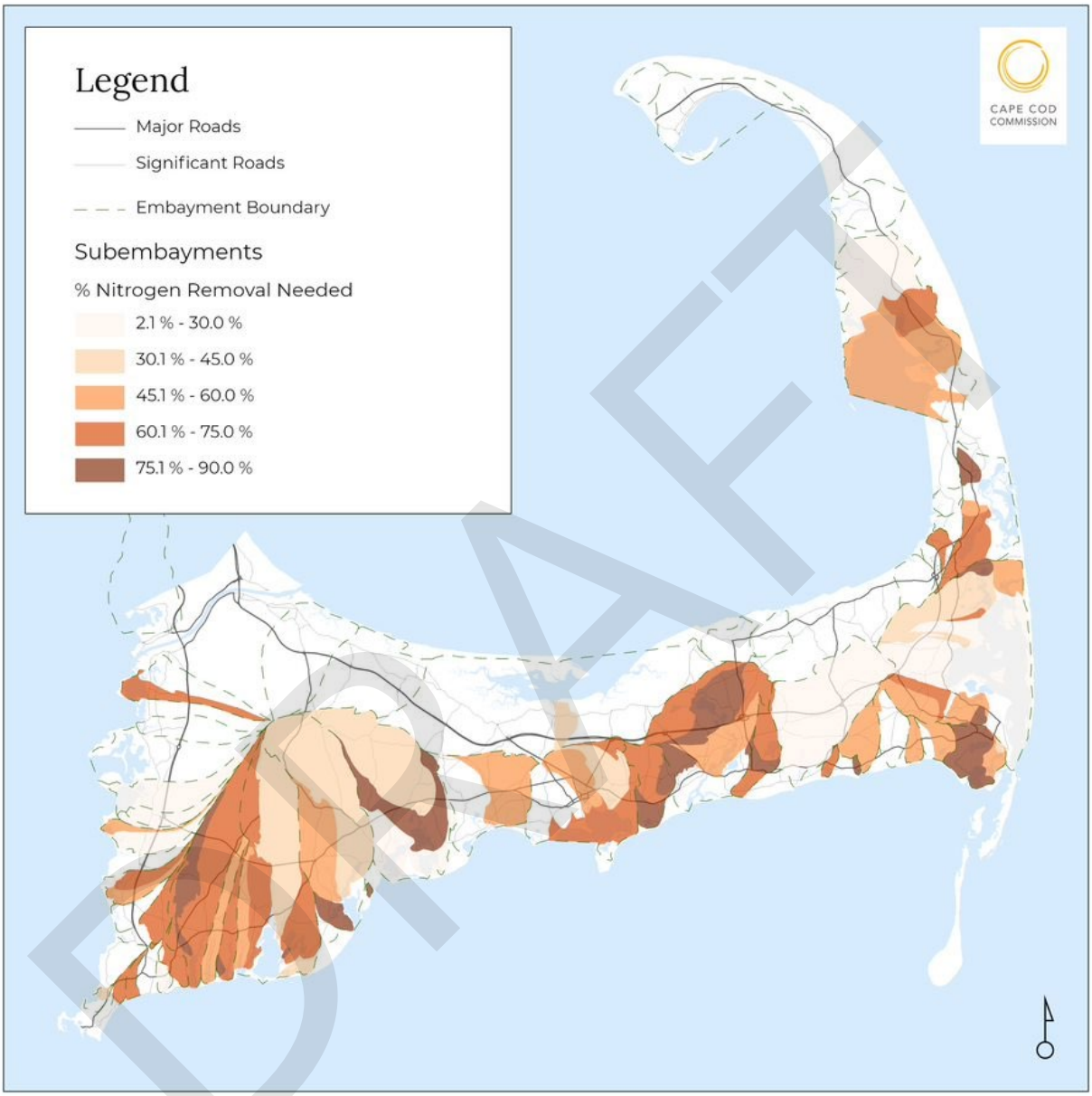
The Cape Cod Area Water Quality Management Plan Update, also known as the "208 Plan," addresses options for Cape Cod communities to address nitrogen loading from controllable sources in Cape Cod watersheds. The 208 Plan outlines many options for addressing nitrogen loading that include the traditional approach of sewering, as well as many alternative approaches such as installing permeable reactive barriers, constructed wetlands, ecotoilets, aquaculture and shellfish bed restoration. There are ample opportunities where stormwater management design on Cape Cod roadways should be coordinated with nitrogen reduction goals of the 208 Plan.

Cape Cod communities that consider constructing sewers as part of their nitrogen mitigation strategy can simultaneously incorporate stormwater management efforts on Cape Cod roadways. For example, as roads are repaved, communities can inspect water and sewer conduits, storm drains, remove illicit connections to sewers and storm drains, repair leaks, and make any other necessary repairs.

Some of the alternative technologies in consideration for nitrogen management on Cape Cod as part of the 208 Plan are actually stormwater treatment systems that also provide significant nutrient removal. Examples of stormwater BMPs proposed for nitrogen management are bioretention/soil media filters, phytobuffers, vegetated swales, and constructed stormwater wetlands. All of these technologies provide physical filtration, uptake of pollutants within plant tissue, nitrification and denitrification, and other microbial biochemical processes that effectively remove a broad range of pollutants from the water column. According to the2016 MS4 Permit, Cape Cod communities need to consider installing BMPs that significantly reduce nitrogen where discharges occur in nitrogen TMDL watersheds.

For optimal effectiveness, sewer infrastructure and alternative nitrogen reduction technologies should be located in areas that contribute the most nitrogen loading to impaired embayments. Roadway development or upgrades within watersheds that drain to subembayments that require a high amount of nitrogen removal should consider opportunities to (1) include sewer infrastructure alongside current roadway plans and (2) implement stormwater BMPs to remove nitrogen.

FIGURE 19. Nitrogen Removal Requirements in Subembayments (DRAFT)



Regional Policy Plan Considerations for Stormwater Management

Transportation infrastructure related to development or redevelopment may be subject to regional regulation by the Cape Cod Commission. If the development project meets a specific size or other threshold identified in the Cape Cod Commission's "Enabling Regulations for the Purpose of Reviewing Proposed Developments of Regional Impact (DRIs)," the project will be subject to review. In order for the project to be granted approval, the project must be consistent with the Goals and Objectives of the RPP (as well as local comprehensive plans, zoning, etc.). In its review, the Commission must also find that the probable benefits of the proposed project outweigh the probable detriments. The Commission may consider best practices and design elements that exceed minimum requirements in this analysis.

Design requirements related to Stormwater Quality are applicable to all DRI projects. Standards related to roadway runoff dictate on-site infiltration practices and devices, bioinfiltration practices, minimum of 2-foot separation to groundwater for infiltration basins or other stormwater leaching structures, and development of maintenance and operation plans. Additionally, the standards require limiting impervious surfaces by constructing overflow peak parking areas from pervious materials (porous pavement, permeable pavers, or grass pavers), and that bioremediation should be incorporated in to parking islands and roadway perimeters. Also, in the RPP is the recommended practice of reducing roadway widths and using permeable features to break up large impervious areas and to minimize runoff from impervious surfaces.

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CAPE COD
COMMISSION

2023 REGIONAL TRANSPORTATION PLAN

Technical Appendix J: Pavement Management

Draft
2023

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Introduction

As an essential task required by the Cape Cod Metropolitan Planning Organization (MPO) through its Unified Planning Work Program, this report provides the status of pavement condition assessment activities on Cape Cod. The objectives of this effort are to collect data and implement a regional pavement management system for Cape Cod to provide an objective rating of pavement conditions and needs. These efforts assist the local municipalities in their decision making as well as with the MassDOT Municipal Pavement Program. The MassDOT Municipal Pavement Program, created in 2021 as a part of the Transportation Bond Bill, seeks to improve the condition of municipally owned state numbered routes to support the long-term condition of the state network, contribute to National Highway System (NHS) pavement performance, and assist municipalities in the management of local infrastructure. The Municipal Pavement Program has been authorized by legislation for $140M in future years and is funded in the FY23-27 Capital Investment Plan (CIP) for $25M a year.

The pavement management process is conducted with the intent to keep the roadway system in the best possible condition with the most efficient use of available funds. There are distinct advantages to managing pavement condition and significant cost savings that can take place with preventative or rehabilitation measures rather than waiting until a road needs reconstruction. As stated in the MPO-approved Cape Cod Regional Transportation Plan, the goal of the pavement management process is for all federal aid-eligible roads to be maintained in "excellent" condition. Of course, due to the reality of limited financial resources, it is necessary to prioritize pavement repair based on affordability. Deciding which roads to improve and by what technique in a fiscally responsible manner is the essence of Pavement Management.

PAVEMENT MANAGEMENT SYSTEMS - BACKGROUND

Pavement Management is the practice of planning for pavement repairs and maintenance with the goal of maximizing the value and life of a pavement network.

To accomplish this, a community needs to have several repair techniques in its arsenal and the knowledge of when to apply them. This is where pavement management comes into play. With a comprehensive database of road conditions, the pavement management software can model when to perform which repairs on a road network. Of course, engineering judgment is required to finalize any list of street repairs, as no computer model can take every variable analyzed in making a repair decision into account. The computer system is a great springboard to help a community start its repair program for each year and is an excellent method of storing the repair data.

Below is a model of how a street's pavement deteriorates over time. Interpreting the curve, a street starts out in excellent condition when it is newly constructed. Midway through life, low-cost repairs

such as crack seal and full depth patch can extend the quality of the road. It takes only a few years for the window of opportunity to perform this low-cost maintenance to pass after which the road would need a more costly repair such as a mill and overlay or full-depth reclamation. By performing timely maintenance using low-cost methods, road conditions can be improved thereby extending the life of the road and save municipalities from spending more in the future.

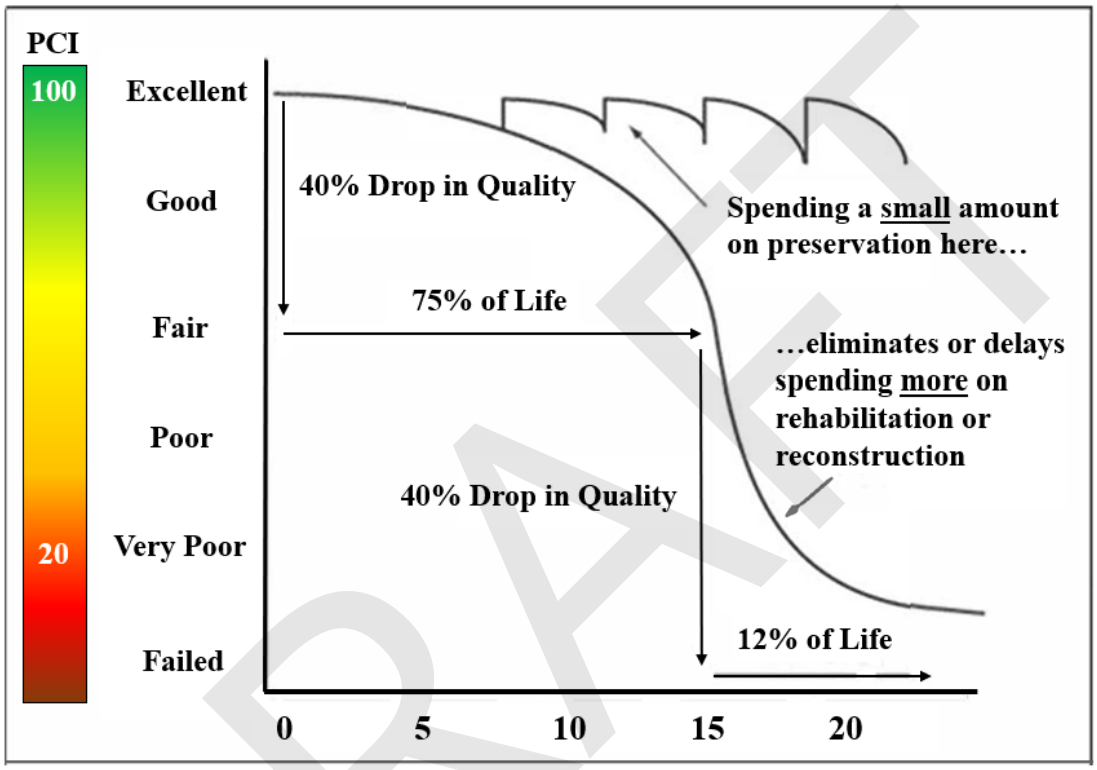

FIGURE 1. Pavement Deterioration Curve
Source: Federal Highway Administration

EVALUATION CRITERIA FOR CCC DATA COLLECTION

The Cape Cod Commission has continued to collect pavement condition data since 2011 through a series of "Windshield Surveys". These "Windshield Surveys" involve driving the roadways in need of collection and filling out a brief survey with observations. Observers were given photographs and descriptions of example pavement distresses. Observers used a 1 – 5 rating system and made notations of distresses. Copies of the observations are provided in the appendix of this report. The following table is a summary of the guidance given to observers:

TABLE 1. CCC Evaluation Criteria

CONDITION	DESCRIPTION	CRITERIA
1	Very Good to Excellent	New pavement with no cracking, rutting, raveling/ signs of wear
2	Good to Very Good	No cracking, rutting, showing a little wear
3	Fair to Good	Showing evidence or more wear and possibly repairs that are in good condition
4	Poor to Fair	Evidence of cracking, rutting, serious wear
5	Poor	Severe cracking, rutting, potholes

SURVEY OF CAPE COD COMMUNITIES' PAVEMENT MANAGEMENT ACTIVITIES

In the Fall of 2021, an email survey was sent to each of the 15 towns' Department of Public Works directors. Follow-up inquiries were made in following years. The survey included the following questions:

1. Do you maintain records of pavement quality on your community's roadways?
2. Can you send [electronically preferred] summaries of pavement quality assessments?
3. What system/method do you use to assess pavement quality?
4. Can you send us a report/documentation of methods used?
5. What method do you use to determine repair strategies?
6. Do you have estimated costs for implementing various repair strategies?
7. Can you forward us cost estimates sheets?
8. Do you have a capital plan for pavement improvement?
9. Can you forward us a copy of the capital plan?

Several communities have responded and the sections following are a summarization of those responses and the up-to-date pavement management efforts underway in each municipality.

Barnstable Pavement Management Activities

The Town of Barnstable utilizes detailed survey and analysis performed by VHB as a Consultant. Their work is entered onto Barnstable's database and periodic reports are provided and discussed. The DPW participates in the data analysis, particularly in the cost analysis. DPW reviews project

bids received by the Town and establishes base line costs for each pavement treatment band, these costs are discussed with the town's consultant - then utilized in the pavement conditions report. In addition to the VHB work, the DPW maintains a record of roadway repairs and relies upon experienced field personnel to assist in planning for individual maintenance tasks such as crack & chip seal. DPW also informally monitors the performance of all treatments. Key to the pavement management program is coordination with other utilities and proposed roadway rehabilitation information is passed to utility companies. A moratorium is in place for 5 years after application of a new surface. The Town of Barnstable does not maintain a public "5-year plan" - because of political considerations.

Submitted materials include:

- VHB-prepared "2010 Pavement Management Report." See section 1.4.1 for discussion of VHB Pavement Management Systems.
- Excel workbook containing typical costs for various items involved in pavement repair and related road work.

Bourne Pavement Management Activities

The Town has retained the services of Environmental Partners, Inc. (EP) to continue the Town's Pavement Management Program (PMP) efforts to adapt to the Town's Capital Improvement Plan (CIP) to accommodate recent changes in staff, environment, and society. The PMP incorporates an extensive database of roadway surface conditions to produce a prioritized list of improvements. The PMP is a planning tool intended to provide the foundation to manage the town's roadway resources by combining professional engineering metrics with local institutional knowledge. EP and Town Staff will work together to identify goals regarding roadway network condition.

The roadway survey in Bourne, consisting of paved, town-accepted roadways, was most recently completed in the Fall of 2017. A total of 97.85 miles of roadway were inspected. The collection effort focused on the primary categories of roadway data including roadway length, width, segment start/end points, surface type, and pavement condition. Additional roadway elements including curbing, sidewalks, striping, roadway width, and pavement material were also assessed as part of this inspection process and recorded in the database.

Upon completion of the survey, the overall Road Surface Rating (RSR) value for Bourne's public roadway network was 75.97. The overall RSR represents a benchmark for performance measuring of the Town's pavement management program moving forward. If the overall RSR were to drop in the years to come, this would be a sign that the program needs to be adjusted or funding for the program may need to be increased. Repair strategies and associated unit costs were defined to develop the Backlog Summary. The current backlog summary for the Town's roadway network is approximately $10.8 Million. This budgetary dollar figure represents the funding necessary if the Town were to perform all required maintenance for the Town's roadway network within the next year.

The Town will continue to monitor its progress and roadway rating by performing periodic network inspections and is committed in maintaining and improving its roadway network.

Brewster Pavement Management Activities

In 2015, the Town of Brewster published its "Pavement Management Plan." Prepared by the consultant CDM Smith, the plan included the following findings:

- The Town's overall Pavement Condition Index (PCI) was a 73.
- If no further money were spent on roadways for 10 years, that PCI would decline to 63.
- Performing all the work necessary on the roads as of the inventory date would cost in the order of magnitude of $12 Million.
- Maintaining the existing PCI of 73 would cost approximately $1.1 Million per year over the next 5 years.
- Continuing to spend at present levels ($470K, if all went to roadway work) will result in a decline over the next 5 years to a PCI of 71. As it nears the critical PCI of 55, the overall condition will decline more rapidly.
- To reach a target PCI of 80 in 5 years, the Town would need to spend approximately $2.3 Million per year.

Within the past few years, Brewster has retained BETA Group, Inc. (BETA) to provide a Pavement Management Program (PMP) to better maintain the Town's roadway network. BETA's pavement services include performing a detailed visual inspection, calculation of a Roadway Surface Rating (RSR), and recommendation of required maintenance for each roadway segment. BETA compiles the pavement data into a web-based application to allow the town to actively manage their priorities.

A total of 48.3 centerline miles were inspected during the summer of 2020. The required field inspections were preformed autonomously using a smartphone application utilizing machine-learning technology. Based on the inventory in 2020, the overall Road Surface Rating (RSR) for Brewster's Town roadway network was 78.64. The PMP allows for the Town to develop a Capital Improvement Plan (CIP) for the existing roadway network. The Town has shown a commitment to maintaining the PMP and improving its roadway network.

Chatham Pavement Management Activities

The Town of Chatham has retained the firm of BETA Group, Inc. (BETA) to develop a Pavement Management Program (PMP). BETA's pavement services include performing a detailed visual inspection, calculation of a Roadway Surface Rating (RSR), and recommendation of required maintenance for each roadway segment. BETA compiles the pavement data into a web-based application to allow the town to actively manage their priorities.

Dennis Pavement Management Activities

The Town of Dennis contracted StreetLogix to provide their Pavement Management System. In 2021, the Town hired StreetLogix to perform an inventory of their roadways (approximately 142 miles) and sidewalks (approximately 29 miles). The results of the inventory completed by StreetLogix is in an interactive, web-based system, which the Town will use as a guide to determine which roads to work on and to project future budgets. The Town will use the system as a guide as yearly construction needs to consider other factors that the pavement management system cannot factor into the calculations such as funding, fairly spreading the improvements through the 5 villages in Dennis and maximizing the bids received by contractors.

Based on the inventory conducted in 2021, the Town's overall PCI rating is 80 (Good condition). The town's road budget for pavement improvement has been consistently funded between $400,000 to $600,000 per year through Capital Requests for "secondary roads" but can vary depending on other capital requests. Chapter 90 funds are also used to maintain the Town's roads and are usually spent on larger resurfacing projects or on arterial and collector roads

Eastham Pavement Management Activities

The Town of Eastham is developing a pavement management system. Current efforts include detailed spreadsheets identifying treatment strategies.

Submitted materials include:

- Spreadsheet listing of town roads with summary of face type
- Spreadsheet listing of Town & Private Roads in Town of Eastham with summary of surface type
- Spreadsheet listing of town roads with itemized surface type

These assessment surveys of all the Town's private ways and town-maintained public roads, prompted mainly by the on-going construction of its town-wide water distribution network, are to assist in the preparation of a Capital Improvements Plan (CIP). The Town of Eastham is also a Massachusetts Complete Streets Tier 3 community, and as such will be looking to include multimodal access options in all repairs related to its Roadway Capital Improvements Plan.

Falmouth Pavement Management Activities

Falmouth uses VUEWorks Asset Management Software to track their Public Works Assets. Falmouth has just begun to use the Pavement Condition rating system that is a module of the system. It is based on the ASTM rating system. Falmouth has provided a copy of their Pavement Manual, a report of the roads they have rated so far, and a sample report of one of the roads. Falmouth uses a couple of strategies to determine their repair schedule. The town has a 10-year roadway plan for major repairs. This is funded by the town operating budget and a Capital Plan. Falmouth has provided both documents. The town also has a service call/ work order system to take requests from the public for signs, potholes, sweeping and grading, etc.

Falmouth does not have cost estimate sheets. The town does some work in-house and contracts its crack sealing and large repairs out. These are covered by the town operating budget and Capital Plan.

Submitted materials include:

- Sample Pavement Condition Form
- VUEWorks Pavement Management System Training Guide
- FY 2013-2022 Capital Improvement Program summary form
- Public Works Department Roadway Maintenance Program FY 2012-2023

Harwich Pavement Management Activities

The Town of Harwich DPW previously utilized an online database that was developed with Bonsai Logic (a small local software developer) to maintain a road inventory, to develop cost estimates, to reconcile DPW estimates against actual expenses and to maintain a roadwork history. As of 2018, the Town has contracted StreetLogix to provide their Pavement Management System. The DPW does not utilize the database to develop a PCI (Pavement Condition Index). The town rates roads in 1 of 4 structural conditions: good, fair, deficient, intolerable

The DPW does have a 5-year road maintenance plan that is updated every few years and is available on the Harwich website. The Town uses Chris Nickerson, Highway Road Manager who is a certified pavement inspector, to develop a plan based on his experience, training, and knowledge of Harwich's 481 public roads (142 miles). The Town attempts to balance maintenance with repair to avoid costly reconstruction utilizing many different processes and procedures. For costs, the town utilizes county bid pricing (p. 2 of the town's Five-Year Maintenance Plan).

The Town of Harwich typically spends $1.4 million on their annual road maintenance program, which is comprised from approximately $700,000 in Chapter 90 funds and $700,000 in a local article. The current plan focus is on installing new drainage systems ahead of the sewer project to avoid paving over old infrastructure.

Mashpee Pavement Management Activities

The Town of Mashpee hired now Stantec in 2020 to complete a town-wide pavement assessment and included the Town's major collector roads. The Town had Stantec do an update in 2020 that also included major collector road. The report was issued in May 2020 and is being used to help prioritize projects and determine required funding levels.

The report evaluated roads in two categories - local/neighborhood and collector. Historically, Chapter 90 funds have been used for all projects on collector roads, excluding routine maintenance such as drainage installation, crack sealing, and similar treatments. This funding is no

longer enough to fund "Complete Street" type projects and resurfacing. The Town must compile several years of Chapter 90 apportionments for the larger projects so the latter will now require another funding source to maintain an acceptable PCI on the collector roads.

Orleans Pavement Management Activities

In Spring 2019, the Town of Orleans retained the firm of Vanasse Hangen Brustlin (VHB) to update the Town's pavement management system by performing pavement condition evaluations on all Town-maintained roadways and parking lots with the goal of prioritizing pavement maintenance and rehabilitation projects and analyzing budgetary needs. With this year's efforts, VHB conducted a street survey and compiled a report update. The Town generally performs a pavement management study update every five (5) years.

The current network PCI rating is 83, which is up from 79 in 2013. The Town appropriates about $384,000 (increases by inflation each year) per year for pavement management above and beyond Chapter 90 funds. VHB estimates that a current budget of approximately $660,000 per year is anticipated to maintain the average PCI over the five-year study period but will allow the backlog of work to increase due in part to inflation.

Provincetown Pavement Management Activities

Environmental Partners Group (EPG) was hired in 2016 to update the Town's pavement management program that has been used to assess existing roadway pavement conditions and establish a Capital Improvement Plan (CIP) for improvements. The planning tool continues to be utilized to establish an order-of-magnitude budget for roadway maintenance and reconstruction.

Recent roadway improvement activities include:

- Redeveloped 920 linear feet of Conwell Street between Route 6 and Cemetery Road to include dedicated bike lanes, pedestrian sidewalks, stormwater drainage improvements.
- Will perform road surface and storm drain repairs on Route 6 in October 2021.
- Currently planning stormwater improvements to West Vine Street. Work to be performed in Fall 2021.
- Currently planning road resurfacing and stormwater improvements to portions of Standish Street, Alden Street, Montello Street and Conant Street. Work to be started in Spring 2022.
- Currently designing stormwater improvements to Howland Street.

Sandwich Pavement Management Activities

The Town of Sandwich retained the firm of Vanasse Hangen Brustlin (VHB) to perform pavement management services. A comprehensive study was undertaken to re-evaluate pavement conditions in Sandwich and to allow for the analysis of various funding scenarios. VHB performed a detailed inspection of the condition of the pavement on all town-maintained roads and updated a database of this information using VHB's "Road Manager" software.

To determine road repair strategies, the town mainly uses PCI (Pavement Condition Index) and Benefit. For estimated costs for implementing various repair strategies, the town uses the County's bid process and incorporates these into their own spreadsheets. The town's 5-Year plan changes dramatically year-to-year but provides a guide to follow as funds become available.

Submitted materials included the following:

- VHB Presentation on Sandwich Pavement Management
- Road Program Map – color coded map of town roads assigned to years (2006 – 2010)
- Excel workbook listing town roads with PCI, Benefit, and Repair Alternative information
- Excel workbook itemizing bid costs for various repairs by various vendors
- Excel workbook itemized by road; listing planned paving projects
- Excel workbook itemizing repair type, treatment, and comments for town roads, separately for each year 2007-2011
- Pavement Management Update Study – VHB-prepared 2006 report. See section 1.4.1 for discussion of VHB Pavement Management Systems.

Truro Pavement Management Activities

Truro uses local knowledge to determine pavement repair priorities.

Yarmouth Pavement Management Activities

The Town of Yarmouth retained the firm of Vanasse Hangen Brustlin (VHB) to perform pavement management services. VHB services consist of performing a comprehensive study to evaluate pavement conditions in Yarmouth and to allow for the analysis of various funding scenarios; perform a detailed inspection of the condition of the pavement on all town-maintained roads and update a database of this information using VHB's "Road Manager" software.

To determine repair strategies, the town reviews an initial list generated by the software and then decides whether to apply chip seal, double ship seal, or overlay. Main roads are treated with rubber chip seal or overlay. In the town's capital plan, annual spending ranges from $1.3 million to $1.5 million for roadway maintenance. As of May 2021, the Town's PCI rating was 80.7.

Wellfleet Pavement Management Activities

The Town of Wellfleet retained the firm of BETA Group, Inc. (BETA) to develop a Pavement Management Program (PMP) in 2015. The Town is currently looking at updating the PMP as of Spring 2022.

In addition, the Town DPW actively keeps their own list and performs inspections on a regular basis. In Fall 2019, the following roads were planned to be resurfaced: sections of Long Pond Road, sections of Gull Pond Rd, Schoolhouse Hill Rd, Coles Neck Road, and sections of Brown's Neck Road. The town also performed crack sealing during the Autumn of 2020 on various roads

including: Chequessett Neck Road, Long Pond Road, Lecount Hollow Road, Nauset Road, Lawrence Road, Cottontail Road, Spring Valley Road, Paine Hollow Road, and Old Wharf Road.

SUMMARY OF TOWN PAVEMENT MANAGEMENT EFFORTS

Based on responses from the email survey and subsequent follow-up, the following table summarizes the techniques that responding towns use for pavement management.

TABLE 2. Summary of Responding Towns' Pavement Management Techniques

TOWN	PAVEMENT MANAGEMENT TECHNIQUE
Barnstable	BETA – Microsoft Access
Bourne	BETA – Microsoft Access
Brewster	BETA – Microsoft Access
Chatham	BETA – Microsoft Access
Dennis	StreetLogix
Eastham	Locally developed spreadsheets
Falmouth	VUEWorks Asset Management Software
Harwich	StreetLogix
Mashpee	Cartegraph Systems
Orleans	VHB Pavement Management System
Provincetown	MicroPaver system
Sandwich	VHB Pavement Management System
Truro	Local knowledge
Yarmouth	VHB Pavement Management System
Wellfleet	BETA – Microsoft Access

PAVEMENT MANAGEMENT SYSTEMS

Despite most towns using different management systems, the prevalent techniques (as identified by many of the towns responding to the email survey) are the same. The following sections contain excerpts describing the techniques involved in pavement management systems.

METHODOLOGY

To start assessing the condition of a town's pavement, a detailed condition evaluation of each town's public roadways to build the pavement management system is a typical starting point. The first step is to identify the roadway network. The second step is to further break each street in the roadway network into pavement management sections. The third step is to carefully categorize, measure, and record the individual pavement distresses within each pavement management section and perform the inventory of sidewalks, curbs, and ramps. Finally, the fourth step is to customize the road repair treatment selection and unit costs within the pavement management software through discussions with Town officials. All these steps are typically performed prior to the study of future funding scenarios.

Network Identification

Network Identification builds an inventory of streets that describe the municipality's complete roadway network. The direction of travel, street length, width, ownership, classification, zone, and pavement type are among the items identified at this initial phase in the pavement management process. This integral step ensures the streets surveyed are the definitive set to be analyzed.

Pavement Management Section Identification

Once the Network Identification is complete, the field work begins. Each street contains one or more pavement management sections. A pavement management section defines the limits of previous construction or maintenance activities within each street. Sections are defined by having the same width, typical distresses, functional class, etc. The goal is to set up homogenous areas of pavement to aid in assigning the appropriate repair. A "street" may be one section, or it may be comprised of several pavement management sections, depending on its construction history.

Surface Distress Assessment

For each pavement management section, the severity and extent of nine major pavement distresses are recorded, and then entered into a weighted formula to arrive at a Pavement Condition Index (PCI). The distresses are categorized as base related or surface related distresses. Base related distresses indicate that the pavement structure is inadequate for the existing traffic load and soil conditions. Streets that show significant base related distresses may need to have the pavement structure strengthened with either thicker or stronger base or pavement materials. Surface related distresses are caused by age and weathering of the pavement. Streets that have predominantly surface related distresses are excellent candidates for maintenance sealing to inhibit further pavement oxidization (the main effect of aging). Streets with more of the base related distresses will most likely need some full depth patching, structural overlays, or reclamation/reconstruction.

The four base related distresses are:

- Potholing or non-utility patching
- Alligator cracking
- Distortion
- Rutting

The five surface related distresses are:

- Block cracking
- Transverse or longitudinal cracking
- Bleeding or polished aggregate
- Surface wear or raveling
- Shoving, slippage, or corrugation

PCI Defined

A PCI is generated for each inventoried pavement management section in a town using the surface distress data collected. PCI is measured on a scale of zero to one hundred, with one hundred representing a pavement in perfect condition and zero describing a road in impassable condition. Each type of observed pavement distress is assigned a deduct value based on the type, severity, and extent of the distress. A weighted sum of the deduct points is subtracted from the perfect "one hundred" road to generate a PCI for each pavement management section. In general, base related (pavement foundation) distresses are weighted more heavily than surface related distresses. For example, if 15% of a road section had medium severity "Alligator Cracking" it would receive a deduction of 40 points. Whereas the same area of "Block Cracking" would only receive a deduction of 15 points. The actual PCI calculation follows:

PCI = 100 – (Highest Deduct Value) – (25% of remaining base related deduct values) – (10% of remaining surface related deduct values)

The Five Treatment Bands

The pavement management system uses broad ranges to group the individual repair types into five major treatment bands. Treatment bands are a useful tool to summarize data on a Town-wide basis. An individual road segment will fall into a category based on the strategy table's output of repair types and will vary due to functional classification. The goal is to gain a broad understanding of the existing conditions in simple yet meaningful terms.

TABLE 3. Treatment Band Descriptions

TREATMENT BAND	PCI*	DESCRIPTION
DO NOTHING	93-100	Excellent condition - in need of no maintenance.
ROUTINE MAINTENANCE	86-92	Good condition – may need crack sealing or minor localized repair.
PREVENTIVE MAINTENANCE	76-85	Fair condition – pavement surface may need surface sealing, full depth patch and/or crack sealing.
STRUCTURAL IMPROVEMENT	56-75	Deficient condition – pavement surface structure in need of added strength for existing traffic. Typical repairs are overlay with or without milling.
BASE REHABILITATION	0-55	Poor condition – in need of base improvement. Typical repairs are reclamation or full depth reconstruction.

**Note: Treatment bands are defined below. These are only general PCI ranges for reference purposes and represent only one pavement type. There are several fields considered by the strategy table when assigning repair types to each individual street. Source: VHB*

Do-Nothing

The Do-Nothing category exhibits roads which need no maintenance. These roads are in excellent condition and existing distresses generally do not need to be addressed.

Routine Maintenance

Routine maintenance activities are those which are taken to correct a specific pavement distress. Routine maintenance usually addresses localized pavement defects and includes activities such as:

- Full depth patching
- Skin patching
- Crack sealing

Preventive Maintenance

Preventive maintenance activities are those which are performed at planned intervals to protect and seal the pavement. Seals are designed to provide one or more of the following benefits:

- Prevent the intrusion of air and moisture
- Fill small cracks and voids
- Rejuvenate an oxidized binder
- Provide a new wearing surface

Structural Improvement

Structural improvement includes the work necessary to restore the pavement to a condition that will allow it to perform satisfactorily for several years. Generally, a structural improvement will consist of a milling the existing pavement down and applying a new Hot Mix Asphalt Overlay allowing existing grades to be maintained. When the existing grade can be increased a new Hot Mix Asphalt course can simply be placed upon the existing surface. Structural improvements also include the work necessary to prepare the pavement for an overlay, either with or without milling. The major activities involved in the rehabilitation process are:

- Partial depth patching
- Full depth patching
- Joint and crack sealing
- Grinding and milling
- Hot Mix Asphalt Leveling Courses

Base Rehabilitation

Base rehabilitation utilizes one of two methods:

- Reclamation
- Reconstruction

Reclamation is the process of rehabilitating existing deteriorated pavements. The existing layers of the roadway are pulverized and then blended to create a homogenous pavement base. This reclaimed pavement base is then paved with a new Hot Mix Asphalt surface. Reconstruction is the complete removal and replacement of a failed pavement, and might also involve widening, realignment, traffic control devices, safety hardware, and major base and drainage work.

Customizing Repair Strategies

Repairs strategies can also be made specific to fit the specific needs of the town. The overarching goal is to understand a town's decision-making process and simulate that process in the budget analysis software based on the pavement condition and other criteria of each pavement section. This allows for the section of which repair methods are the best to use and when.

Preparing Budget Scenarios

Once the roadway conditions are inventoried and analyzed, and the repair strategies are defined, the impact of various spending programs on the roadway network is assessed. These studies can range from 1 to 20 years; typically, 5-year studies are used. The purpose of the budget planning process is to determine the impact of various spending levels to find a funding level that will best meet the town's needs. Budget analysis software uses pavement deterioration curves, unit costs,

and strategy tables developed in the repair strategy definition phase to assign each street a repair type and associated cost for each year of the study. Budget analysis software can also assign each street a benefit value that is used to prioritize which streets the software will select for repair each year. It is important to understand that a pavement management system is a network-wide planning tool and is not intended to give definitive street-by-street repair data. Field verification and testing are recommended to confirm any street repair list generated.

Deterioration Curves

To properly plan for future repairs, pavement management system uses deterioration curves. The deterioration curves estimate the rate at which the pavement condition decreases over time. These pavement deterioration curves depict two major categories of functional classification - arterials and collectors in one curve and local roads in the other. An example deterioration curve is presented in the following figure:

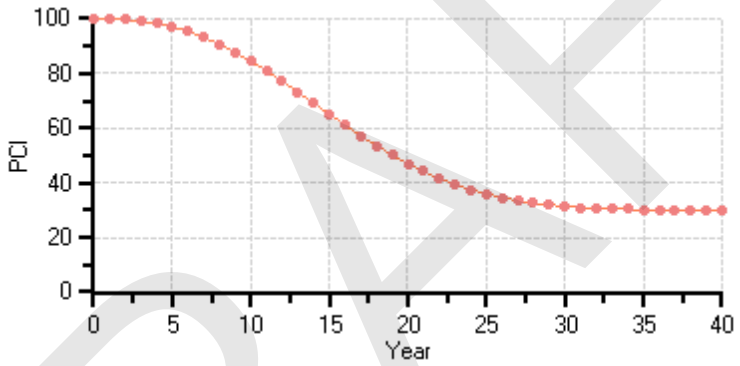

FIGURE 2. Sample Deterioration Curve
Source: VHB

Strategy Table

With data collected and processed, a pavement management system would then use a table of repair strategies to assign specific road repair types to individual roadway segments. The repair strategy table incorporates PCI ranges as well as functional class and pavement type to simulate decisions consistent with Barnstable's repair practices and procedures.

Project Prioritization

Budget analysis software prioritizes needed system repairs based on the estimated "Benefit Value". The Benefit Value formula is calculated using variables representing traffic volume, repair service life, PCI, and unit repair costs for each pavement management section. For each plan year, software can prepare a future roadway condition projection, exhausts the assigned budget, and then produces an annual list of roads included in the repair program. The system also allows the user to enter an inflation rate to account for estimated increases in future year construction costs. A 4% inflation rate is typically used.

The Benefit Value prioritization process generally favors cost effective maintenance alternatives. Repair actions are typically delayed on those sections that require reconstruction or major rehabilitation because the benefits for dollars spent are generally lower than maintenance candidates. After the relatively good roads are "saved," improvements are directed towards the poorer arterial and collector roads, and then to the local roads in need of major rehabilitation.

PAVEMENT MANAGEMENT ANALYSES

The data collected in the monitoring process will be continually analyzed to identify overall pavement conditions in the different Cape Cod towns to assist in programming maintenance and reconstruction activities.

According to information prepared for the Cape Cod Regional Transportation Plan, the Cape Cod Region possesses 739 miles of roadway eligible for federal funding. Of those miles, 565 are under the jurisdiction of the Cape's local communities.

MassDOT evaluates roads under their own jurisdiction and a selection of municipally owned roadways. The following table lists the corresponding rating from Excellent to Poor, based on a "PSI" (Pavement Serviceability Index) rating – roughly analogous to the "Pavement Condition Index" (PCI) commonly used.

Pavement Condition	Excellent	Good	Fair	Poor
"PSI" Range	PSI >=3.5	PSI 2.8-3.5	PSI 2.3-2.8	PSI < 2.3

CCC Evaluations of Pavement Conditions – "Windshield" Surveys

Beginning in 2011, Cape Cod Commission staff undertook a series of "windshield" surveys throughout Barnstable County. Starting in 2014, a new data collection strategy was deployed, based on Geographic Information Systems' needs and strengths. Data-collection regions of each town were identified which contained roughly one-third of the mileage of federal-aid eligible municipal roadways. The quality and accuracy of the data collection was greatly improved using GPS-capable tablet computers. The following figure shows the roadways that the CCC staff collected data on in 2022.

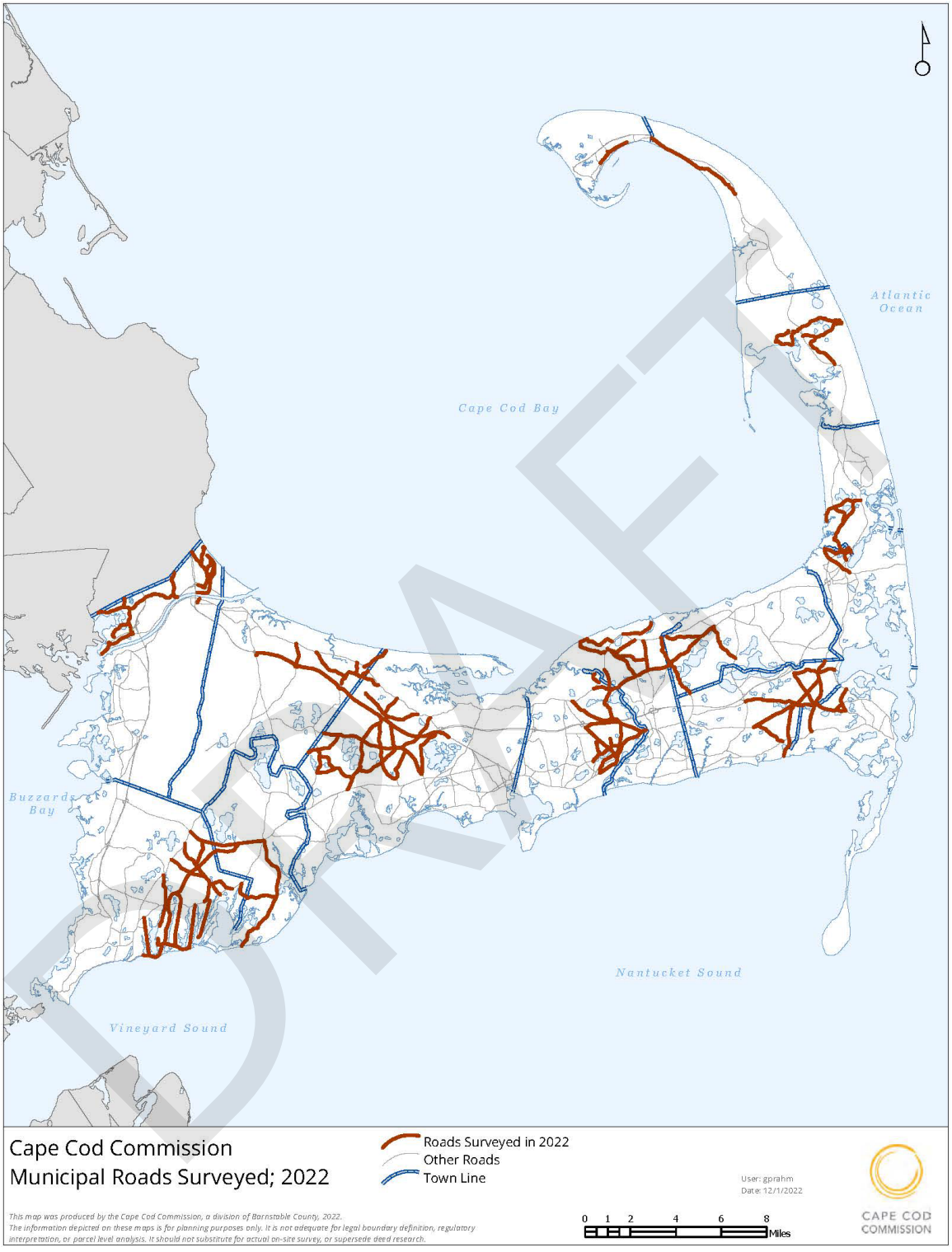

FIGURE 3. Municipal Roads Surveyed in 2022

The following table provides a summary by town of the Cape Cod Commission's windshield survey data.

TABLE 4. Surveys of Pavement Condition - miles

TOWN	VERY GOOD TO EXCELLENT	GOOD TO VERY GOOD	FAIR TO GOOD	POOR TO FAIR	POOR	TOTALS
Barnstable	3.1	12.2	87.7	7.9	0.3	111.2
Bourne	1.3	2.7	29	8.7	0.2	41.9
Brewster	2.6	10.1	9.8	2.7	1.4	26.6
Chatham	0.0	0.4	11.5	0.9	0.0	12.8
Dennis	0.4	10.6	33.9	0.5	0.0	45.4
Eastham	0.5	2.3	12.4	1.7	0.0	16.9
Falmouth	2.4	11.3	60.7	10.7	0.3	85.4
Harwich	0.3	9.2	30.4	3.2	0.0	43.1
Mashpee	0.0	1.4	23.2	5.0	0.0	29.6
Orleans	0.6	3.6	12.1	0.6	0.0	16.9
Provincetown	0.0	1.4	11.4	0.6	0.0	13.4
Sandwich	0.7	7.5	24.0	5.1	0.7	38.0
Truro	0.0	2.5	6.4	3.5	0.0	12.4
Wellfleet	0.7	2.9	15.5	0.6	0.0	19.7
Yarmouth	1.6	12.6	37.2	0.7	0.0	52.1
Total:	14.2	90.7	405.2	52.4	2.9	565.4

Source: latest data available from 2020-2022 collected by Cape Cod Commission

As shown in the table above, approximately 560 miles of roadway have been surveyed at least once as recently as 2022. The most common rating "Fair to Good" yielded over 400 miles and resulted in a higher result in comparison to the 2020 and 2021 observations. This is followed by 90 miles of "Good to Very Good", 52 miles of "Poor to Fair," approximately 14 miles for "Very Good to Excellent" and approximately 3 miles of "Poor." The following figures provide a graphic of the CCC survey data in a series of four maps (Upper Cape, Mid-Cape, Lower Cape, and Outer Cape). The CCC evaluations are shown as colored parallel lines ranging from Blue (Very Good to Excellent) to Red (Poor).

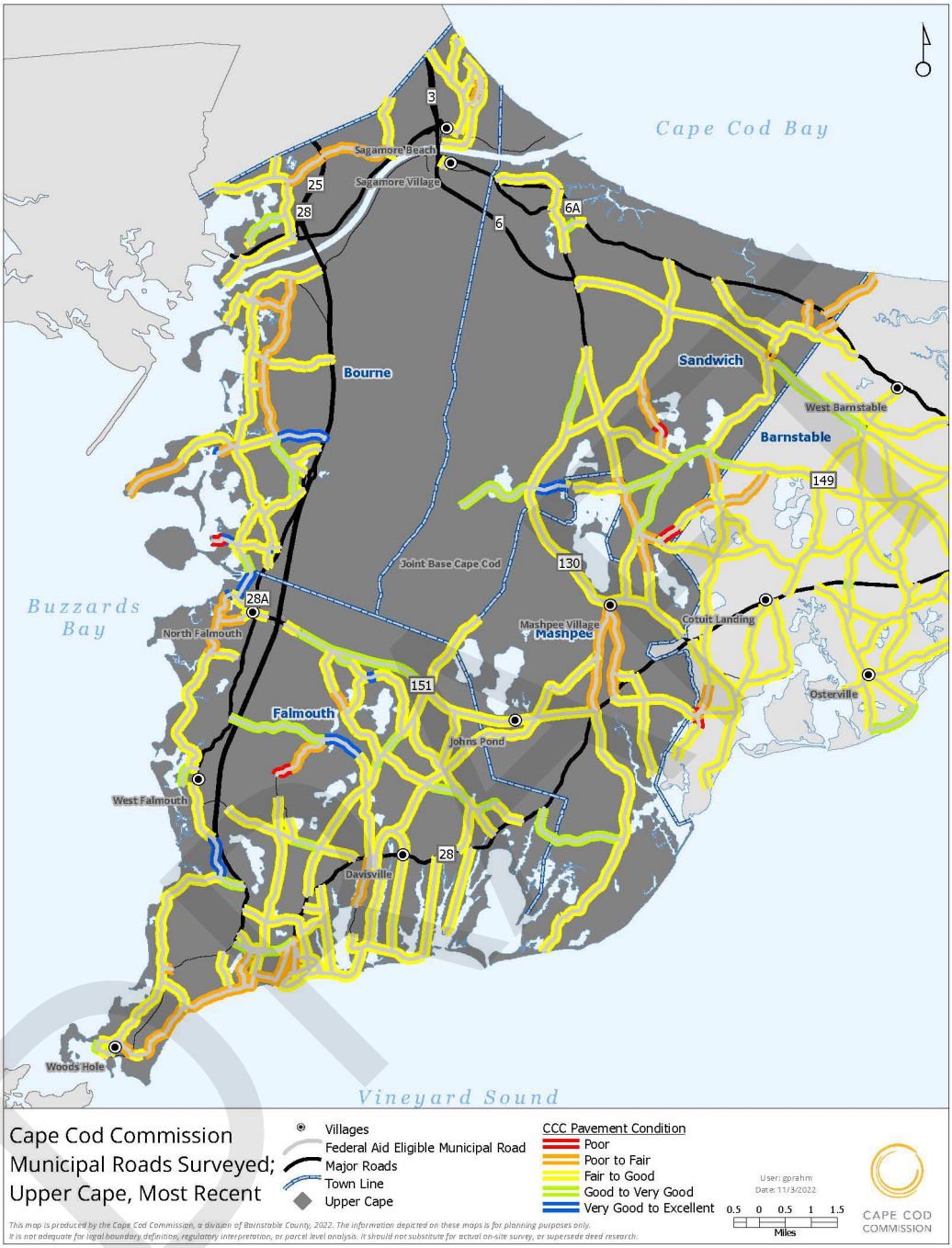

FIGURE 4. Pavement Condition Surveys: Upper Cape

Source: latest data available from 2020-2022 collected by Cape Cod Commission

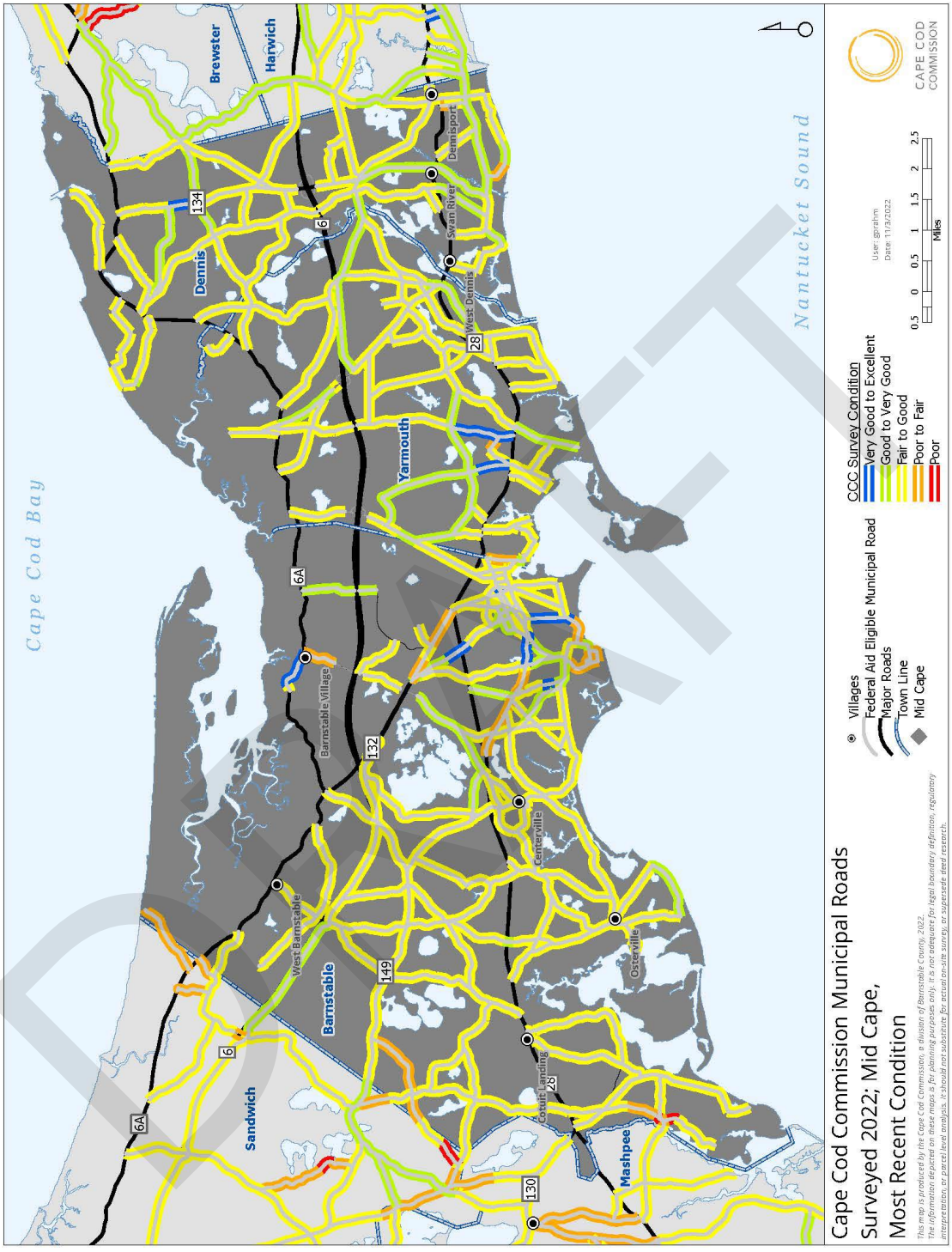

FIGURE 5. Pavement Condition Surveys: Mid-Cape

Source: latest data available from 2020-2022 collected by Cape Cod Commission

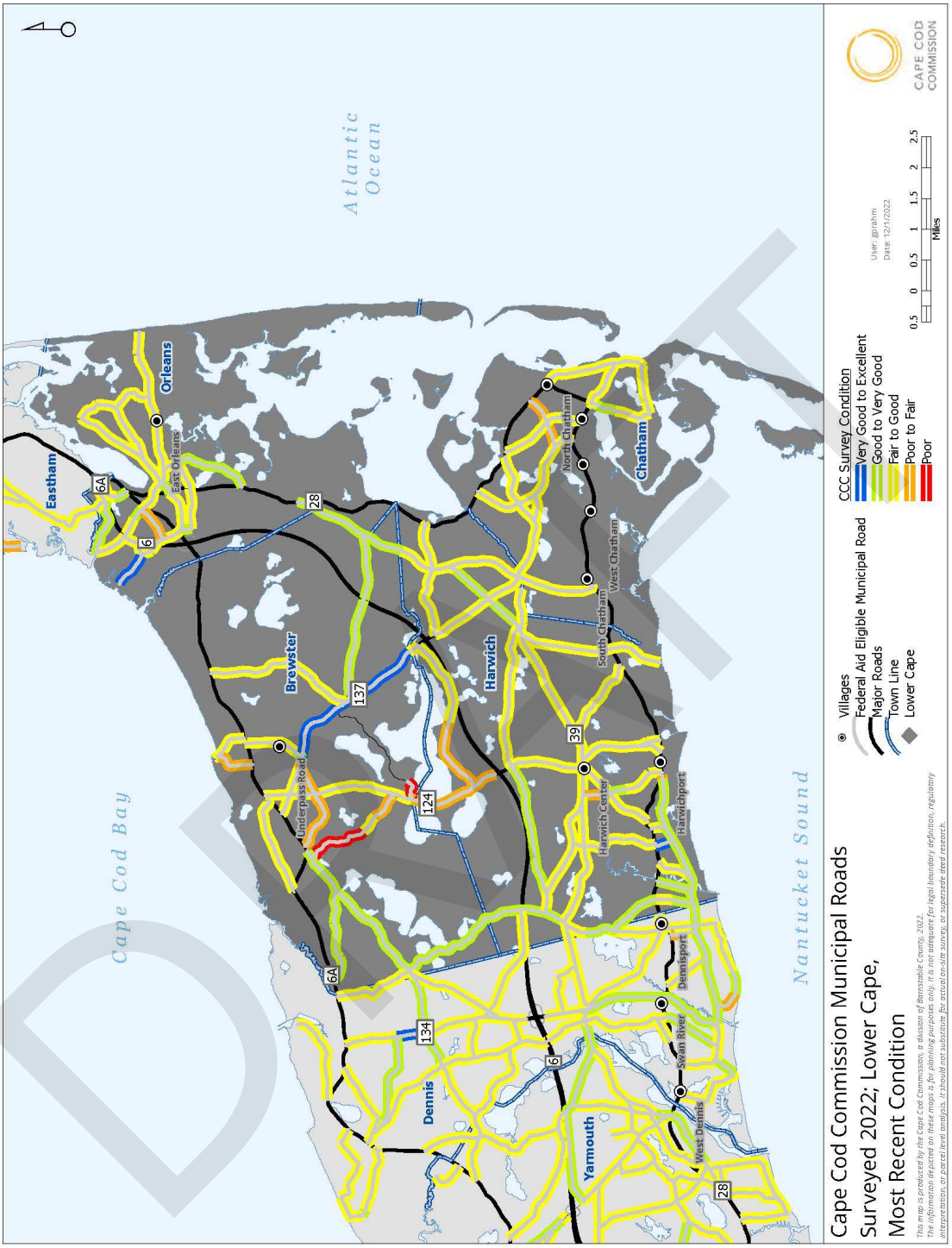

FIGURE 6. Pavement Condition Surveys: Lower Cape

Source: latest data available from 2020-2022 collected by Cape Cod Commission

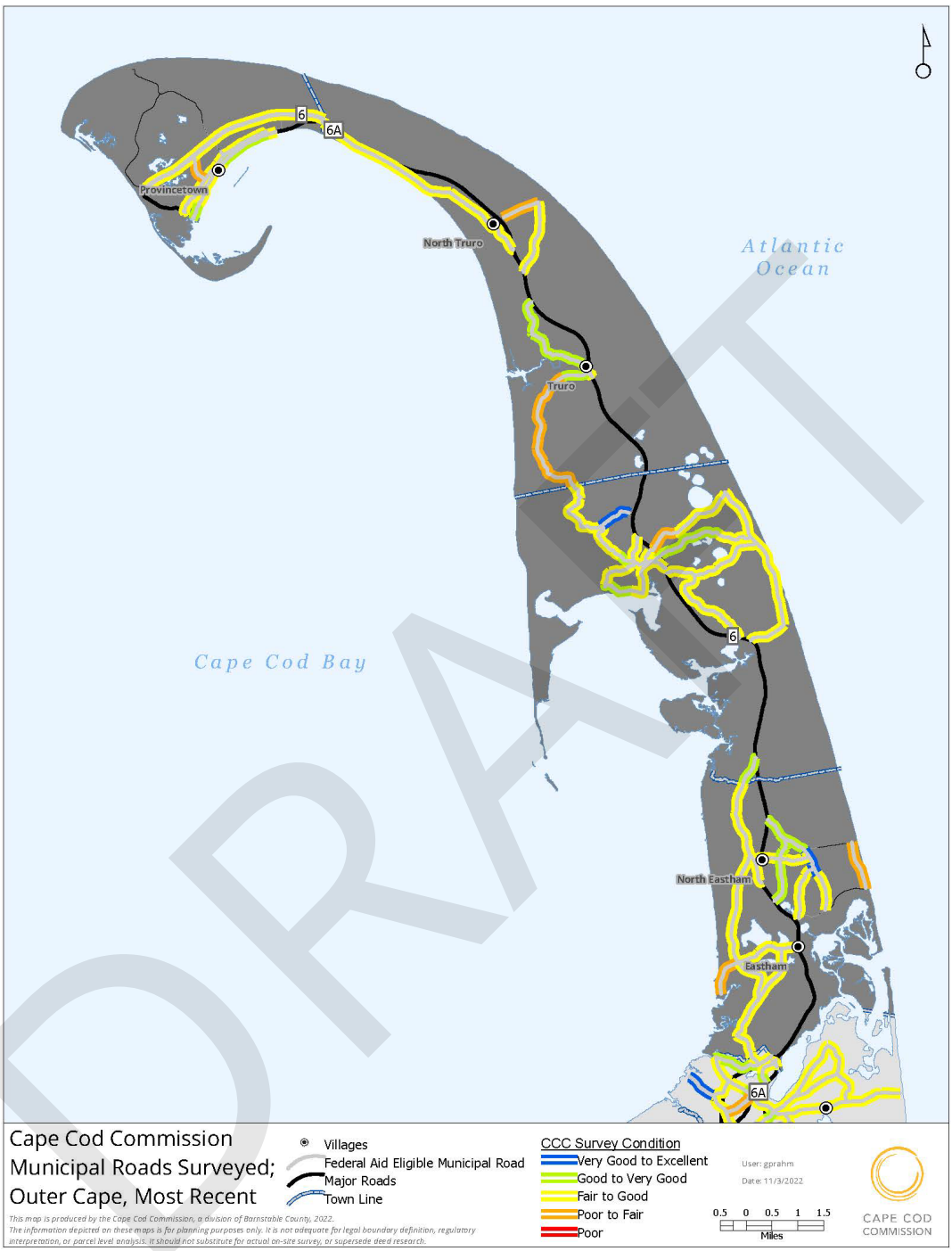

FIGURE 7. Pavement Condition Surveys: Outer Cape

Source: latest data available from 2020-2022 collected by Cape Cod Commission

RECOMMENDATIONS FOR ACHIEVING IMPROVED PAVEMENT CONDITION

The pavement deterioration curve shown in Figure 1 demonstrates the advantages of maintaining good roads to avoid expensive rehabilitation and reconstruction. For each level of Pavement Condition there is a corresponding Pavement Condition Index (PCI) – indicated by the column "PCI Start" in the table below.

By plotting the PCI for each condition level on the deterioration curve we can estimate the PCI after 5 years (this number corresponds to the 5-year "time bands" used in the Regional Transportation Plan for programming transportation projects). This is indicated by the column "5 Year – PCI No Repair" in the table below.

Repair strategies for each pavement "Starting Condition" vary according to starting PCI. For example, pavement currently categorized as "Good" or better (PCI greater than 89.0) may undergo "Maintenance" (e.g., crack-sealing, cleaning catch basins, etc.) with an associated modest cost per mile. Pavement currently categorized from Fair to Good (PCI of 80.5) would undergo "Rehabilitation" and with a higher cost. Pavement below Fair condition (PCI below 65.5) would require the most expensive repair of "Reconstruction." The estimated costs per mile for each repair strategy were originally estimated by the Old Colony Planning Council.

On average, pavement categorized as Good or above that is maintained would retain the same PCI. Pavement that is rehabilitated or reconstructed would on average achieve a PCI equal to "Very Good – Excellent" (PCI 96.5).

Therefore, it is possible to calculate a "Benefit" (i.e., the difference in the PCI between performing a repair and doing nothing). For example, if a segment of road is currently assessed to be at a PCI of 80.5 (Fair to Good) there are two possibilities: (1) rehabilitate the pavement resulting in an average PCI of 96.5 or (2) allow the pavement to deteriorate over the five-year time span down to a PCI of 29.7. In this case, the benefit of performing the repair (i.e., rehabilitation) is calculated to be the difference from 96.5 minus 29.7, or 66.8.

By relating the PCI Benefit of performing roadway repairs to the repair cost per mile, it is possible to calculate a Benefit/Cost ratio. These ratios are shown in the right-most column of the table below. To make the comparisons easier to review, the Benefit/Cost ratio of all the pavement conditions have been factored by 10,000.

TABLE 5. Change in Pavement Condition – Improvement Strategy

STARTING CONDITION	PCI START	5 YEAR - PCI NO REPAIR	REPAIR STRATEGY	REPAIR COST PER MILE	5 YEAR PCI REPAIR	PCI BENEFIT	BENEFIT / COST (SCALED BY 10,000)
Very Good to Excellent	96.5	83.6	Maintain-ance	$35,000	96.5	12.9	3.69
Good to Very Good	89.0	54.6	Maintain-ance	$45,000	89	34.4	7.64
Fair to Good	80.5	29.7	Rehabilit-ation	$100,000	96.5	66.8	6.68
Poor to Fair	65.5	22.2	Recon-struction	$550,000	96.5	74.3	1.35
Poor	27.5	16.6	Recon-struction	$554,000	96.5	79.9	1.44

The table above indicates that the most cost-effect repair strategy would be focused on performing maintenance on "Good to Very Good" roads with an estimated Benefit/Cost of 7.64, closely followed by performing rehabilitation on "Fair to Good" roads with an estimated Benefit/Cost of 6.68.

As a matter of policy, it is also recommended that funds be reserved to reconstruct a subset of "Poor to Fair" and "Poor" Roads.

The Cape Cod MPO is committed to exploring improved pavement management strategies and techniques to help optimize investment and achieve maximum improvement in overall PCIs.

CONCLUSION/RECOMMENDATIONS FOR PMS ENHANCEMENT

Cape Cod Commission staff will continue advance PMS activities throughout the fifteen towns of Barnstable County. Commission staff issue a status report on the pavement condition on Cape Cod each year. The pavement condition data collected during the Commission's summer data collection is modeled and analyzed to provide an objective rating of pavement conditions and needs. The annual assessments contribute to the implementation of a regional pavement management system for Cape Cod that keeps the roadway system in the best possible condition with the most efficient use of available funds. The latest PMS Reports and ones from previous years can be viewed here.

The Cape Cod Commission also has a Pavement Condition Viewer. The viewer displays the annual pavement survey results in a GIS web-based application to assist towns in their pavement management efforts. The GIS web application is available for public viewing on the Cape Cod Commission website on the same page as PMS Reports. The data collected by the Commission, in the monitoring process, will be continually analyzed to identify overall pavement conditions in the different Cape Cod towns to assist in programming maintenance and reconstruction activities. Efforts will continue such as:

- Identify individual towns' methods for pavement condition evaluation and programming for improvements
- Identify "gaps" in pavement condition information on Municipally-owned Federal Aid eligible roadways – and – prioritize and implement CCC data collection activities on these roadways
- Improve CCC skills in performing pavement evaluations
- Analyze local communities' bid prices to develop Cape-specific improvement costs of various pavement conditions
- Generate listings of roadways with poor pavement conditions
- Continue to provide yearly PMS Reports
- Provide a web-viewer to display the most recent pavement condition data collected

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2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix K: Access to Essential Services and Regional Cooperation

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Technical Appendix K: Access to Essential Services and Regional Cooperation

ACCESS TO ESSENTIAL SERVICES

This section identifies Cape Cod's essential services and facilities, including housing, employment, healthcare, education, and transportation and assesses how well Cape Cod's transportation system serves them in terms of access and connectivity to the regional transportation network. As discussed throughout the 2024 RTP the following strategies represent key objectives for the Cape's regional transportation network:

- Reduce congestion for all modes,
- Improve travel time reliability for all modes,
- Improve safety for all modes,
- Increase connections opportunities between different modes,
- Close gaps in the bicycle and pedestrian network, and
- Improve transit options.

Cape Cod's transportation network includes regional and local roadways, plus bicycle and pedestrian facilities, ferries, and airports. The transportation system, particularly roadway conditions, fluctuates significantly between the summer season and off-season. The additional seasonal population and influx of summer tourists increase traffic volumes and create summertime congestion and safety hazards, as discussed in the Congestion Management and Safety appendices. Access to essential services is impacted by the summertime congestion. The Cape is heavily auto-dependent, with most residents and visitors reliant on their cars to travel around the region. Area roadways are less congested in the off-season, but safety issues for motorists, bicyclists, and pedestrians are still present in some areas.

Access to and from Cape Cod

All motor vehicles travelling to Cape Cod must cross the Cape Cod Canal in Bourne, using the Bourne Bridge or the Sagamore Bridge, which are functionally obsolete and proposed for replacement. During the summer and during periods of bridge maintenance or in emergency situations, multi-mile backups are common. This limits travel for those living near the bridges, commuters, and vacationers. While this chapter on interregional access to essential services focuses on travel and accessing facilities within the region, access into and out of the region is

impacted by bridge access. Provincetown, located at the tip of Cape Cod, serves as a multi-modal hub for residents and visitors during the summer season, with daily ferry service to and from Boston. Thousands of travelers leave their cars behind and opt for the ferry from Boston to Macmillan Wharf, where they can connect with bus service or bicycle to their destination.

Impacts of Climate Change on Access

Climate change impacts could affect access to regional facilities and services. Flooding is currently a regular event along numerous low-lying roads during extreme high tides and storm events. As seas rise and storms intensify, the impact to our coastlines and flooding occurrences will increase in frequency and depth. Low lying roads are vulnerable to flooding from the combined effects of hazards such as sea level rise, storm surge, and erosion.

Cape Cod Commission staff are working with all 15 Cape towns to examine vulnerabilities in the roadway network and identify adaptation alternatives. With funding support from the U.S. Economic Development Administration and the Massachusetts Municipal Vulnerability Preparedness program, the Commission contracted with the Woods Hole Group to conduct a vulnerability assessment of roadway segments, bridges, and culverts due to flooding from the combined effects of sea level rise and storm surge. The project employs state of the art modeling and community engagement to identify and prioritize low lying roads to target for coastal resiliency action. Access to critical facilities, services, and socially vulnerable populations are among considerations for prioritization. More information about the project is available at https://www.capecodcommission.org/our-work/low-lying-roads-project/

Community Activity Centers

The 2019 Cape Cod Regional Policy Plan provides a growth policy and land use vision for the region that directs growth to be focused in centers of activity and areas supported by adequate infrastructure and guided away from areas that must be protected for ecological, historical or other reasons. Community Activity Centers are areas with a concentration of business activity, community activity, and a compact built environment. Buildings are generally smaller in scale and connected by a network of streets, ways or alleys. Community Activity Centers are more walkable and densely developed than other Placetypes and often contain concentrations of historic buildings that contribute to the Cape's unique character. Mixed commercial and residential uses make it possible to live and work within the same walking distance. Smaller parks provide greenspace and recreation within Community Activity Centers, with ample access to transit, bike connections and sidewalks. The vision for these areas is to accommodate mixed-use and multifamily residential development in a walkable, vibrant area, preserve historic buildings, and to provide diverse services, shopping, recreation, civic spaces, housing, and job opportunities at a scale of growth and development desired by the community, with adequate infrastructure and pedestrian amenities to support development.

CACs support the region's essential facilities and services, including commercial uses and housing. Roadway infrastructure investment, including bicycle and pedestrian accommodations, in these areas will help foster smart growth and ensure accessibility to important services and facilities. As the Cape Cod Commission develops its Regional Housing Strategy, CAC's are areas for future housing and infrastructure investments. Coordination of the region's transportation planning with its land use visioning planning will help ensure multi-modal accessibility to these areas.

Town Centers

While the mapped CACs represent activity nodes of regional scale, Cape Cod's town centers and downtowns represent smaller scale local areas of community activity and mixed uses. Connectivity and access to facilities and services in town centers from regional and local roadways, for motor vehicles and transit and bicycle and pedestrian is an important objective in the region's transportation planning.

Essential Facilities

HOUSING

Cape Cod faces a limited housing supply and a limited range of housing type options, as well as high levels of demand for seasonal and retiree housing. Owner-occupied units, seasonal rental units, and single-unit detached homes are prevalent in Barnstable County, rendering year-round rental options scarce and expensive. Within the region, the Lower Cape and Outer Cape sub-regions have the highest concentration of seasonal homes, though the Upper and Mid Cape sub-regions also have significant shares of seasonal homes. Seasonality is one factor accounting for the difference between the number of households and number of housing units in the region as housing units account for any residential unit, whether occupied or not, whereas households only account for those housing units that are primary places of residence.

HOUSING AFFORDABILITY

Barnstable County's housing market has been shaped by both long-standing factors, including Cape Cod's appeal to generations of retirees and visitors, historical development patterns, natural resource constraints, and acute events including the housing market crash of 2009 and the COVID-19 pandemic. Taken together, these factors have created a highly constrained housing market that does not meet the diverse needs of Barnstable County's residents. One of the core challenges to the adequate provision of affordable housing is the gap between the region's comparatively low average wages and comparatively high housing costs: the median household income falls short of the amount needed to affordably purchase a median-priced home in all fifteen Barnstable County towns. Housing profiles for the region an each out the 15 towns is available at www.capecodcommission.org/housing.

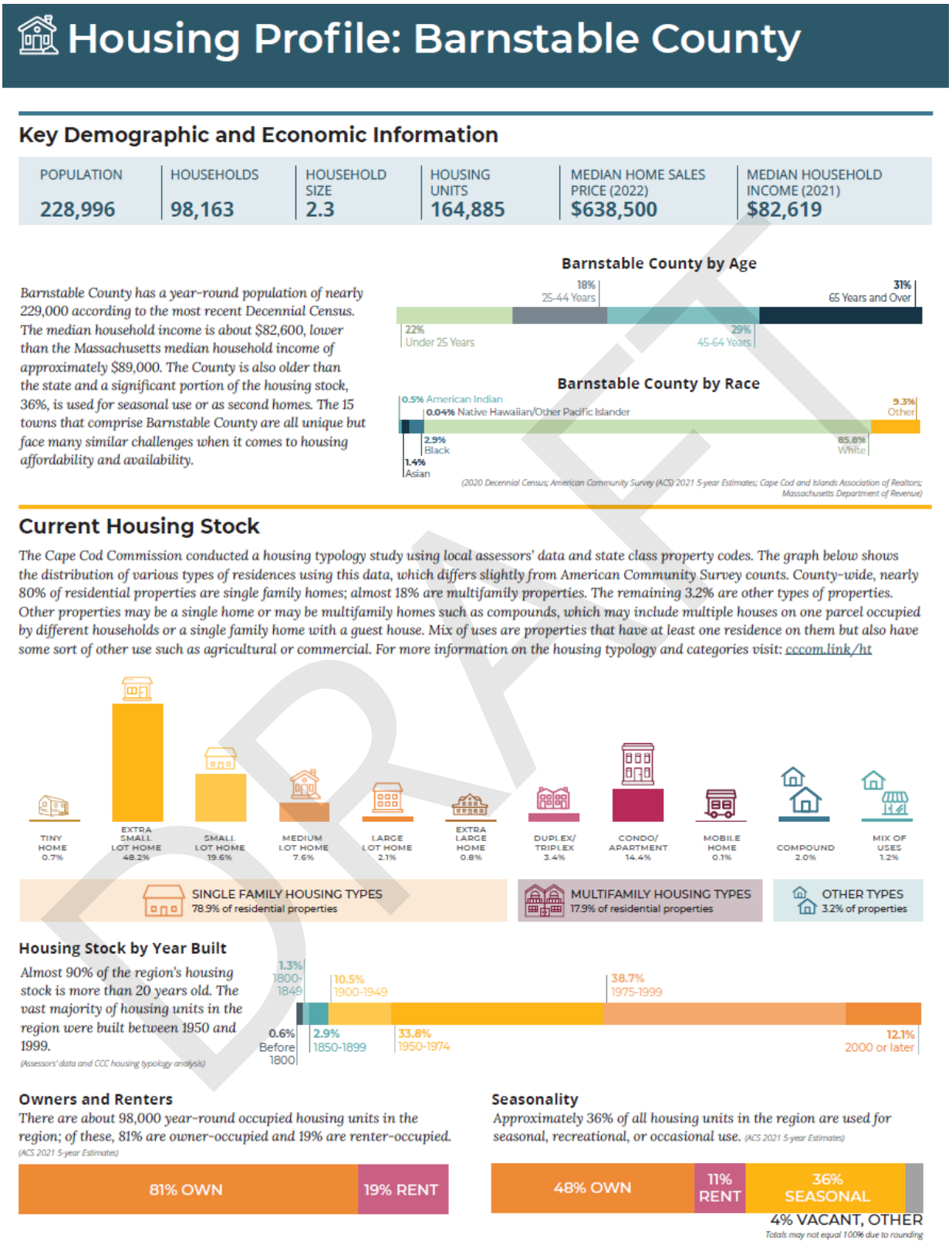

FIGURE 1. Snapshot of Regional Housing Profile

HOUSING AND TRANSPORTATION ACCESS

Most of the region's existing housing is dispersed across the 15 Cape Cod towns in residential zoning districts, outside of Community Activity Centers and village centers. Existing development patterns and zoning have contributed to residential sprawl, including single family home development served by local subdivision roads. Most households depend on automobiles for commuting and access to services.

For households that lack access to automobiles, transit service (CCRTA), bicycle and pedestrian facilities are critical needs for access to jobs, schools, and services.

Employment Centers

Two key components of employment on Cape Cod are the region's large employers and the seasonal economy and several large employers. The table below identifies the top 10 employers on Cape Cod. The two facilities that employ between 1,000 and 4,999 people according to the Massachusetts database are Cape Cod Health Cape and Woods Hole Oceanographic Institution. Facilities that employ between 500 and 999 people according to the Massachusetts database are Air National Guard, Cape Cod Community College, Nantucket Airlines, Ocean Edge Resort, Steamship Authority, and the Woods Hole Steamship Authority. All other employers on Cape Cod are not recognized to have over 500 employees. Retail Centers also have a high number of employees. Many locations increase employment or are only open in the summer months. Accesses to facilities that employ over 1000 people and large retail centers are discussed below.

TABLE 1. Largest Employers on Cape Cod

EMPLOYER	RANGE OF EMPLOYEES
Cape Cod Healthcare Inc.	1,000-4,999
Woods Hole Oceanographic Institute	1,000-4,999
Cape Cod Community College	500-999
CBI Operations, Chatham	500-999
Commscope Inc Teaticket Path, Falmouth	500-999
Falmouth Hospital	500-999
Nantucket Airlines,	500-999
Ocean Edge Resort & Golf Club	500-599
Woods Hole Steamship Authority	500-599

Source: Massachusetts Department of Economic Research

LARGE EMPLOYERS

Cape Cod Health Care operates several locations including the Cape Cod Hospital and other facilities that include outpatient centers and rehab centers across the Cape. Access to the hospital is detailed in the Healthcare Facilities sections below.

Woods Hole Oceanographic Institution (WHOI) is located in Woods Hole in Falmouth. Access to Woods Hole by personal vehicle can be difficult due to the geographic location. Woods Hole is the southwestern most part of the region and only road accessing this area is Woods Hole Road which deviates south from Route 28. Both Route 28 and Woods Hole Road experience year-round congestion and several traffic volume measurements indicate a LOS F. Woods Hole is accessible by fixed route transit on the Sealine and seasonally on the WHOOSH Trolley. The majority roads surrounding the WHOI have sidewalks and the Shining Sea Bike Path is located under one quarter of a mile from the facility. There is ferry service to Martha's Vineyard from the Woods Hole Steamship Authority Terminal.

Employers with over 500 employees are listed below:

- Community College is located on Route 132 in Barnstable and on Main Street in Hyannis. Access issues associated with this facility are detailed in the Educational Facilities section of this appendix.
- CBI (Chatham Bars Inn) is located on Shore Road in Chatham. The property is accessible by fixed route CCRTA service. Shore Road lack sidewalks and bicycle accommodations, so walking or bicycling from neighboring Harwich/Orleans area is challenging, but the Old Colony Rail Trail spur provides a connection from to the west. Most of the adjacent streets are low speed and low volume and connect to the downtown/Main Street.
- Commstock is located in East Falmouth about a mile off of Route 28. The Sealine fixed route service runs along Route 28. Route 28 lacks bicycle accommodations and is hazardous in this area, though a sidewalk is available.
- Falmouth Hospital, located on Route 28 in Falmouth. Access detail are provided in Healthcare Facilities section below.
- Nantucket Airlines is located in Hyannis at the Hyannis Airport. Access issues associated with this facility are detailed in the Transportation Services section of this appendix.
- Ocean Edge Resort is located in Brewster on Route 6A. There are not significant access issues to this location.
- Steamship Authority is located in Hyannis and the Woods Hole Steamship Authority Terminal is located in Woods Hole. Access associated with both the Steamship Terminal locations are identified in the Transportation Services section of this appendix.

RETAIL CENTERS

The Hyannis area, particularly Route 132 is the location for the region's high density retail/commercial uses, including the Cape Cod Mall and several shopping plazas. Most commercial development on Route 132 (and Route 28) is auto-oriented, with large on site parking areas between the highway and the buildings. Despite its location along two major road corridors, vehicular access to the Hyannis commercial center is limited by year-round congestion. Numerous traffic volume measurements in Hyannis show a roadway LOS of F. Transit service to many retail locations is available on the Barnstable Villager. Intercity busses and numerous other CCRTA fixed routes access the Hyannis Transportation Center. The Hyannis commercial area is not accessible by bicycle. Several adjacent roads have sidewalks, but pedestrian travel can be hazardous, particularly road crossings. Downtown Hyannis, in the Main Street area, is a mixed use node that is walkable, with smaller scale buildings. It is adjacent to the Cape Cod Regional Transit Center and the ferry docks. Accessibility by vehicle is also limited by year young congestion on Rites 132 and 28.

Mashpee Commons and the adjacent commercial shopping plazas also represent a regional high-density retail center location. Mashpee Commons is located by the Mashpee Rotary on both sides of Route 151. Access to this location by personal vehicle is affected by congestion on Route 28 and Route 151. Numerous traffic volume measurements near the Mashpee Rotary show a roadway LOS of F. A fixed bus stop on the Bourne Run and the Sealine is located at Mashpee Commons. Several roads around Mashpee Commons lack sidewalks and bicycle accommodations, and access is oriented for motorists.

Healthcare Facilites

Health care facilities, both large and small practices, are located throughout Cape Cod. The Hyannis area, with Cape Cod Hospital serving as the region's largest and most central facility, represents the regional hub for medical services. Descriptions of location and accessibility to the two largest hospitals and access to Boston medical facilities is detailed below.

HOSPITALS

Cape Cod Hospital is located in Hyannis south of Route 28 on Lewis Bay Road. Access by vehicle to this location is difficult due to year-round congestion from all directions. Long-distance travel from points east (i.e Lower and Outer Cape) has significant access issues because most traffic accesses the hospital from Route 6 at Exit 7 to the north, then travels down Yarmouth Road/Willow Street and Camp Street. The intersection of Yarmouth Road and Route 28 is one of the most congested and poorly functioning intersections on Cape Cod, but is currently being reconstructed.

A fixed route transit stop is located at Cape Cod Health Care on the H2O Route. The Hyannis Transportation Center, where numerous local and regional busses stop, is located a few blocks from the hospital. Access to the hospital from the Outer Cape communities is difficult for people who lack personal vehicles. The hospital is an hour away from Provincetown during the off-season.

At peak season, with Route 6 and other major roads congested, even travel by ambulance is delayed. Regular/hourly transit service from the Outer Cape is not available. Social service agencies, including local Councils on Aging, provide van service to the hospital but it is insufficient for demand. Social service agencies report that clients hesitate and have avoided emergency room care due to lack of transportation home from the hospital. The region's labor shortage has impacted transportation options and accessibility to critical medical services, with transit and other private transport services lacking workers. Social service agencies have requested more frequent transit service between the Outer Cape and Cape Cod Hospital (and other medical services) in Hyannis.

Most roads surrounding the Cape Cod Hospital have sidewalks, but bicycle accommodations are lacking. The Steamship Authority and HyLine ferry's terminals are located a few blocks away connecting patients from Nantucket and Martha's Vineyard to the hospital area.

Falmouth Hospital is located on Ter Heun Drive west of Route 28 in Falmouth. Traffic congestion impacts access to this location by personal vehicle. Traffic volume measurements on most roads near the Falmouth Hospital including Route 28 and Jones Road show roadway LOS of F. The intersection of Route 28 and Jones Road/Ter Heun Drive does provide signal prioritization for emergency vehicles. The closest fixed route transit stop is at the Falmouth Bus Depot on the Sealine, over a half a mile away. Demand response services are available to bring patients to the hospital on a limited basis. The RTA's DART service is available only in Barnstable and Yarmouth.

Ter Huen Drive and Route 28 do have sidewalks on one or both sides and the Shining Sea Bikeway is located under a quarter mile away.

Cape Cod residents also travel to Boston for medical service. Methods of access include personal vehicle, transit. Severe cases are transported by medical flight using a helicopter. Demand response transit services are offered by the CCRTA that travel directly to the Boston hospitals. These services are critical to people who lack access to personal vehicles, but the trips are a full day's worth of travel. For Outer Cape residents, the only stop for departure is in Wellfleet at 7AM. The return bus home leaves Boston at 3PM.

Education

Education facilities on Cape Cod include private and public K-12 school, technical high schools, higher education, and continued education. The table below shows the enrollment at each of Cape Cod's 19 school districts or independent. Access to the largest Cape Cod Community College, Massachusetts Maritime Academy and the high schools or independent schools in districts that enroll over 3,000 students is discussed below.

TABLE 2. Enrollment at Cape Cod Schools (2020-21 School Year)

SCHOOL DISTRICT/ INDEPENDENT SCHOOL	STUDENTS
Barnstable	4,713
Falmouth	3,029
Dennis-Yarmouth	2,739
Sandwich	2,326
Monomoy Regional School District	1,763
Bourne	1,650
Mashpee	1,468
Nauset Regional (Middle and High Schoola)	1,426
Sturgis Charter Public (District)	853
Upper Cape Cod Regional Vocational Technical	722
Cape Cod Regional Vocational Technical	626
Brewster	420
Cape Cod Lighthouse Charter (District)	250
Eastham	194
Orleans	175
Provincetown	133
Wellfleet	103

ACCESS TO K-12 SCHOOLS

School busses exclusively transport students to and from school. Regional Transit Authorities are not legally able to provide trips to and from public schools.

Barnstable School District is the largest district, with 4,900 students. Bus service is available but families must pay for it, which is a hardship for lower income students. The high school is located

on West Main Street in Hyannis. Access by vehicle is limited by congestion during the school year due to the school's proximity to Hyannis. The Sandwich Line and Sealine stop about one quarter mile to the west at the intersection of Route 28 and West Main Street. The Sandwich Line also stops about one quarter mile to the east at the Star Market on West Main Street. There are sidewalks in both directions and there is not bike accommodation along West Main Street. There is a second entrance to the north on Route 28 that provides connection to residential neighborhoods. The entrance on Route 28 also provides access to the Barnstable Senior Center and Barnstable Intermediate School. A multi-use path on the south side of Route 28 is walkable but lacks a safe crossing for those walking to school.

Falmouth School district is the second largest school district with 3541 students enrolled. The high school is located on Gifford Street Extension, north of Brick Kiln Road. There is not a fixed route transit stop near this school. Access by vehicle to this location is not limited by congestion. There are sidewalks along the west side of Gifford Street Extension that terminates at the intersections to the north and south of the school.

Dennis-Yarmouth School District is the third largest school district in the region with 3044 students enrolled. The high school is located on Station Avenue Road. Route 6 is located to the north and Route 28 is located to the south. Access by vehicle can be limited by congestion. Traffic volume measurements near the intersection of Gifford Street at Brick Kiln Road show a roadway LOS of F. The closest transit stop is located on Route 28 over three quarters of a mile away. There is a sidewalk on the west side of Station Avenue.

Sandwich School District is the fourth largest school district with 3,017 enrolled students. The high school is located on Quaker Meeting House Road between Route 6A from to the north and Route 6 to the south. Access by vehicle to this location is not limited by congestion. The closest transit stop is located three quarters of a mile to the south on Quaker Meeting House Road. There is sidewalk on the east side of Quaker Meeting House Road.

Schools in every cape Cod town participate in Massachusetts Safe Route to School Program. Cape Cod Commission Staff has worked with SRTS staff to provide technical assistance for partner schools seeking bicycle/pedestrian improvements for improved access. Commission staff completed a 2017 study with recommendations for improved connectivity between schools and the bicycle and pedestrian facility network.

HIGHER EDUCATION

Cape Cod Community College is located in Barnstable on Route 132 north of Route 6. The programs offered include 32 associates in arts degrees, 32 associates in science degrees and 56 career certificates. The college estimates that approximately 7,300 individuals from all over southern Massachusetts enroll in courses each year. The college is located about one quarter mile north of Route 6 at Exit 6. Access by personal vehicle is limited by congestion and the nearest traffic volume measurement on Route 132 indicated a roadway LOS of F. The entrance and exit points on Route 132 have been identified as dangerous in a Road Safety Audit (RSA). The study recommended considering a modern roundabout or traffic signal, providing a walking path and sidewalks to connect the facility with the Exit 6 Park and Rider Lot, and improving signage and lighting. Currently the Barnstable Villager stops at the college and intercity buses stop at the park and ride lot located less than a mile to the south at the Route 6 Exit 6 park and ride lot. Route 132 has a sidewalk on the west side near the college.

Massachusetts Maritime Academy is located in Buzzards Bay, Bourne. Access to Buzzards Bay by automobile is limited by congestion. Numerous traffic volume measurements indicate a roadway LOS of F. The geographic location of Massachusetts Maritime provides only one access road, Taylor Point. There is a stop on the Bourne Run approximately one quarter mile from the Academy. Regional Buses and the weekend summer train the CapeFLYER stop at the same place the Bourne Run does. There are not sidewalks or bike paths on the roads that access Massachusetts Maritime Academy.

Transportation Services

There are numerous transportation services provided by both private and public agencies on Cape Cod. Transportation services are essential to the region for reasons including the number of seniors needing assistance to medical appointments, congestion in the summer months or at the canal bridges, and access to the islands across the water. Access to services provided by the Cape Cod Regional Transit Authority, intercity and commuter buses, ferries and airports are discussed below.

CAPE COD REGIONAL TRANSIT AUTHORITY

Access to this type of service requires that passengers get to the stop locations without parking. In a survey conducted by the Regional Coordinating Committee, lack of sidewalks and other pedestrian facilities was identified by consumers as the number one barrier to transit services. Pedestrian access to transit stops varies at each location. The number of amenities such as shelters or bike racks also varies. The Cape Cod Commission staff is performing a study in 2015-2016 to identify locations to improve pedestrian access to transit stops and subsequent studies to prioritizes locations for improvements.

The CCRTA offers several types of demand response services including Dial-A-Rider Transportation, Paratransit Service and coordinated service with health care facilities and Councils on Aging. Access to the services depends on the type of service, but the bus typically arrives curbside at homes or businesses if a request is made in the day prior.

The CCRTA office and the major transit hub on Cape Cod are located at the Hyannis Transportation Center. Access by vehicle to this location is limited by year-round congestion. Several access points lead to this location. From the north access is off Route 28 west of the Yarmouth Road at Route 28 intersection. Yarmouth Road and Route 28 is one of the worst functioning intersections on Cape Cod. The access point is unsignalized and does not provide an aesthetic entrance to the facility. It is difficult to take a left-hand turn into this entrance because of the high volume of traffic on Route 28. The second access point is on Ridgewood Avenue. Access to Ridgewood Avenue is affected by congestion. The third access point is on Center Street north of the Main Street intersection. This location does not have significant access issues, but it is less direct than the other access points. The CCRTA has conducted a Transit Oriented Development study to identify ways to improve the Hyannis Transportation Center in terms of access and development. The recommendations in this study include building a village center around the transit hub that includes commercial, residential and recreational facilities. Roads accessing the Hyannis Transportation Center have sidewalks.

INTERCITY AND COMMUTER SERVICES

Intercity and commuter buses are essential to the Cape Cod economy because it allows individuals to live in the region and work in a location with more financial opportunity. Each carrier and bus facility are discussed in more detail in the Existing Condition Appendix of this report. Access to bus terminal and park and ride lots are detailed below.

The Falmouth bus terminal is located on Depot Avenue west of North Main Street at the elbow of Route 28 in Falmouth near the Falmouth Hospital. Peter Pan Buses depart from this location. The Falmouth Bus Depot has limited parking and a poorly functioning facility. Access to this location by vehicle can be affected by congestion. There are sidewalks on both sides of Depot Avenue in this location and on both sides of North Main Street. The CCRTA busses that stop at this location include the Sealine and the WHOOSH Trolley in the summer months.

Macmillan Pier is located in Provincetown south of Commercial Street and serves as a multi modal hub for the Outer Cape. This location is congested with bicyclist and pedestrians in the summer months and parking is limited. The Plymouth and Brockton services this location with a connection to the Hyannis Transportation Center. There are sidewalks on the roads that access Macmillan Pier and the CCRTA FLEX route access the bus terminal.

The Park and Ride lots on Cape Cod are located north of the Sagamore Bridge; at Exit 6 on Route 6; and at Exit 10 on Route 6. Parking is free, which also results in use by carpoolers who are not commuting. Parking at the Exit 6 and Sagamore lots is often at capacity. The Exit 6 and Sagamore Lots are serviced by intercity buses traveling to Boston. The Exit 10 lot is a stop on the Plymouth and Brockton Hyannis to Provincetown route. The lots are located near limited access highways, and congestion does not affect vehicle access. The Sagamore Lot has CCRTA service on the Sandwich Line and Bourne Run. Neither Exit 6 or the Exit 10 lot have a fixed route CCRTA transit stop.

The CapeFLYER train is available for people traveling from Boston to Cape Cod in the summer months on weekends. The train includes bicycle storage and dining services. It travels from the city and stops at several locations on the way to Cape Cod. On Cape it stops in Buzzards Bay and in Hyannis at the Hyannis Transportation Center. The stop in Buzzards Bay has access restrictions including congestion and limited parking. The Bourne Run transit route provides service that connects this parking location to the Falmouth Bus Depot.

MBTA commuter rail stations in Kingston and Lakeville also provide service to Boston. These stations are outside of the MPO region. Cape Cod Canal bridge crossing congestion can impact travel to these stations from the Cape.

FERRIES

The Woods Hole Steam Ship Authority Terminal is located in Falmouth on Woods Hole Road near the Woods Hole Oceanographic Institute. Access by vehicle is limited by congestion and parking. There are sidewalks on the roads that access the Woods Hole Steamship Authority Terminal. The CCRTA fixed route Sealine and seasonal fixed route WHOOSH Trolley access this location. The Boston to Woods Hole commuter bus stops at this location. The Shining Sea Bike Path terminated at this location.

The Hyannis Steamship Authority and Highline Ferry terminals are located in Hyannis on the Lewis Bay Waterfront near the Cape Cod Hospital. Access by vehicle is limited parking and congestion. There are sidewalks on the roads that access both ferry terminals. The CCRTA does not have year-round fixed route transit stops at this location but does offer seasonal stops at both ferry terminals on the Hyannis Trolley.

Macmillan Pier is another location that has ferry service provided by Bay State Cruise Company. The Provincetown Ferry travels from Provincetown to Boston. This access to this location was discussed in the Intercity and Commuter Bus section of this appendix.

AIRPORTS

Cape Cod has two airports with several scheduled passenger service and several smaller airports. Access to the commercial airports is detailed below. The functionality of the airports is discussed in the Existing Conditions Appendix.

Barnstable Municipal Airport is the largest airport on Cape Cod. It is located in Hyannis north of the Airport Rotary. There are several access points for vehicles including through airport road north of Route 132, through Hinckley Road north of Route 132, or the terminal entrance east of the airport rotary on Route 28. Traffic leaving the airport can join airport rotary traffic through a one-way street. Congestion associated with Hyannis affects vehicle access. There are not sidewalks on many of the roads accessing the airport including Route 28 and Route 132. There is not a fixed route transit stop provided at this location by the CCRTA. A prior transit stop was discontinued due to low ridership generation at the airport.

Provincetown Municipal Airport is located on Province Lands Road in Provincetown. Access by vehicle is not affected by summer congestion. There are not sidewalks on the roads near the airport, but the Province Lands Bike Path crossed the vehicle entrance to the airport. There is not a CCRTA year-round fixed route stop here but there is a stop on the seasonal fixed route service the Provincetown Beach Shuttle.

Access Improvements

Traffic congestion and unsafe conditions limits vehicular access to some essential services on Cape Cod, as identified in this appendix. Several transportation projects are in progress that would that would improve access to the essential services.

Access restrictions due to the functionally obsolete Sagamore and Bourne Bridges create barriers to the region. During summer months and periods of bridge maintenance the bridge traffic can be backed up multiple miles. Projects which could improve access across the Cape Cod Canal and adjacent roads e.g. the Bourne Rotary, Belmont Circle, Sandwich Road, Route 6 exit 1 reconfiguration, replacement bridges would improve access to essential services.

Hyannis is the most urbanized region of Cape Cod and a location hub for numerous essential services.

Projects have been identified that could improve access to Hyannis in recent studies including the Hyannis Access Study, Hyannis Access Implementation Study, and Yarmouth Road Study. The Yarmouth Road Study identified the potential improvements along Yarmouth Road between Higgins Crowell Road and Route 28, including a multi-use path and two additional lanes of travel. The Hyannis access study and Hyannis Access Implementation Study identified improvements at the intersection at Yarmouth Road and Route 28, Route 28 between Yarmouth Road and the

Airport Rotary, and at the Airport Rotary. The improvements at the Airport Rotary include an underpass for critical directional volumes. The intersection of Yarmouth Road and Route 28 is currently programed through the Transportation Improvement Program (TIP).

Other areas that were identified to have access issues to essential services include at the Mashpee Rotary, in the Woods Hole Area, the southwest elbow of Route 28 in Falmouth, Provincetown, and along Route 6 in the Outer Cape. These roadways should be further investigated for proposed improvements and opportunities to study.

REGIONAL COOPERATION

Regional Partners

Development of the RTP and other planning efforts include consultation with or consideration of a wide range of federal, state, and local agencies and organizations including:

- Barnstable County Government
- Bay Colony Railroad
- Cape Air
- Cape Cod Central Railroad
- Cape Cod Commission
- Cape Cod Joint Transportation Committee
- Cape Cod Metropolitan Planning Organization
- Cape Cod National Seashore (National Park Service)
- Cape Cod Regional Transit Authority
- Cape Cod Towns
- Federal Highway Administration
- Federal Transit Administration
- Hy-Line Cruises
- Joint Base Cape Cod
- Martha's Vineyard Commission, Nantucket Planning and Economic Development Commission, Old Colony Planning Council, and Southeastern Regional Planning and Economic Development District
- Massachusetts Department of Recreation and Conservation
- Massachusetts Department of Transportation
- MassBike
- Nantucket Air
- Peter Pan – Bonanza Bus Lines
- Plymouth and Brockton Street Railway Company
- U.S. Army Corps of Engineers
- Woods Hole, Martha's Vineyard and Nantucket Steamship Authority

Urbanized Area Boundaries

Cooperation across Cape Cod Metropolitan Planning Organization (MPO) Boundaries occurs through meeting and consultation on studies. The Cape Cod borders both the towns of Wareham and Plymouth. The Barnstable Town Urbanized Area, defined by the 2010 census, extends into the abutting regional planning districts, Old Colony Planning Council (OCPC) and Southeastern Regional Planning and Economic Development District (SRPEDD). In some cases, federal funds are distributed to Urbanized Area (UZA) requiring coordination on planning efforts. When this occurs coordination meetings are organized, and Cape Cod Commission Staff may attend MPO meetings in these MPO districts.

The neighboring regional transit authority, Greater Attleboro Taunton Regional Transit Authority (GATRA) operated a fixed route service into the Buzzards Bay area. This agency is consulted when planning studies reach across the MPO boundary. Most recently this occurred in the Coordinated Public Transit- Human Service Transportation Plan because this plan released transit funds that were distributed to UZA districts, of which the GATRA and CCRTA service area are included.

Metropolitan Planning Organization

There are several meetings facilitated or frequently attended by the Cape Cod Metropolitan Planning Organization Staff that promote coordination.

Cape Cod MPO meeting are held monthly and in attendance representatives from four sub regions in Barnstable County, MassDOT Secretary/CEO, MassDOT Highway Division Administrator, Chair of the Cape Cod Commission Chair of the Cape Cod Regional Transit Authority Advisory Board, President of the Barnstable Town Council, and the Tribal Chairman of the Mashpee Wampanoag Tribal Council. Sub region A consists of the town of Bourne, Falmouth, Mashpee, and Sandwich. Sub region B includes the town of Yarmouth and Dennis. Sub region C includes the towns of Brewster, Harwich and Orleans. Sub region D includes the town of Eastham, Wellfleet, Truro and Provincetown. The MPO is formed and abides by rules established under a formal agreement in the form of a Memorandum of Understanding (MOU). MPO meetings are attended by the public.

The Joint Transportation Advisory Committee (JTC) is an advisory committee to the Cape Cod MPO. The committee is made up of representatives from each town, often a director of the town Department of Public Works (DPW) or the town engineer. Materials presented before the MPO are often presented first to the JTC to receive local feedback and to recommend action by the MPO. JTC meetings are attended by the public.

Coordination on Cape Cod

The CCRTA hosts monthly Multi-Modal Meetings, quarterly advisory board meetings and Regional Coordination Committee (RCC) which Cape Cod MPO staff attends. The Multi-Modal meetings are

regularly attended by representatives from the Barnstable Municipal Airport, Steamship Authority, Hy-line, Plymouth and Brockton Street Railway Company, Town of Barnstable, Cape Cod Chamber of Commerce, State Legislation Representatives. The advisory board consists of representatives from each town and meetings are attended by various interested agencies. The RCC includes various members of human service agencies on Cape Cod. CCRTA staff and Cape Cod MPO staff also meet as frequently as bi-weekly to discuss planning efforts.

The majority of the east coast of Cape Cod is owned and managed by the National Park Service. Transportation issues that affect the National Park are discussed with their staff. Recently this agency was engaged to coordinate data collection for bicycles, the conduction of the Outer Cape Bicycle and Pedestrian Master Plan and for safety upgrades for Route 6 in Wellfleet resulting in the implementation of rumble strips on the centerline of the roadway.

Statewide Coordination

Coordination with the state transportation department, MassDOT occurs through many means including MPO and JTC meetings. Conversation with the state department is constant in planning efforts to determine scopes of work or impacts to local character. There have been several recent large studies that have been performed in coordination between the MPO staff and MassDOT including the Hyannis Access Study, Bourne Rotary Study and the Canal Area Study. In all three of these studies data collection, public outreach was coordinated in addition to consistent consultation on the outcomes and conduction of the study.

The Cape Cod MPO staff also coordinates with other state departments. In planning efforts to extend commuter rail to Buzzards Bay the Cape Cod MPO staff consulted with the Central Transportation Planning Staff and the MBTA. These groups lead their own investigation into the feasibility of providing the service.

The Cape Cod MPO staff attends statewide meetings with the Massachusetts Association of Regional Planning Agencies (MARPA) and Transportation Managers Group (TMG). MARPA meetings are attended executive directors from each of the thirteen planning agencies in Massachusetts and statewide and local planning issues including but not limited to transportation are discussed. TMG meetings are attended by transportation directors at regional planning agencies to discuss statewide and local transportation issues. The islands south of the Cape Cod region, Nantucket and Martha's Vineyard have representation at these meetings. At this time critical transportation coordination with these regions may be discussed.

Road Safety Audits (RSA) is performed by Cape Cod MPO staff or private consultants. An RSA is performed to identify problems are intersection and roadways and establish long- and short-term solutions. At these events Cape Cod Commission staff, MassDOT staff, and town staff are present. The resent RSAs performed on Cape Cod are listed in the Safety appendix item.

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CAPE COD COMMISSION

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CAPE COD COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix L: Title VI/Nondiscrimination Program

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Technical Appendix L: Title VI/Nondiscrimination Program

The Cape Cod Metropolitan Planning Organization (MPO) follows federal and state non-discrimination laws and seeks to ensure that all interested parties in Barnstable County have access to the MPO's activities and services and that public involvement in the MPO's decision making comes from a diverse socioeconomic group that is representative of the county's population. The MPO has developed a nondiscrimination program, in accordance with federal and state requirements, to encourage broad public participation, representation, and equity in the region's transportation planning.

TITLE VI BACKGROUND

Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color, or national origin.[1] Related federal nondiscrimination authorities add the protected categories of sex (23 USC 324), age (42 USC 6101), disability (29 USC 790), low-income (Federal Executive order 12898), and limited English proficiency (federal executive order 13166). Organizations that receive Federal funds are obligated to assure nondiscrimination in their programs and activities and are required to have a comprehensive Title VI enforcement program to prevent and eliminate discrimination in their federally funded programs[2]. Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) set forth Title VI compliance requirements for "primary" funding recipients such as MassDOT and sub-recipients such as the MPOs to follow. Effective transportation decision making depends upon understanding and properly addressing the needs of different groups. The MPO's Title VI program includes identifying the demographic distribution of minority and limited English proficiency populations within the region and implementing a comprehensive strategy to

[1] "No person in the U.S. shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under a program or activity receiving financial assistance." [Civil Rights Act 1964] as amended (42 USC 200d et sec) and the Civil Rights Restoration Act of 1987 (P.L. 100.259).

[2] See 49 C.F.R. part 21(Non-discrimination in Federally- Assisted Programs of the Department of Transportation- Effectuation of Title VI of the Civil Rights Act of 1964); 28 C.F.R. section 50.3 (US Department of Justice Guidelines for Enforcement of Title VI of the Civil Rights Act of 1964).

ensure that the MPO conducts effective outreach to encourage their involvement in and access to the transportation planning and decision-making process.

The Massachusetts Department of Transportation (MassDOT) is responsible for ensuring that the state's MPOs comply with federal program requirements. Following MassDOT's 2013 Title VI program update, the Cape Cod MPO developed and adopted a Title VI Program in 2014. This plan was updated in accordance with MassDOT's directives in 2022 which also included updates to its Public Participation Plan in 2022. The 2022 Title VI plan update provides certifications and assurances, Title VI notices, complaint procedures and forms, information about beneficiaries' rights,, regional demographic data and profile of the area, mobility needs of minority populations, demographic maps and charts of funding distribution a Public Participation Plan, a language access plan, data collection reporting, the dissemination of Title VI information, and analyses of MPO transportation system investments in the region, project locations and potential impacts from projects to ensure equity in the planning and implementation process for the region.

Although Title VI is the focal point of non-discrimination law in the United States, FHWA incorporates a broader spectrum of statutes, executive orders, and regulations into its requirements for states and MPOs. Other pertinent non-discrimination authority identified by MassDOT and FHWA include the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 USC Ş 4601); Federal-Aid Highway Act of 1973 (42 USC 324 et seq.); Section 504 of the Rehabilitation Act of 1973 (29 USC 794 et seq.); Age Discrimination Act of 1975, as amended (42 USC 6101); Airport and Airway Improvement act of 1982 (49 USC 471); Civil Rights Restoration Act of 1987 (PL 100-209); Titles II and III of the Americans with Disabilities Act (42 USC 12131-12189); Federal Aviation Administration's Non-Discrimination Statute (49 USC 47123); Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations; Executive Order 13166, Improving Access to Services for people with Limited English Proficiency. In addition to mapping demographic data that identifies areas (census blocks) in the county with higher proportions of low income and minority populations, the staff conducts analyses on the geographic distribution region's transportation spending and project construction, to ensure equity in the distribution of transportation improvements. In examining the Title VI based project distribution analysis, the proximity, frequency, value and nature of projects are identified in relation to statistically significant population concentrations of the Title VI protected categories: i.e. race, color or national origin(including limited English proficiency) for transit related projects with the addition of age, sex and disability for highway related projects. The analysis also includes a review of potential project impacts – positive and negative – to ensure that that potentially underserved areas neither adversely impacted by, nor denied the benefits of, transportation projects. A key piece of the program is engaging such communities in the MPO's activities and decision making through expanded and targeted public outreach. The Public Participation Plan, as discussed below, establishes the MPO's public involvement goals and strategies.

Environmental Justice, Equity and Justice40

FHWA and FTA are collaborating with MassDOT, the MPO's and public transportation providers to advance racial equity and support for underserved and disadvantaged communities. Strategies within this plan will be developed that improve infrastructure for non-motorized travel, public transportation access, increased public transportation service in underserved communities, plan for the safety for all users, reduce single occupancy vehicle travel near high volume corridors, target demand-response service towards communities with higher concentrations of older adults and those with poor access to essential services, and equitable and sustainable practices while developing transit-oriented development.

PUBLIC PARTICIPATION PROCESS

The CCMPO is committed to following its Public Participation Plan approved in 2022 to ensure multiple stakeholders are provided a reasonable opportunity to comment. To ensure an inclusive and accessible public engagement processes for development of the Regional Transportation Plan (RTP), staff looked to the framework established in the Cape Cod MPO Public Participation Plan (PPP). Goals of the PPP are to:

1. Obtain Quality Input and Participation
2. The MPO staff worked to fulfill this goal by holding public meetings across the entire region including meetings on the Upper, Mid, Lower, and Outer Cape regions with specific note to areas of Environmental Justice communities. These meetings were intentionally scheduled at different times of the day and at many different locations and formats (virtual versus in-person) to enable greater participation. Input received from the public during the development of the plan was incorporated into the draft plan. Establish Consistent Commitment
   The MPO staff made a concerted effort to communicate with the communities as it developed and implemented its outreach for the RTP. Part of this effort was building community capacity to provide comments. This included but was not limited to seeking additional venues for public input such as conducting open houses seeking comments at the Hyannis Transportation Center (which enabled passing transit users based upon their familiarity with the transit system to provide detailed comments), creating and installing yard signs in English and Portuguese with a QR code to the online survey and placing on the region's rail trails and at Hyannis Transportation Center.
3. Increase Diversity
   The rollout of the outreach involved for this RTP further engaged the community. In an effort to increase participation, MPO staff sought input from a range of socioeconomic perspectives and traditionally underserved people. Staff participated in an English as a Second Language class and shared the online survey with many diverse organizations throughout the region.
4. Ensure Accessibility
   Every effort was made to ensure participation opportunities were accessible for all.
5. Provide Relevance
   The message developed for outreach on the RTP was "What is YOUR vision for Transportation on Cape Cod?" The intent was to frame the issue clearly and simply to involve the greatest number of participants.
6. Foster Participant Satisfaction
   Recognizing that people who take the time to participate feel it is worth the effort to join the discussion and offer feedback, the MPO staff made certain that there was a Portuguese translator at a virtual public outreach events in which the analysis showed potential for greater participation and allowed for a translated recording of the online meeting. Staff also was readily available to receive the input as it arose in the meetings/open houses and provide that feedback to the MPO.
7. Clearly Define Potential for Influence

The process identified that the comments made would be transmitted to the MPO members who, per the Public Participation plan, would directly consider such comments.

8. Establish and Maintain Partnerships
   The MPO staff, working to expand its outreach, developed a broader base in which to connect on the RTP. This included the following groups:
   - Bicycle and Pedestrian Committees and Advocate Groups
   - Community & human services programs and providers
   - Community centers
   - Councils on aging
   - Day care and child development programs
   - Environmental and climate organizations
   - English language media outlets (print and audio)
   - Financial institutions
   - Fire districts
   - Hospitals and health centers
   - Interested citizens (those who requested to be included in the list)
   - Lesbian, gay, bisexual, and transgender (LGBT) organizations
   - Libraries
   - Local and area chambers of commerce
   - Local and regional housing partnerships, authorities, and groups
   - Local and regional transportation providers (all modes)
   - Local community-based organizations
   - Local financial development corporation and economic development corporations
   - Local legislators
   - Local police and fire departments
   - MPO and CCJTC members
   - Portuguese language media (print and radio)
   - Public and private educational institutions and school departments
   - Religious institutions
   - Town clerks, managers, departments of public works directors, town planners, and other similar town personnel
   - Town councils
   - Transportation consulting firms
   - Veterans services

9. Provide Opportunities to Build Consensus
   The MPO discussions were structured to allow for conflicting views to be aired with the eye to satisfy the greatest number of community concerns and objectives.

The PPP is available in English and Portuguese at www.capecodcommission.org/ppp

Meetings and Open Houses

Numerous meetings have been held to discuss development of the RTP. Table 1 identifies meetings held solely for the plan, as well as meetings of various organizations at which the RTP was discussed. Meeting locations where selected to provide geographic and demographic diversity as well as ensure that persons with disabilities were able to actively participate. CCRTA DART paratransit services were available to bring interested parties to meetings. Notices were disseminated to English and Portuguese media outlets.

TABLE 1. Regional Transportation Plan Meetings

CAPE COD METROPOLITAN PLANNING ORGANIZATION MEETINGS		
Meetings beginning in September 2022 and continuing through July 2023 Generally held once per month on a Monday at 1:00 PM, virtually		
CAPE COD JOINT TRANSPORTATION COMMITTEE MEETINGS		
Meetings beginning in September 2022 and continuing through July 2023 Generally held once per month on a Friday at 8:30 AM, virtually		
CAPE COD RTP SUBCOMMITTEE MEETINGS		
Regional Transportation Plan Subcommittee Meeting - Virtual	Wednesday, November 16	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Friday, January 13	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Wednesday, March 8	1:00 PM
Regional Transportation Plan Subcommittee Meeting - Virtual	Friday, April 14	1:00 PM
LISTENING SESSIONS/OUTREACH TABLE EVENTS/PUBLIC MEETINGS		
Hyannis Open Streets – Outreach Table	Sunday, October 16	12:00 PM
WXTK (95.1) Radio Interview	Monday, February 6	
The Harvard Club of Cape Cod	Thursday, March 9	11:30 AM
Truro Town Hall – Public Meeting	Monday, March 20	5:00 PM
Regional Transportation Plan Virtual Public Meeting	Tuesday, March 21	6:00PM
Hyannis Transportation Center – Public Meeting	Tuesday, March 21	11:00 AM
WCAI Radio Interview	Thursday, March 30	
RTP Bicycle Committee Meeting - Sandwich	Thursday, April 13	6:30 PM
TIP/UPWP Outreach Table – CCRT Trailhead, Station Ave, Yarmouth	Tuesday, May 9	3:00 PM
TIP/UPWP Outreach Table – OCRT at Stepping Stones Rd, Chatham	Thursday, May 11	9:00 AM
IPR Cape Cod Church	Sunday, May 21	9:00 AM
OTHER MEETINGS/ACTIVITIES		
Barnstable County Public Works Association	Thursday, November 3	11:00 AM
Retired Mens Club of Cape Cod	Thursday, November 3	12:30 PM

Nauset Neighbors	Thursday, November 10	3:00 PM
Outer Cape Council on Aging's	Thursday, January 26	10:00 AM
ESL Class – Dennis Public Library	Friday, March 24	12:00 PM
ESL Class – Falmouth Public Library	Tuesday, March 28	7:00 PM
Association to Preserve Cape Cod	Monday, April 24	4:30 PM
Barnstable County Economic Development Council Executive Committee	Tuesday, April 25	9:30 AM
CCAIOR Leadership Meeting	Tuesday, May 23	10:00 AM
Cape Cod Electric Vehicle Expo and Test Drive Event	Saturday, June 3	10:00 AM

Collectively, the RTP meetings provided a wide array of opportunities for the public to learn about the document and share their comments. Comments received reflected both regional interests in the Cape Cod transportation system as well as more location specific concerns based on the location of the meeting.

Figure 1 shows a collection of photographs that were taken at various RTP outreach events.

FIGURE 1. Photographs of Outreach Activities

Other Outreach Strategies

In addition to the traditional outreach approaches, staff utilized a number of new strategies in an effort to increase public participation.

EXPANDED EMAIL OUTREACH DISTRIBUTION

In an effort to better connect with the various groups and agencies in the region that interact in different ways with the transportation system every day, an expanded email distribution list was created to share all notices and announcements on the development of the plan. This expanded outreach list including the following groups and agencies that were identified in the region:

- Bicycle and Pedestrian Committees and Advocate Groups
- Community & human services programs and providers
- Community centers
- Councils on aging
- Day care and child development programs
- Environmental and climate organzations
- English language media outlets (print and audio)
- Financial institutions
- Fire districts
- Hospitals and health centers
- Interested citizens (those who requested to be included in the list)
- Lesbian, gay, bisexual, and transgender (LGBT) organizations
- Libraries
- Local and area chambers of commerce
- Local and regional housing partnerships, authorities, and groups
- Local and regional transportation providers (all modes)
- Local community-based organizations
- Local financial development corporation and economic development corporations
- Local legislators
- Local police and fire departments
- MPO and CCJTC members
- Portuguese language media (print and radio)
- Public and private educational institutions and school departments
- Religious institutions
- Town clerks, managers, departments of public works directors, town planners, and other similar town personnel
- Town councils
- Transportation consulting firms
- Veterans services

PORTUGUESE-LANGUAGE COMMENT LINE

In an effort to ensure that anyone with questions or comments on the plan was heard, a Portuguese-language comment line was set up to field calls from Portuguese-speaking individuals. The recorded message, in Portuguese, thanked the caller for their interest in the plan and asked that they leave their name and number so that staff, with the assistance of a translator, could respond to them.

PLAN WEBSITE AND SURVEY

The website dedicated to the development of the 2024 RTP was created as a place where the public could find general information about the plan development, learn about upcoming meetings, access materials from past meetings, complete the online survey, download the draft RTP, and provide comments. A link to the website was included on all project materials and linked from the Cape Cod MPO website. The website included a statement in Portuguese with contact information should they need the information in another language. A Portuguese-language version of the website was also provided through real-time Google translation.

BUS SIGNS

In addition to hosting an open house at the Hyannis Transportation Center, a regional intermodal hub, further efforts were made to ensure that transit riders had an opportunity to participate in the development of the document. Signs were placed on all Cape Cod Regional Transit Authority buses and paratransit vehicles. The message on the sign was presented in both English and Portuguese.Outreach Cards and Other Materials

FIGURE 2. Portuguese RTP Yard Signs

YARD SIGNS

Yard signs with a QR code to the RTP webpage were distributed throughout the region, including on the region's bike paths and bus stops. The two-sided yard signs, as seen in Figure 2, included messaging in both English on one side and Portuguese on the other side. The yard signs assisted with an increase in response to not only the RTP webpage where viewers gained a general awareness of the development of the RTP, but also to the online survey and mapping tool.

OUTREACH FLYERS AND HANDOUTS

Business card-sized outreach cards were developed to hand out at all public events attended by staff during the development in the plan. A few versions were created through the process, including a version to guide people to the online survey, but included a link to the website where information was kept up to date. Similar information was contained on water bottles and a banner used in outreach activities.

VIRTUAL MEETINGS

The Public Participation Plan was amended to add a virtual meeting component to expand access to the public. The expansion of the Open Meeting Law and the ability to conduct virtual meetings allowed the CCMPO to reach an even broader audience, especially when a Portuguese translator was added.

MEASURES OF EFFECTIVENESS

CCMPO will be tracking its efforts to better understand the effectiveness of its public outreach efforts using a Measurements of Effectiveness (MOE) analysis every other year. Selection Process for Highway Regional Target Projects

Of the funding represented in the plan, a portion is available for "regional target projects." These are projects that the Cape Cod MPO has jurisdiction to select and prioritize. To ensure equity in the prioritization of these funds, Title VI and other equity considerations were incorporated in both the screening and analysis phases of the project selection process.

SCREENING OF HIGHWAY REGIONAL TARGET PROJECTS

In order to determine the projects to be contained within the financially constraint of the document, analysis was conducted on the universe of projects (includes all potential projects identified during the development of the document). Analysis of projects was limited to projects $10 million or greater as staff determined this is the scale of project appropriate for specific inclusion in this document. Analysis was conducted with a subcommittee of the Cape Cod Joint Transportation Committee (CCJTC, an advisory body to the Cape Cod MPO) where each project was considered for potential benefit, estimated cost, consistency with the objectives of the RTP, equity as it relates to minority, low income, Limited English Proficiency (LEP) and other protected populations, and GHG reduction potential. Considering these factors and the anticipated available funding, a financially-constrained program of projects was developed with the CCJTC subcommittee, reviewed by the CCJTC, and ultimately endorsed by the Cape Cod MPO.

Analysis of Highway Regional Target Projects

Following the screening process, a more detailed analysis of potential impacts (positive or negative) on low income, minority, and LEP populations was conducted as presented in Table 2.

Of the approximately $387 million programmed for specific projects, approximately 75% was on projects within and proximate to minority populations, 92% was on projects within and proximate to low income populations, and 80%, was on projects within and proximate to LEP populations. Given the regional nature of these projects, even projects that are not proximate to these identified population are likely to positively impact these identified populations as they travel through these locations to access regional services. This represents an investment in transportation infrastructure serving these areas proportionally higher than other areas on Cape Cod. In summary, the areas with higher proportions of low income and minority populations see more transportation dollars spent than other areas on Cape Cod.

Of the approximately $387 million in highway regional target funding, approximately $339 million is programmed for specific regional target projects while the remainder will go to "Programs and Smart Solutions." Analysis was limited to the specific projects, with existing TIP analysis procedures ensuring that the "Programs and Smart Solutions" will be programmed in an equitable way.[3]

[3] The most recent slate of highway projects programmed in the 2024-2028 Cape Cod TIP indicated that approximately 98% of funding is allocated on projects within and proximate to low income, minority, and LEP populations. This represents an investment in transportation infrastructure serving these areas that is proportionally higher than other areas on Cape Cod.

TABLE 2. Highway Regional Target Projects – Income, Minority, and LEP Population

PROJECT	LOW INCOME [I], MINORITY [M], OR LIMITED ENGLISH PROFICIENCY [LEP] POPULATION AREA PROXIMATE	NATURE OF IMPACT ON LOW INCOME, MINORITY, OR LEP AREA
Mashpee: Route 151	M	Improved bicycle/ pedestrian access, safety, traffic flow
Route 28 Multimodal Improvements: Various Locations	TBD	Improved bicycle/ pedestrian access, safety
Provincetown, Shank Painter Road and Route 6 Improvements	I	Improved bicycle/ pedestrian access, safety
Rail Trail Extensions (Mid- and Upper-Cape)	I, M, LEP	Improved bicycle/ pedestrian access, safety
Route 6 Safety Improvements (Outer Cape)	I	Improved bicycle/ pedestrian access, safety, traffic flow
Rail Trail Extensions (Upper and Outer Cape)	I	Improved bicycle/ pedestrian access, safety
Hyannis Area Improvements	I, M, LEP	Improved bicycle/ pedestrian access, safety, traffic flow
Route 6 Safety Improvements (Interchanges and Shoulders)	I, M, LEP	Improved safety, traffic flow
Route 28 Bass River Bridge Replacement[1]	I, M	Improved bicycle/ pedestrian access, safety
Cape Cod Canal Bridges Program[1]	I, M	Improved bicycle/ pedestrian access, safety, traffic flow

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

CAPE COD COMMISSION

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix M: Transportation Project Analysis

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Technical Appendix M: Transportation Project Analysis

UNIVERSE OF PROJECTS

The universe of projects identified for funding can be divided into one of four funding categories:

- Transportation Projects
- Transportation Programs
- Smart Solutions
- Transportation Studies

A "transportation project" is specific in the location and nature of construction or other activity that is anticipated. Examples of potential transportation projects include the Provincetown Shank Painter Road and Route 6 Improvement project and the construction of a new multi-use trail from the end of the existing Shining Sea Bikepath to the Cape Cod Canal Path. Any project over $20 Million in total cost must be included in the RTP to receive federal funding. Projects under $20 Million may be included in the RTP depending on the level to which the project has been developed.

Given that the RTP, covers a 20-25-year time-span it beyond our ability to define every specific transportation project that will implemented. Therefore, "transportation programs" identifying categories of specific transportation projects that are anticipated to be implemented and identifying funds to pay for these bundles of transportation projects. Examples of potential transportation programs include roadway resurfacing, intersections improvements, and transit operating assistance and capital needs.

"Smart solutions" are initiatives that do not require major investments in capital or operations. Examples of potential smart solutions include coordination of Cape Cod Regional Transit Authority and ferry schedules with each other and the development of a Cape-wide bicycle route system.

Finally, "transportation studies," seek to solve problems through planning efforts that focus on analysis of alternatives and public participation. These transportation studies ultimately identify solutions to problems that may be in the form of future transportation projects, programs, and/or smart solutions.

Each of the transportation projects, transportation programs, smart solutions, transportation studies listed with the universe of projects includes the town, title, description, and category. A score is presented for projects that have been scored the Transportation Improvement Program

(TIP) Transportation Evaluation Criteria. Remaining project are considered to be a "stage zero" with insufficient information on the nature of the potential project to score the project. These criteria, as summarized in the table below, were approved by the Cape Cod MPO following the adoption of the 2020 RTP. These criteria may be updated following the adoption of the 2024 RTP to ensure consistency between on RTP and the TIP.

TABLE 1. Transportation Improvement Program (TIP) Transportation Evaluation Criteria

CATEGORY	CRITERIA	POINTS (OUT OF 100)
System Preservation and Modernization	■ Primary asset condition / effect on condition ■ Sidewalks and other infrastructure enhancement ■ Use of modern technology/ITS regional efforts	35
Mobility	■ Motorist congestion ■ Non-motorist congestion ■ Effect on Connectivity / access	10
Safety	■ Motorist crash history and anticipated safety impact ■ Non-motorist crash history and anticipated safety impact	10
Economic Impact	■ Access to or within a regionally-designated economic development area ■ Access to or within a locally-designated business district ■ Connections between housing, job, cultural centers, and essential services ■ Ability of the region's freight network to handle current and future freight needs	10
Environmental and Health Effects	■ Wetlands, wildlife, or other resource protection ■ Water quality through stormwater management and treatment ■ Air quality / GHG emission ■ Coastal Resiliency/Sea Level Rise Vulnerability ■ Cultural resources or open space ■ Healthy Transportation Options	10
Cost Effectiveness	■ Project cost per user	15
Policy Support	■ Community support (demonstrated through highest elected officials) ■ Regional plans/policies ■ Local plans/policies ■ Supports Federal/State policies/goals	10

The Universe of Projects for the 2024 RTP are shown on the following pages.

Type	TOWN	Title	Description	Category
Project	Barnstable	Rt 6A W. Barnstable Sidewalk	Construct sidewalk along Route 6A in W. Barnstable	Bicycle/Pedestrian
Smart Solution	Barnstable	CCRTA Bike Rental	Provide bike rental service at Hyannis Transportation Center	Bicycle/Pedestrian
Project	Barnstable	Hyannis Access Improvements	Improve access to downtown Hyannis per Hyannis Access Study. Construct 2 additional travel lanes w/landscaped median on Yarmouth Road to connect from existing 4-lanes in Yarmouth to Route 28 in Hyannis. Includes multi-use path and sidewalk. Implement rotary retrofit to Airport Rotary	Highway
Project	Barnstable	Truck Staging at Route 6 Interchange	Construct truck transfer staging area near a Route 6 (e.g., Exit 6 or Exit 7) interchange for transfer of freight from large trucks to smaller trucks for destinations in the Hyannis Area. Consider rail freight transfer.	ITS/Management
Study	Barnstable	Route 149 Improvements	Improve grading and alignment of Route 149; includes bicycle and pedestiran accommodations	Multi-Modal
Study	Barnstable	Exit 6 Park-and-Ride Lot Expansion	Examine options at Exit 6 Park-and-Ride Lot such as parking structure or surface lot expansion to expand parking supply	Park & Ride
Project	Barnstable	Route 132 Corridor Improvements	Construct median, signal improvements, and multi-modal improvements to improve safety from Airport Rotary to Bearses Way	Safety
Project	Barnstable	Airport Rotary Traffic Improvements	Reconfigure Airport Rotary to improve traffic flow and safety. May include realignment of approaches and reduction of diameter to conform to modern roundabout design. Includes multi-modal improvements	Safety
Project	Barnstable	Barnstable Roundabout	Improve traffic flow and safety of the Route 6A/Route 132 intersection through channelization of traffic movements (roundabout)	Safety
Project	Barnstable	Route 28 at Santuit-Newtown Road Intersection Improvement	Route 28 at Santuit-Newtown Road intersection improvement to address this high crash location.	Safety
Project	Barnstable	Route 28 at Pitchers Way Intersection Improvement	Route 28 at Pitchers Way intersection improvement to improve safety at this high crash location and incorporate multi-modal accomodatoins to connect to the Bearses Way improvements.	Safety
Project	Barnstable	Bicycle Lockers	Install secure bicycle storage at Hyannis Transportation Center (i.e. bike lockers)	Bicycle/Pedestrian
Program	Barnstable	CCRTA TOD	CCRTA Transit Oriented Development improvements in Hyannis	Transit
Project	Barnstable	CCRTA Transit Station Improvements	Hyannis Transit Center Infrastuture and Building Improvements	Transit
Project	Barnstable Boston	Barnstable-Boston Ferry Service	Ferry service: Barnstable to Boston	Ferry
Smart Solution	Barnstable Boston	Passenger Rail - Hyannis	Expand passenger rail service to Hyannis	Rail
Project	Barnstable Bourne	Upper/Mid Cape Real Time Traffic Information System	Real Time Traffic Information System -- Design Build of year-round 24/7 Web based traffic information system based on cameras, sensors, with 511 to reduce road rage, congestion, and improve mobility and incident management through improved information	ITS/Management

Smart Solution	Boston	Logan Intercity Bus Information	Provide real-time bus location information, schedules, fares etc. for service from Logan to Cape Cod	ITS/Management
Project	Bourne	Scenic Highway/Rte 25 Connector Ramp	Develop a direct connection from Scenic Highway to Rte. 25 to divert traffic from the Belmont Circle.	Highway
Project	Bourne	Bourne Rotary Improvements	Reconfigure Bourne rotary to allow direct connection between Bourne Bridge to Route 28 (MacArthur Blvd). Interim improvements to improve flows and safety at rotary entrances and exits by widening and pavement markings/signage.	Highway
Project	Bourne	Rte 28 MacArthur Boulevard Improvements	Bourne - Construction of 2 new northbound lanes on Rte 28, reverse existing northbound, existing southbound becomes frontage road	Highway
Project	Bourne	Exit 1C Ramp Relocation	Relocated westbound Route 6 Exit 1C ramps away from Sagamore Bridge	Highway
Project	Bourne	Reconfigure Route 6/28 Bypass (Buzzards Bay)	Reduce road width to 1 travel lane in each direction; provide local access to cross-streets; construct multi-use path from Memorial Circle to Belmont Circle. Per 2007 "Buzzards Bay Village Comprehensive Transportation Plan."	Highway
Project	Bourne	Memorial Circle Reconfiguration (Routes 6/28, Main Street Buzzards Bay)	Convert Memorial Circle to 4-way Intersection; includes slip lane connection for eastbound Routes 6/28 to Main Street. Per 2007 "Buzzards Bay Village Comprehensive Transportation Plan."	Highway
Project	Bourne	Infrastructure Improvements for Buzzards Bay Commuter Rail Service	Infrastructure Improvements (Platform, Parking, etc.) for Buzzards Bay Commuter Rail Service	Rail
Study	Bourne	Rail Connection at "Y"	Examine construction of direct connection from Canal-side rail to Falmouth rail (eliminating need to lower Canal rail bridge)	Rail
Project	Bourne	Scenic Highway Median Barrier	Complete construction of median barrier along Route 6 Scenic Highway from Nightingale Rd to Edgehill Rd in Bourne	Safety
Study	Bourne	Sagamore Bridge Speed Management	Identify measures to encourage safe speeds on Route 3 and Route 6 approaches to the Sagamore Bridge	Safety
Smart Solution	Bourne Boston	Passenger Rail - Buzzards Bay	Expand passenger rail service to Buzzards Bay	Rail
Study	Bourne Falmouth	Falmouth-Wareham Bike Connection	Connect Falmouth bike paths to Bourne/Wareham town line at William Dalton Bridge including connection to Cod Canal bike paths	Bicycle/Pedestrian
Project	Bourne Sandwich Barnstable Yarmouth Dennis Brewster Orleans	Route 6A Improvements	Provide bicycle & pedestrian accommodations along Route 6A	Bicycle/Pedestrian
Project	Bourne Sandwich Barnstable Yarmouth Dennis Harwich Brewster Orleans	Interchange Improvements Rte 6	Mid-Cape Hwy - Implement improvements to Route 6 Interchanges and on and off ramps	Highway
Project	Bourne Sandwich Barnstable Yarmouth Dennis Harwich Brewster Orleans	Route 6 Hydroplaning	Route 6 stormwater improvements to remove runoff from traveled way, including construction of shoulders as needed	Safety
Project	Bourne, Sandwich	Cape Cod Canal Bridge Program	Replace existing Cape Cod Canal bridges and improve Canal Area roadways and approaches. Includes expansion of multimodal accomodations	Highway
Project	Bourne, Sandwich	Cape Cod Canal Park-and-Ride Lot(s) Improvements	Construct new and/or expand existing Park-and-Ride facilities on both sides of the Cape Cod Canal near highway bridges	Multi-Modal
Project	Brewster	Linnell Road Bike Path Connection	Construct a connection from the CCRT to Linnell Landing and the future development at the former CCSC bay property	Bicycle/Pedestrian
Project	Capewide	Bike Path Connectors to town centers	Bike Path Connectors to town centers per CCC studies	Bicycle/Pedestrian
Project	Capewide	Bikeshare	Deploy bikeshare bicycles to village centers and strategic locations	Bicycle/Pedestrian

Program	Capewide	Bicycle/Pedestrian Projects	Bicycle and/or pedestrian facilities and programs. Includes development of a regional bike network, bike lane construction, bicycling accessibility improvements and amenities, pedestrian accessibility improvements and sidewalk network expansion.	Bicycle/Pedestrian
Program	Capewide	Safe Routes to Schools	Installation of sidewalks and provide other improvements and programs to promote safe routes to schools	Bicycle/Pedestrian
Smart Solution	Capewide	Zoning/Planning Support for Sidewalks	Improve zoning regulations & planning efforts to invest in sidewalks	Bicycle/Pedestrian
Project	Capewide	Shared Use Path Crossing Improvements	Install uniform safe road crossings for shared use paths	Bicycle/Pedestrian
Program	Capewide	Bridge	Bridge Replacement/Reconstruction	Bridge
Program	Capewide	Climate Change Adaptation & Mitigation	Implement adaptive measures at strategic locations to respond to the effects of climate change. Includes technological upgrades to support the electification of the transportation system	Climate Change
Study	Capewide	EV Charging Stations	Deploy electric vehicle charging stations at strategic locations throughout Cape Cod	Enhancements
Study	Capewide	Renewable Fuels Pilot Stations	Develop pilot stations for renewable fuels such as biodiesel and ethanol. Proposal includes one station in the Mid-Cape area and one in the Outer Cape area	Enhancements
Study	Capewide	Renewable Fuels Partnership Strategic Implementation Plan	Identify potential renewable fuel options, technologies, markets, and infrastructure needs to make use of biofuels both viable and sustainable	Enhancements
Program	Capewide	Installation of DC Fast Charging Stations	Installation of DC Fast Charging Stations along Route 6 and other regionally strategic locations	Enhancements
Program	Capewide	Electrification of CCRTA transit fleet	Implentation of CCRTA transit fleet electrificatoin study acocording to CCRTA strategic plan	Enhancements
Program	Capewide	Culvert & Bridge Abutment Improvements	Remove tidal restrictions and restore river and stream connectivity	Environmental
Program	Capewide	Stormwater Treatment	Improve roadway stormwater volume and treatment including nutrient management in key watersheds	Environmental
Program	Capewide	Prioirity Low Lying Roads segments	Implementation of resilence projects for prioirity Low Lying Roads segments	Environmental
Program	Capewide	New Ferry Service	Passenger ferries connecting Cape Cod harbors	Ferry
Project	Capewide	HOV Lanes	Construct High-Occupancy Lanes at key segments of freeways such as Route 6, 3, 25, and 28.	Highway
Program	Capewide	Roadway Rehabilitation & Reconstruction	Roadway resurfacing, rehabilitation, and reconstruction	Highway
Program	Capewide	Intersection Improvements	Intersection Improvements, including roundabouts, to address safety and congestion relief. Includes left-turn lanes & phases at signalized intersections	Highway
Project	Capewide	Transportation Management Center	Design & construct Operations Center to monitor traffic operations, issue real-time reports to traveling public, control variable message signs and coordinated traffic signals	ITS/Management
Project	Capewide	Canal Area Intelligent Transportation System	Expand transportation monitoring system to improve congestion & safety while providing real-time information Capewide & beyond	ITS/Management
Project	Capewide	Outer Cape ITS Operations Control Center	Design and build an initial control center to accommodate ITS deployment for the Outer Cape	ITS/Management
Project	Capewide	Information Kiosks	Procure, install, and enable public transportation information kiosks	ITS/Management
Project	Capewide	Upgrade Radio System for CCRTA Service	Improve communications systems and provide capacity to accommodate ITS components /Narrowband Radio.	ITS/Management
Project	Capewide	Surveillance Cameras	Permit, and install surveillance cameras for the Outer Cape to observe traffic conditions and monitor Nat'l Seashore parking facilities.	ITS/Management

Program	Capewide	Cape-wide Intelligent Transportation Systems (ITS)	Design and implement real-time transportation monitoring and notification technologies at facilities throughout Cape Cod. Includes highway and transit users traveling to and within Barnstable County.	ITS/Management
Program	Capewide	Land Conservation	Strategic purchase of land to reduce sprawl and inefficient allocation of transportation resources. Also used to acquire land for improvement of intersections and protection of operations at new interchanges	ITS/Management
Program	Capewide	Access Management	Eligible for all state and local numbered routes. Curb cut consolidation, medians, other access improvements	ITS/Management
Program	Capewide	Travel Demand Management/Transportation Systems Management (TDM/TSM)	Travel Demand Management/Transportation Systems Management projects (TDM/TSM). Includes support of Transportation Management Associations (TMAs). Provide assistance to employers and institutions for the development and coordination of alternative transportation options for employees and patrons.	ITS/Management
Program	Capewide	Congestion Management	Consider peak period pricing at strategic locations to provide funding for transportation needs	ITS/Management
Smart Solution	Capewide	Right-of-Way Preservation	Maintain rights-of-way for future transportation uses and to avoid future traffic generation	ITS/Management
Smart Solution	Capewide	Vanpooling & Carpooling Incentives	Provide incentives to increase vanpooling and carpooling	ITS/Management
Smart Solution	Capewide	Employer TDM Plans	Create incentives for employers to prepare and implement Travel Demand Management (TDM) plans (>25 Employees)	ITS/Management
Smart Solution	Capewide	Redesignate 195 & 495	Redesignate Route 25 Extension as Route 195 or Route 495 or Route 195/495	ITS/Management
Smart Solution	Capewide	Remote Continuous Traffic Counting	Encourage installation of equipment at signalized intersections and other locations to conduct traffic counts throughout Cape Cod throughout the year using remotely-accessible detection equipment	ITS/Management
Smart Solution	Capewide	Carpooling "Stands/Stops"	Install signage and implement education & marketing program for the use of carpooling stands/stops" to promote higher occupancy vehicle use	ITS/Management
Smart Solution	Capewide	Wi-Fi Hotspots	Install wireless internet services at strategic locations throughout Cape Cod	ITS/Management
Study	Capewide	Sustainable Freight Options Study	Conduct a study of sustainable freight options to follow-up on the Freight Study completed February 2015	ITS/Management
Study	Capewide	Evaluation of Existing Transit Info Software/Procurement	Evaluate customer information software to be used for a web-based system to support CCRTA operations	ITS/Management
Study	Capewide	ITS Evaluation and Phase II Recommendation study	Evaluate ITS deployment and make recommendations.	ITS/Management
Program	Capewide	Mashpee Wampanoag Roadway & Transit Projects	Implement roadway & transit improvements to improve accessibility & mobility to and within tribal lands in Mashpee	Multi-Modal
Program	Capewide	Park-and-Ride Lot Management	Monitor parking usage of parking facilities at Barnstable, Sagamore, Harwich; identify & acquire new facilities, expansions as necessary	Multi-Modal
Smart Solution	Capewide	Vanpooling at Steamship Authority Lots	Permit use of Steamship Authority parking facilities for vanpooling	Multi-Modal
Study	Capewide	Mashpee Wampanoag Roadway & Transit Study	Identify roadway& transit improvements to improve accessibility & mobility to and within tribal lands in Mashpee	Multi-Modal
Project	Capewide	Bicycle Wayfinding	Install bicycle wayfinding signage for on-road bicycle facilities (i.e. State Bike Route 1) and wayfinding to rail trails and to connect to village centers.	Multi-Modal
Project	Capewide	Parking Improvement Implementation - Phase 1	Develop inland parking for the National Seashore	Park & Ride

Program	Capewide	Railway Infrastructure	Maintain & provide rail infrastructure	Rail
Study	Capewide	Freight Rail	Increase use of rail for movement of freight	Rail
Program	Capewide	Adaptive Signalization	Install and maintain signal priorititization hardware (e.g., Opticom) at traffic signals to improve public safety vehicle access, and transit priority	Safety
Program	Capewide	Street Lighting	Install street lighting in high crash and pedestrian and transit activity areas	Safety
Program	Capewide	Underground Utilities/Pole Relocation	Remove above ground utilities adjacent to roadways and install them underground or away from roadsides to improve safety where appropriate	Safety
Program	Capewide	Vegetation Management	Implement a comprehensive program to trim/remove vegetation from encroaching areas	Safety
Program	Capewide	Red Light Running Cameras	Support legislation to allow installation of red-light running cameras at high-crash signalized intersections	Safety
Program	Capewide	Traffic Calming	Promote the installation of traffic calming features at town accepted locations	Safety
Smart Solution	Capewide	Speed Management	Implement education, signage and enforcement to lower traffic speeds on roadways with speed-related safety problems	Safety
Smart Solution	Capewide	Bicycling & Motorist Traffic Law Enforcement	Enforce traffic laws on bicyclists and motorists	Safety
Project	Capewide	Emergency Routes & Shelters Signage	Install signage indicating emergency routes and shelter locations	Security
Study	Capewide	Disaster/Emergencies/Security Plan	Develop plans to address disasters, emergencies, and security issues	Security
Study	Capewide	Railways for Transporting Emergency Supplies	Develop contingency plan to use railways for transporting supplies during emergencies	Security
Project	Capewide	Transit Frequency Improvements	Increase frequency of transit service (including additional night & weekend service)	Transit
Project	Capewide	Intercity Commuter Rail	Intercity Commuter Rail service from Buzzards Bay to Boston (year round)	Transit
Project	Capewide	Beach Shuttle Expansion	Acquire additional buses to accommodate inland National Seashore parking needs - National Park Service.	Transit
Project	Capewide	Expansion of Next-Gen Mobile Data Terminals to Paratransit	Install new and upgrade existing dynamic transit service signage displays, global positioning systems (GPS), automatic vehicle location (AVL) systems, in-vehicle navigation systems, digital driver manifests and mobile data collection.	Transit
Program	Capewide	Transit Operating	Transit Operating Assistance	Transit
Program	Capewide	Additional CCRTA Service	Public transit shuttles connecting villages along Route 6A from Sandwich to Orleans, Provincetown-Orleans Shuttle, etc.	Transit
Program	Capewide	Local Transportation Centers	Construct intermodal transportation centers in Buzzards Bay, Orleans, Mashpee etc.	Transit
Program	Capewide	Bus Service Amenities	Provide bus schedule signage & related amenities	Transit
Program	Capewide	Transit Marketing, Promotion & Education	Implement education programs and marketing and promotion activities to support public transit	Transit
Program	Capewide	Construction of Enhanced Bus Shelters	Build intelligent, accessible, and energy efficient Cape Cod style bus shelters that provide real-time customer information and amenities.	Transit
Smart Solution	Capewide	CCRTA Coordination	Coordinate schedules and service between CCRTA and regional service providers	Transit
Smart Solution	Capewide	Transit Education & Marketing on Local TV	Implement education programs and marketing activities on community-access television to support public transit	Transit
Study	Capewide	Develop Origin/Destination Transit Mode Split Model	Create a transit model for Cape Cod	Transit

Program	Capewide	Cape Cod TMA	Establish a Cape Cod Transportation Management Association to encourage carpooling and transportation demand measures to reduce greenhouse gas emissions	Multi-Modal
Program	Capewide	CCRTA Zero Emissions Fleet	Implementation of Cape Cod Regional Transit Authority Zero Emissions Vehicle Fleet Charging Infrastructure	Transit
Program	Capewide	Speed Reduction in Village Centers	Develop Safe Speed standards with MassDOT for village center areas along Route 28 and Route 6A	Safety
Project	Chatham	Rt 28/Crowell Rd/Depot Rd/Queen Anne Rd Intersection Improvements	Intersection improvements at Rt 28/Crowell Rd/Depot Rd/Queen Anne Rd in Chatham	Highway
Project	Dennis	Route 6A/Route 134 Intersection Improvements	Upgrade intersection to include pedestrian accomodations and signal upgrades	Bicycle/Pedestrian
Project	Dennis	Route 28 Complete Street Upgrade	Upgrade Route 28 Corridor to include sidewalks and bicycle lanes from Old Main Street to Dennis Commons (Phase III)	Bicycle/Pedestrian
Project	Dennis	Lower County Road Bridge over Swan River	Replace 1955 bridge	Bridge
Project	Dennis	Highbank Road Bridge over Bass River	Replace 1953 bridge	Bridge
Project	Dennis	Rt 6A (Dennis) Sidewalks	Route 6A sidewalks Yarmouth TL to Sesuit Neck Road	Bicycle/Pedestrian
Project	Dennis	Rt 134 (Dennis) Bike/Ped Accommodation	Route 134 multi-modal and safety improvements from Bob Crowell Road to Theophilius Smith Rd	Bicycle/Pedestrian
Project	Dennis	Rt 6 Bridge over Bass River	Bridge replacement/rehabilitation of Route 6 bridge over Bass River	Bridge
Project	Dennis	Rt 134/Airline Rd Roundabout	Route 134 at Airline Road, Intersection Improvements (roundabout)	Highway

Project	Dennis	CCRTA New Maintenance Facility	Cape Cod Regional Transit Authority New Maintenance Facility	Transit
Project	Dennis/Yarmouth	Route 28 Bass River Bridge Replacement	Route 28 Bass River Bridge Replacement project to address this deficient structure and incorporate multi-modal accomodations.	Bridge
Study	Eastham	Route 6 Complete Street	Route 6 in Eastham: add bike accommodation, improve sidewalks, bus turnouts & stops to create "Complete Street"	Multi-Modal
Project	Eastham	Route 6/Gov. Prence Road Intersection Improvements	Install improvements at Route 6/Governor Prence Road intersection in Eastham	Safety
Project	Eastham	Governor Prence Road reconstruction and improvements	Reconstruction to improve sub-surface, pavement, and multimodal accommodation	Safety
Project	Eastham Orleans	Eastham Rotary Retrofit	Rotary retrofit safety improvements with signage and striping. Include bike/ped accommodation to connect Orleans to Rock Harbor Rd & Rt 6 in Eastham via periphery of rotary	Safety
Project	Falmouth	Route 151 Improvements - Falmouth	Provide bicycle & pedestrian accommodations along Route 151	Bicycle/Pedestrian
Project	Falmouth	Cross-Falmouth Bikepath	Bike path connection from E. Falmouth to Gifford St. to Shining Sea Bike Path	Bicycle/Pedestrian
Smart Solution	Falmouth	New Bedford-Martha's Vineyard Freight	To reduce traffic on Woods Hole Rd, operate barges between New Bedford and Martha's Vineyard to carry fuel trucks and garbage trucks.	Ferry
Project	Falmouth	Route 28A at Route 151 Intersection Improvement	Route 28A at Route 151 Intersection Improvement Project to address this high crash locatoin and incorporate multi-modal accomodations	Safety
Project	Falmouth	Route 151 Safety	Route 151 corridor improvement project to improve safety along this high speed corridor. Key intersection upgrades.	Safety
Project	Falmouth and Hyannis to New Bedford	2 New Ferry Services	Provide new ferry services: New Bedford-Woods hole, New Bedford-Hyannis	Ferry
Project	Falmouth Bourne Sandwich Barnstable Yarmouth	Cape Cod Bike Path Extensions (Mid- and Upper-Cape)	Extend path (Cape Cod Rail Trail) from Yarmouth to Canal bikepath and from Canal through Bourne to Shining Sea Bikeway (Bourne Rail Trail)	Bicycle/Pedestrian
Project	Falmouth, Mashpee, Barnstable, Yarmouth Dennis, Harwich, Chatham, Orleans	Rte 28 Multimodal Improvements	Multimodal improvements on Route 28 from Falmouth to Orleans including markings, signage, minor widening, multi modal and intersection improvements per the MassDOT Rte 28 Complete Streets Study.	Multi-Modal
Project	Falmouth, Mashpee, Barnstable, Yarmouth, Dennis, Harwich, Chatham	Southside Bike Route	Define network (on- and off-road) for bike route from Woods Hole to Chatham	Bicycle/Pedestrian
Project	Harwich	Bike Path Connector	Bike Path Connection from Old Colony Rail Trail to Rt 28 & Beaches (Harwich)	Bicycle/Pedestrian
Program	Harwich to Truro	Flex Parking	Construct or designate parking areas for The Flex transit service	Multi-Modal
Project	Mashpee	Route 151 Improvements - Mashpee	Provide bicycle & pedestrian accommodations along Route 151 and safety upgrades along corridor.	Bicycle/Pedestrian
Study	Mashpee	Mashpee Rotary Area Improvements	Modify Mashpee Rotary and approachs to improve traffic flow and safety. Includes accomodations for bicycle and pedestrian use.	Multi-Modal
Project	Mashpee Barnstable	Route 28 Improvements-Mashpee/Barnstable	Improvements on Rte 28 from Santuit/Newtown Road to Orchard Road in Mashpee	Highway
Smart Solution	New Bedford	Promote Ferry Service from New Bedford	Work with relevant agenices to promote the New Bedford ferry service to the Islands as an alternative mode to reduce traffic on congestion	Ferry

Project	Orleans	Main Street (Orleans) Improvements	Main Street Sidewalk extension and reconstruction of Meeting House Road intersection	Bicycle/Pedestrian
Project	Orleans, Eastham, Wellfleet, Truro, Provincetown	Route 6 Improvements Orleans to Provincetown	Implement safety improvements in the Route 6 corridor between Orleans and Provincetown	Highway
Project	Provincetown	Shank Painter Rd Corridor Improvements	Corridor improvements including new sidewalks, curb cut consolidation, landscaping, bicycle lanes, etc.	Bicycle/Pedestrian
Project	Provincetown	Provincetown Bicycle Path Ext - Phase I	Develop an extension from Race Point to McMillan Pier	Bicycle/Pedestrian
Project	Provincetown	Provincetown Bicycle Path Ext	Develop ped/bicycle facility using a portion of the Rte. 6 ROW	Bicycle/Pedestrian
Project	Provincetown	Provincetown Intermodal Gateway Project - Construction	Construct the Intermodel Center Gateway	Enhancements
Project	Provincetown	Commercial St (Provincetown) Reconstruction	Commercial Street Reconstruction	Highway
Project	Provincetown	Circulator Bus	High frequency trolley bus circulating among parking areas to serve downtown	Transit
Study	Provincetown Boston	Improved Ferry Service	Increase ferry frequency throughout the year	Ferry
Project	Sandwich	Route 130 Shared Use Path	Install shared use path or sidewalk on Route 130 from Quaker Meetinghouse Road to Service Road	Bicycle/Pedestrian
Project	Sandwich	Quaker Meetinghouse Road	Upgrade existing signalized intersections of Quaker Meetinghouse Road at Cotuit Road and Route 130	Highway
Project	Sandwich	Route 6A Intersection Improvements	Signalized intersection improvements along Route 6A to improve accessibility at Tupper Road, Jarves St and Quaker Meetinghouse Road	Highway
Project	Sandwich	Cotuit Road corridor	Corridor improvement project to improve multi-modal accomodations and improve vehicular safety	Highway
Project	Sandwich	Canal Connector Bike Path	Bike Path Connection from Cape Cod Canal to Service Road (Tunnel under Route 6 long term need)	Bicycle/Pedestrian
Project	Sandwich	Rt 6A over Scorton River Bridge	Replace bridge: Rt 6A over Scorton River in Sandwich	Bridge
Study	Sandwich Mashpee	Rt 130 Road Diet	Narrow travel lane width to reduce speeds and accommodate bicycles/ pedestrians	Safety
Program	Sandwich, Barnstable, Yarmouth, Dennis, Brewster, Orleans	Route 6A/Scenic Byways	Corridor Management Plan update and implement recommended improvements. Includes connection of sidewalks (on both sides in villages), "Sharrow" pavement markings for bike accommodation. For report, see www.gocapecod.org/6Away	Highway
Project	Sandwich, Bourne	Bus-Only Lanes for Rte 3 & Rte 6	Provide bus-only lanes between for both Rte. 3 and Rte. 6. This is expected to be achieved by widening and strengthening the shoulder section	ITS/Management
Project	Wellfleet	Chequessett Bridge	Chequessett Bridge Replacement	Bridge
Project	Wellfleet, Truro, Provincetown	Cape Cod Bike Path Extensions (Outer Cape)	Extend Cape Cod Rail Trail from Wellfleet to Provincetown	Bicycle/Pedestrian
Project	Yarmouth	South Shore Dr (Yarmouth) Sidewalks	Yarmouth, Sidewalk improvements: South Shore Drive sidewalk- from Sea View Ave. to South Middle Beach	Bicycle/Pedestrian

Project	Yarmouth	Winslow Gray Rd (Yarmouth) Sidewalks	Yarmouth, Sidewalk improvements: Winslow Gray Rd. sidewalk 0.75 miles long from Buck Island Rd. to Long Pond Dr.	Bicycle/Pedestrian
Project	Yarmouth	Route 6A/Union Street Intersection Improvements	Route 6A/Union Street intersection improvements in Yarmouth	Highway
Project	Yarmouth	Old Townhouse Rd/Forest Rd Intersection Improvements	Intersection improvements at Old Townhouse Rd/Forest Rd in Yarmouth	Highway
Project	Yarmouth	West Yarmouth Rt 28 Intersection Improvements	Construct intersection improvements at Route 28 & East Main Street in West Yarmouth	Safety

PROJECT ANALYSIS

Of the funding represented in the plan, a portion is available for "regional target projects." These are projects that the Cape Cod MPO has jurisdiction to select and prioritize. To ensure equity in the prioritization of these funds, Title VI and other equity considerations were incorporated in both the screening and analysis phases of the project selection process.

Screening of Highway Regional Target Projects

In order to determine the projects to be contained within the financially constraint of the document, analysis was conducted on the universe of projects (includes all potential projects identified during the development of the document). Analysis of projects was limited to projects $20 million or greater as staff determined this is the scale of project appropriate for specific inclusion in this document. Some projects under $20 million were included if it was determined that the potential benefits were commensurate with these larger scale projects. Analysis was conducted with a subcommittee of the Cape Cod Joint Transportation Committee where each project was considered for potential benefit, estimated cost, consistency with the goals of the RTP, impact on performance targets, project score (where available), equity as it relates to minority, low income, Limited English Proficiency (LEP) and other protected populations, and GHG reduction potential (presented in Appendix N). Considering these factors and the anticipated available funding, a financially-constrained program of projects was developed with the CCJTC subcommittee, reviewed by the CCJTC, and ultimately endorsed by the Cape Cod MPO. This evaluation including scoring based on level of support for the goals of the RTP. Scores up to five were given depending on the level of impact of the project and level of support of the RTP goa as follows:

- 5 - Strongly supports goal; highest level of positive impact
- 4 - Strongly supports goal; high level of positive impact
- 3 - Strongly supports goal; moderate positive impact
- 2 - Supports goal; moderate positive impact
- 1 - Supports goal; minor positive impact
- 0 - Not applicable
- Overall adverse impact (potential disqualification of project)

With these scores, a weighing was applied for each of the seven RPT goals with a total maximum score of 100 points.

- 20 points – Safety
- 15 points – Environmental and Sustainability
- 15 points – Livability and Economic Vitality
- 15 points – Multimodal Options/ Healthy Transportation
- 15 points – Congestion Reduction
- 10 points – System Preservation
- 10 points – Freight Mobility

TABLE 2. Highway Regional Target Projects – Scoring

PROJECT	SAFETY	ENVIRONMENT AND SUSTAINABILITY	LIVABILITY AND ECONOMIC VITALITY	MULTIMODAL/ HEALTHY TRANSPORTATION	CONGESTION REDUCTION	SYSTEM PRESERVATION	FREIGHT MOBILITY	TOTAL
Mashpee: Route 151	16	3	9	9	6	6	6	**55**
Route 28 Multimodal Improvements: Various Locations	20	6	15	15	6	8	8	**78**
Provincetown, Shank Painter Road and Route 6 Improvements	16	6	9	15	3	6	6	**61**
Rail Trail Extensions (Mid- and Upper-Cape)	12	6	6	15	6	6	6	**51**
Route 6 Safety Improvements (Outer Cape)	12	6	6	15	6	6	6	**51**
Rail Trail Extensions (Upper and Outer Cape)	12	6	6	15	6	6	6	**51**
Hyannis Area Improvements	16	6	12	12	9	8	8	**71**
Route 6 Safety Improvements (Interchanges and Shoulders)	20	0	3	0	3	8	4	**38**
Route 28 Bass River Bridge Replacement[1]								-
Cape Cod Canal Bridges Program[1]								-
Maximum Possible	20	15	15	15	15	10	10	**100**

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

Analysis of Highway Regional Target Projects

Following the screening process, a more detailed analysis of potential impacts (positive or negative) on low income, minority, and LEP populations was conducted as presented in the following.

Of the approximately $387 million programmed for specific projects, approximately 75% was on projects within and proximate to minority populations, 92% was on projects within and proximate to low-income populations, and 80%, was on projects within and proximate to LEP populations. Given the regional nature of these projects, even projects that are not proximate to these identified population are likely to positively impact these identified populations as they travel through these locations to access regional services. This represents an investment in transportation infrastructure

serving these areas proportionally higher than other areas on Cape Cod. In summary, the areas with higher proportions of low income and minority populations see more transportation dollars spent than other areas on Cape Cod.

Of the approximately $387 million in highway regional target funding, approximately $339 million is programmed for specific regional target projects while the remainder will go to "Programs and Smart Solutions." Analysis was limited to the specific projects, with existing TIP analysis procedures ensuring that the "Programs and Smart Solutions" will be programmed in an equitable way.

TABLE 3. Highway Regional Target Projects – Income, Minority, and LEP Population Impacts

PROJECT	LOW INCOME [I], MINORITY [M], OR LIMITED ENGLISH PROFICIENCY [LEP] POPULATION AREA PROXIMATE	NATURE OF IMPACT ON LOW INCOME, MINORITY, OR LEP AREA
Mashpee: Route 151	M	Improved bicycle/ pedestrian access, safety, traffic flow
Route 28 Multimodal Improvements: Various Locations	TBD	Improved bicycle/ pedestrian access, safety
Provincetown, Shank Painter Road and Route 6 Improvements	I	Improved bicycle/ pedestrian access, safety
Rail Trail Extensions (Mid- and Upper-Cape)	I, M, LEP	Improved bicycle/ pedestrian access, safety
Route 6 Safety Improvements (Outer Cape)	I	Improved bicycle/ pedestrian access, safety, traffic flow
Rail Trail Extensions (Upper and Outer Cape)	I	Improved bicycle/ pedestrian access, safety
Hyannis Area Improvements	I, M, LEP	Improved bicycle/ pedestrian access, safety, traffic flow
Route 6 Safety Improvements (Interchanges and Shoulders)	I, M, LEP	Improved safety, traffic flow
Route 28 Bass River Bridge Replacement[1]	I, M	Improved bicycle/ pedestrian access, safety
Cape Cod Canal Bridges Program[1]	I, M	Improved bicycle/ pedestrian access, safety, traffic flow

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

For reference, demographics maps are included in Appendix L. GHG project analysis is presented in Appendix N.

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2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix N: Greenhouse Gas Analysis/Air Quality Conformity Determination

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GREENHOUSE GAS (GHG) ANALYSIS BAKGROUND

State policy context

The Global Warming Solutions Act (GWSA), which was signed into law in August 2008, makes Massachusetts a leader in setting aggressive and enforceable GHG reduction targets, and implementing policies and initiatives to achieve these targets. In keeping with the law, on December 29, 2010 the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, released the Massachusetts Clean Energy and Climate Plan for 2020. In December 2014, DEP issued new regulations that require MPOs to quantify impacts from project investments, track, progress towards reductions, and consider impacts in the prioritization of project investments. The targets for overall statewide GHG emissions are:

- By 2020: 25 percent reduction below statewide 1990 GHG emission levels
- By 2050: 80 percent reduction below statewide 1990 GHG emission levels

The role of MPOs

The Commonwealth's MPOs are integrally involved in supporting the GHG reductions mandated under the GWSA. The MPOs are most directly involved in helping to achieve the GHG emissions reductions through the promotion of healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments – and assisting smart growth development patterns through the creation of a balanced multi-modal transportation system. This is realized through the transportation goals and policies espoused in the 2024 Regional Transportation Plans (RTPs); the major projects planned in those RTPs; and the mix of new transportation projects that are programmed and implemented through the TIPs. GHG tracking and evaluation processes enable the MPOs to identify anticipated GHG impacts of planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects.

Project-level GHG tracking and evaluation in TIPs

It is also important to monitor and evaluate the GHG impacts of the transportation projects that are programmed in the MPOs' TIPs. The TIPs include both the larger, regionally-significant projects from the RTPs, which are reported in the Statewide GHG report, as well as smaller projects that are

not included in the RTP but that may nevertheless have impacts on GHG emissions. The primary objective of this tracking is to enable the MPOs to evaluate expected GHG impacts of different projects and to use this information as a criterion for prioritizing and programming projects.

Calculation of GHG Impacts for TIP Projects

MassDOT has adopted spreadsheets used by MPOs to determine CMAQ eligibility and that also include CO2 impacts. The data and analysis required for these calculations is available from functional design reports that are submitted for projects that would produce a measurable GHG impact.

Projects with quantified impacts

RTP PROJECTS

Major capacity expansion projects are expected to have a significant impact on GHG emissions. These projects are included in each MPO's RTPs and analyzed using either the statewide model or the Boston MPO's regional model, which reflect GHG impacts. As a result, no independent TIP calculations are required.

QUANTIFIED DECREASE IN EMISSIONS

For those projects that are expected to produce a measurable decrease in emissions, the approach for calculating these impacts is described below. These projects are categorized in the following manner:

- Quantified Decrease in Emissions from Traffic Operational Improvement - An intersection reconstruction or signalization project that is projected to reduce delay and congestion.
- Quantified Decrease in Emissions from Pedestrian and Bicycle Infrastructure - A shared-use path that enables increased walking and biking and decreases vehicle-miles traveled (VMT).
- Quantified Decrease in Emissions from New/Additional Transit Service - A bus or shuttle service that enables increased transit ridership and decreased VMT
- Quantified Decrease in Emissions from a Park and Ride Lot - A park-and-ride lot that enables increased transit ridership/ increased ridesharing and decreased VMT
- Quantified Decrease in Emissions from Bus Replacement - a bus replacement that directly reduces GHG emissions generated by service.
- Quantified Decrease in Emissions from Complete Streets Improvements - Improvements to roadway networks that include the addition of bicycle and pedestrian accommodations where none were present before.
- Quantified Decrease in Emissions from Alternative Fuel Vehicle Procurements – A vehicle procurement where alternative fuel/advanced technology vehicles replace traditional gas or diesel vehicles.

- Quantified Decrease in Emissions from Anti-idling Strategies – Implementation of policies such as limiting idling allowed, incorporating anti-idling technology into fleets and using LED lights on trucks for the purpose of illuminating worksites.
- Quantified Decrease in Emissions from Bike Share Projects – A new bike share project or capacity added to an existing project.
- Quantified Decrease in Emissions from Induced Travel Projects – A project that changes roadway capacity
- Quantified Decrease in Emissions from Speed Reduction Programs – Programs that reduce speed to no less than 55 miles per hour.
- Quantified Decrease in Emissions from Transit Signal Priority Projects – A project that applies this technology to a signal intersection or along a corridor that impacts bus service.
- Quantified Decrease in Emissions from Truck Stop Electrification Projects – A new truck stop electrification project or capacity added to an existing project.
- Quantified Decrease in Emissions from Other Improvement

QUANTIFIED INCREASE IN EMISSIONS

Projects expected to produce a measurable increase in emissions.

Projects with no assumed impacts

NO ASSUMED IMPACT/NEGLIGIBLE IMPACT ON EMISSIONS

Projects that do not change the capacity or use of a facility (e.g. roadway median barrier or retaining wall replacement, or a bridge rehabilitation/replacement that restores the bridge to its previous condition) are assumed to have no/negligible GHG impact.

QUALITATIVE DECREASE IN EMISSIONS

Projects expected to produce a minor decrease in emissions that cannot be calculated with any precision. Examples of such projects include roadway repaving, signage improvement, ITS improvement, or transit marketing/customer experience improvement.

QUALITATIVE INCREASE IN EMISSIONS

Projects expected to produce a minor increase in emissions that cannot be calculated with any precision.

GREENHOUSE GAS (GHG) RTP PROJECT ANALYSIS

An analysis of regional target projects was also analyzed in relation to greenhouse gas (GHG) emissions. As presented in Table A-1, it is anticipated that most of the projects will result in nominal decreases in emissions for sidewalk and/or bicycle infrastructure or other improvements.

TABLE A-1. Highway Regional Target Projects – Anticipated GHG Impacts

PROJECT	ANTICIPATED GHG IMPACT
Mashpee: Route 151	Quantified Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Route 28 Multimodal Improvements: Various Locations	Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Provincetown, Shank Painter Road and Route 6 Improvements	Quantified Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Rail Trail Extensions (Mid- and Upper-Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Route 6 Safety Improvements (Outer Cape)	Assumed Nominal Decrease in Emissions from Sidewalk, and Bicycle Infrastructure
Rail Trail Extensions (Upper and Outer Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Hyannis Area Improvements	Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure
Route 6 Safety Improvements (Interchanges and Shoulders)	Assumed Nominal Decrease in Emissions from Roadway Infrastructure
Rail Trail Extensions (Mid-Cape)	Assumed Nominal Decrease in Emissions from Bicycle Infrastructure
Route 28 Bass River Bridge Replacement[1]	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure
Cape Cod Canal Bridges Program[1]	Project included MassDOT modeling used to develop the "Evaluation and Reporting of Statewide Greenhouse Gas Reductions in Transportation" presented in Appendix N

[1] Projects funded or intended to be funded through a combination of state and federal sources outside of the regional target.

EVALUATION AND REPORTING OF STATEWIDE GREENHOUSE GAS REDUCTIONS IN TRANSPORTATION MASSACHUSETTS DEPARTMENT OF TRANSPORTATION (MASSDOT) AND THE METROPOLITAN PLANNING ORGANIZATIONS (MPOS)

This section documents recent progress made by MassDOT and the MPOs in working to help achieve greenhouse gas (GHG) reduction goals as outlined in state regulations applicable to Massachusetts. This "progress report" estimates future carbon dioxide (CO_2) emissions from the transportation sector as part of meeting the GHG reduction goals established through the Commonwealth's Global Warming Solutions Act (GWSA).

GWSA Transportation Status: Future Carbon Dioxide Emissions Reductions

The Global Warming Solutions Act of 2008 requires statewide reductions in greenhouse gas (CO2) emissions of 25 percent below 1990 levels by the year 2020, and 80 percent below 1990 levels by 2050.

The Commonwealth's thirteen metropolitan planning organizations (MPOs) are involved in helping to achieve greenhouse gas reductions mandated under the GWSA. The MPOs work closely with the Massachusetts Department of Transportation (MassDOT) and other involved agencies to develop common transportation goals, policies, and projects that would help to reduce GHG emission levels statewide, and meet the specific requirements of the GWSA regulation – *Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation (310 CMR 60.05).* The purpose of this regulation is to assist the Commonwealth in achieving their adopted GHG emission reduction goals by:

- Requiring each MPO to evaluate and report the aggregate GHG emissions and impacts of both its Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP).
- Requiring each MPO, in consultation with MassDOT, to develop and utilize procedures to prioritize and select projects in its RTP and TIP based on factors that include GHG emissions and impacts.

Meeting the requirements of this regulation is being achieved through the transportation goals and policies contained in the Federal Fiscal Year (FFY) 2024 RTPs, the major projects planned in the RTPs, and the mix of new transportation projects that are programmed and implemented through the TIPs.

The GHG evaluation and reporting processes enable the MPOs and MassDOT to identify the anticipated GHG impacts of the planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects. This approach is consistent with the greenhouse gas reduction policies of promoting healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments; as well as supporting smart growth development patterns through the creation of a balanced multi-modal transportation system. All of the MPOs and MassDOT are working toward reducing greenhouse gases with "sustainable" transportation plans, actions, and strategies that include (but are not limited to):

- Reducing emissions from construction and operations
- Using more fuel-efficient fleets
- Implementing and expanding travel demand management programs
- Encouraging eco-driving

- Providing mitigation for development projects
- Improving pedestrian, bicycle, and public transit infrastructure and operations (healthy transportation)
- Investing in higher density, mixed use, and transit-oriented developments (smart growth)

Regional GHG Evaluation and Reporting in RTPs

MassDOT coordinated with MPOs and regional planning agency (RPA) staffs on the implementation of GHG evaluation and reporting in development of each MPO's 2016 and 2020 RTPs. This collaboration has continued in developing the MPOs' FFY 2024 RTPs and FFYs 2024-28 TIPs. Working together, MassDOT and the MPOs have attained the following milestones:

- Modeling and long-range statewide projections for GHG emissions resulting from the transportation sector, as a supplement to the FFY 2024 RTPs. Using the newly updated statewide travel demand model, GHG emissions have been estimated for 2019 (base) conditions, and for 2050 base ("no-build" including existing and committed projects) and build (action) conditions (see the chart in this section for the results of this modeling).

- All of the MPOs have addressed GHG emission reduction projections in their RTPs (including the statewide estimates in the chart that follows), along with a discussion of climate change and a statement of MPO support for reducing GHG emissions from transportation as a regional goal.

MassDOT's statewide estimates of CO_2 emissions resulting from the collective list of all recommended projects in all Massachusetts RTPs combined are presented in the table below. Emissions estimates incorporate the latest planning assumptions including updated socio-economic projections consistent with the FFY 2024 RTPs:

TABLE A-2. Massachusetts Statewide Aggregate CO2 Estimated Emissions Impacts from Transportation (all emissions in tons per summer day)

YEAR	CO_2 ACTION EMISSIONS	CO_2 BASE EMISSIONS	DIFFERENCE (ACTION – BASE)
2019	75,113.6	75,113.6	n/a
2050	53,772.5	53,781.4	-8.9

This analysis includes only those larger, regionally significant projects that are included in the statewide travel demand model. Many other types of projects that cannot be accounted for in the model (such as bicycle and pedestrian facilities, shuttle services, intersection improvements, etc.), are covered in each MPO region's RTP with either "qualitative" assessments of likely CO2 change, or actual quantitative estimates listed for each project.

As shown above, collectively, all the projects in the RTPs in the 2050 Action scenario provide a statewide reduction of over 9 tons of CO2 per day compared to the base (existing and committed projects) case.

These results demonstrate that the transportation sector is expected to continue making positive progress in contributing to the achievement of GHG reduction targets consistent with the requirements of the GWSA. MassDOT and the MPOs will continue to advocate for steps needed to accomplish the Commonwealth's long-term goals for greenhouse gas reductions.

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Technical Appendix O: Survey Results

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Technical Appendix O: Survey Results

The RTP was developed through input from a wide range of federal, state, and local agencies and organizations, and the public. In addition to over two dozen meetings including six regional public meetings, eight outreach tables and two English as a Second Language (ESL) events, feedback was also solicited through an online survey and comment cards from a local Portuguese church service. The extensive public feedback throughout the development provided valuable input into the process including the identification of locations with transportation issues or challenges. Comments received reflected both regional interests in the Cape Cod transportation system as well as more location specific concerns based on the location of the meeting.

ONLINE SURVEY

To facilitate public input in the development of the RTP, an online survey was developed and advertised through several outreach techniques as discussed earlier in this chapter. The RTP survey was advertised at RTP outreach meetings and events as well as other local and regional meetings and open houses. The survey was also distributed through the extended email distribution list, social media platforms, and picked up by several local media outlets.

The survey was open from March 20, 2023 to May 5, 2023 and a total of 394 responses were received.[1]

QUESTION 1 – RTP VISION STATEMENT AND GOALS

The online survey began with a draft vision statement and draft goals. As follow:

Draft Vision Statement:

"The Cape Cod Metropolitan Planning Organization, informed by public input, envisions a multi-modal transportation system that supports the environmental and economic vitality of the region through infrastructure investment that focuses on safety, livability, sustainability, resiliency, equity, and preservation of the character that makes our special place special."

[1] Given the relatively small sample size and the potential for self-section bias, the survey results should not be assumed to be necessarily representative of the overall population of Cape Cod

To support this vision, the RTP includes the following goals:

- **Safety**: Provide safe travel options for all users
- **Environmental and Economic Vitality**: Maintain, protect, and enhance the natural environment while strengthening the economy.
- **Livability and Sustainability**: Support livable communities and village centers that strengthen the long-term sustainability of the region.
- **Multimodal Options/Healthy Transportation**: Provides a variety of healthy transportation options to all users.
- **Congestion Reduction:** Reduce congestion and improve travel time reliability.
- **System Preservation**: Preserve, maintain, and modernize the existing transportation system.
- **Freight Mobility**: Improve efficiency and reliability of freight movement.

In question 1, respondents were asked to provide any suggested additions or revisions. Responses included:

- Where's the feeds of cape traffic?
- Tolls for visitors on the islands would help with the cost of road maintenance. Visitors, not residents, cause much of the road deterioration. Ideally, a bridge or passage for visitors during peak season would be ideal to allow residents of the islands to traverse on and off the cape … just an idea … !! Frustrating to leave the cape during summer months.
- *Specific suggestion* Revitalization of the Falmouth Secondary and preservation of active rail service on this line.
- Not removing any freight mobility and congesting our already congested highways in the summertime. Removing the Falmouth secondary and the rails to Cape Cod will also remove the forms of transportation that Cape Cod has to bypass the congested highways, Trash, military equipment, and passenger service. Trains offer a service of carrying one huge load of freight by several cars, trains would also produce less emissions than the total amount of trucks combined to take trash off cape.
- Less traffic
- Bathrooms on Rt. 6 or at least somewhere where visitors can take advantage of the need to relieve themselves.
- Easy, rapid and environmentally friendly commute
- The preservation and revitalization of Cape Cod's railroad such as the Falmouth Secondary and the addition of commuter rail service to the Cape.
- None of the goals address equity even though the word is in the vision statement. Equity is about not only the individual people served but the regions of the Cape that are served or underserved.

- "Reducing car dependency" needs to be a specific goal. "Prioritizing walking, bicycling, and transit over driving" must be a gating priority for all projects.
- Accessibility For All - Including Though Not Limited to Those With Disabilities
- Equity is in the overall statement but not reflected in list of goals. Maybe add to livability and vitality goal.?
- "Multi-modal options that specifically meet the work schedules of workers year-round (but especially from May 15 through Sept 15 to accommodate J-1 cultural exchange workers). Issues: 1. Seasonal schedule should begin May 15th to accommodate J-1 workers. 2. Routes to major J-1 employers must run 7 days a week and run both early buses and late ones to accommodate students' work schedules."
- Make sure objectives are SMART objectives.
- Not sure what "system preservation" means. Not sure what "livability and economic vitality" entails. Something that more clearly conveys the ideas would be more effective. For each goal, it would be more compelling if you stated what the goal around each item is, as the list is rather vague. For example: Make Route 6 safer for motorists; Reduce congestion on Route 6 west of the Orleans roundabout.
- Bus shelters in Truro Center and please consider earliest morning bus stop in Truro Center which is supplied to other stops but skipped over in Truro at the Cobb stop and not available until 9am rather than near 7 am. Thanks.
- Preservation of character is code words for "build/change absolutely nothing at any time for any reason". I don't like the character of Cape Cod - suburban sprawl that leaves houses disconnected from commercial and civic centers with little options for anything other than driving.
- I'm not too sure what multi-modal means exactly but I would love to see more bike paths and sidewalks for easier biking and walking commuting. We also need a LOT more EV charging stations. Many of the older ones are breaking down and not getting fixed and there are a lot more electric cars on the roads now without an increase in charging stations. The free charging stations are few and far between and always busy when I try to use them and there are hardly any pay chargers.
- Handicap accessibility, Elderly accessibility,
- Justice and equity! Improvements and public works around here largely seem to cater to the extremely wealthy second home-owners and tourists, and it does quite well at that. Yet the Cape is actually a very difficult and limiting place to live for us year-rounders in terms of local infrastructure. Putting more weight on justly and equitably planning improvements could really benefit the people whose actual livelihoods depend on the local infrastructure, rather than just those who are here for relatively short leisure time.
- Revaluate Exit Safety along the single lane Route 6 (13 Miles) stretch between Orleans and Harwich.
- More bike paths and sidewalks around the Cape!

- Local community building/connectivity and reliability
- "Add to congestion reduction - pollution reduction (fewer cars on road) Also in safety - creating community bicycle norm that makes it safer for all riders when every driver is aware of bicycles, dangers to bicycles (sudden stops, opening doors, mirrors swipes, distance/speed/actions for safe passing, etc.)"
- Inclusion of diversity (race, class, etc.)
- nothing to add, these are very thoughtful and comprehensive goals!
- "Split the long sentence into two: "The Cape Cod Metropolitan Planning Organization, informed by public input, envisions a multi-modal transportation system that supports the environmental and economic vitality of the region. Infrastructure investments will focus on safety, livability, sustainability, resiliency, equity, and preservation of the character that makes our special place special." Also, some of the goals are a bit vague. For example, freight mobility. What does this mean? What do you want to accomplish in this area? "
- Frequency and accuracy (i.e. real time bus updates)
- Zero deaths
- "Do NOT allow a high-Density development at 35 Scudder Ave. We need to protect our open space recreational space for our community and endangered migratory wildlife."
- Preservation of what rail lines are left including this latest attempt to abandon the Falmouth Branch. The non-military portion of Otis should be multi-modal with freight transloading and passenger/bus connection to Woods Hole from/to passenger service.
- Scheduling that makes bus travel a realistic option for workforce commuting year-round, but particularly from May to October.
- "That focuses on..." it needs to be convenient for large numbers of people to wean us off private transportation.
- More emphasis could be put on supporting diverse housing options, through transportation interventions that make already-developed areas more attractive for new housing development. Similarly, transportation improvements can support new small business opportunities by increasing access to statewide or New England-wide markets for businesses on the Cape.
- "I suggest an additional goal related to improved connectivity between modes. An example would be a new and expanded park and ride lots for people traveling to and from the Cape by bus. It also seems to me that multi-modal options and healthy transportation should be separate goals. To me, multi-modal encompasses various forms of transit, whereas healthy transportation focuses on biking and walking. I'm not keen on the congestion reduction goal and wonder if travel time reliability might be a good substitute. The plan should not be driven by peak hour V/C ratios. "
- Needs to be more succinct.
- Convenience

- "Sustainability is a worthless term if not defined. Identify ""Emission reduction"" as a goal, encompassing air quality improvement and climate mitigation."
- Accommodating Youth
- Although the topic may fall under "Environmental and Sustainability," suggest including the theme of "Improving air quality." Excessive idling is rampant on the Cape and there No Idling regulatory signage and education is lacking. This would apply to public spaces such as beach parking lots to schools to limiting the quantity of vehicle drive-thru's.
- Instead of "System Preservation" maybe System Improvements?
- Will provide alternatives to cars for short trips AND for long trips on Cape Cod.
- Affordability.
- Efficiency, ease of use, predictability
- Accommodating the seasonal influx in the region as well as the year-round population.
- N/A
- "The vision statement to me is a list of broad vague terms which more or less renders the vision statement as empty and relatively useless. For me a vision statement about Cape Cod must include integration with a regional system of transportation where the region is defined as a line from Providence to Boston and everything south including Cape Cod, Nantucket and Martha's Vineyard. Freight in particular must be diverted NORTH of the Cape cod Canal bridges. An aerial view of this region clearly shows that New Bedford is the center of intermodal transportation with a deep-water harbor, Federal Highway, Airport, train, bus depot, etc. population growth has overgrown the steamship Authority and its present form. Created in 1960 The SSA has had its season and should now be dismantled replaced by a New Bedford centered transportation hub with freight deliveries direct to the islands. There is no longer any reasonable rational for driving Island bound freight and passenger vehicles over the Cape Cod Canal bridges! Furthermore, maritime licensing authority must stand alone, separate from a service provider such as the SSA, and private carriers engaged to provide creative multi- modal solutions in the service of reducing environmental and financial cost. Cape Cod, Nantucket Island and Martha's Vineyard Island are no longer independent isolated entities. They are part of a larger community system the northern border of which, as mentioned above, is a line from Providence to Boston and all municipalities south including Cape Cod and both islands. Bill Hallstein, SMART Citizens Task Force"
- "Accessibility (both on and over bridges) and to all areas on Cape Parking and bus options"
- "First thank you for this survey, it's great to see a public agency asking for the tax-payers opinion. I believe that a sky liner like they have in Disney would be great. It's like a gondolier. This would be a relaxing way for people to travel and help with gas guzzling SUV traffic. Each town could have a stop where people could call for an uber, lift or taxi from a local resident to help friendly Cape Coders earn extra money and share their knowledge of things to do and places to see and recommend local restaurants! It is also a clean form of energy to help

with climate change. This could be started in Bourne on the main land side to help elevate traffic on the bridges, which we all see deteriorate more and more every year. "

- dementia friendly, more accessibility in rural areas/isolated places
- The second point, Environmental and Sustainability… Environmental what… Environmental protection?
- My suggestion after living here for 12 years is that in the summer there are families on Woods Hole Road and it's NOT safe! Why not add a bike line on the Woods Hole Road all the way to Woods Hole.
- "Include environmental values in the mission statement—meaning electric vehicles, bike racks, etc. Consider affordability somewhere in goals. Like allowing hop-on-hop-off passes"
- "Community impact Cost"
- I don't understand why people are looking to envision something in the year 2050 when no one is taking care of the problems that are here now. Decades ago, I and other Cape Codders stated that things needed to be done in order to maintain our beautiful Cape Cod the way it was. Unfortunately, no one listened, so now we no longer have an off-season. Instead, we have unprecedented trash and all kinds of pollution (including noise pollution), destruction of Cape Cod itself and all of its inhabitants, the disgusting smell and look of Boston (toxic fumes, way too many oversized useless buildings etc.), among so much more destruction. People are moving here in record numbers, while others price gouge like I have never seen before. Mashpee claims to have a septic issue yet look at all the buildings that are being allowed to be constructed that contain at least one to two bathrooms, toilets included. Also, according to the police department in Mashpee, killing is allowed on conservation land. How can you call it conservation land if you allow people to kill with guns and other weapons on that land? And why don't the residents of Mashpee have the right not to have to listen to gunshots? When we hear gunshots and we call the Mashpee Police Department, they claim that it's coming from hunters. How can they possibly know this if they're not out there? If violent people, murderers, and serial killers find this out, Mashpee will be their new playground! What is a person supposed to believe, what the politicians in Mashpee say, or the evidence that we see all around us? I could say the same about the entire Cape, not just Mashpee. We supposedly have an association to preserve Cape Cod, yet if you look at the Cape 20+ years ago and compare it to today, all you will see is destruction. Don't worry about the year 2050, take care of your problems now. Remember, this is what you are leaving our children, grandchildren, and future generations. If we can't have clean air, clean water, and decent caring intelligent people here, can we please try to ensure that for our children and all future generations?
- Emphasis on both passenger and freight rail to the cape
- "Leave Rails to Joint Base Cape Cod. This is important as although Military movements do not happen "all the time" they are "oversize" and Rail saves a lot of planning. If the base is closed in part or whole, having no rail will greatly affect the way it can be redeveloped.

Another reason to leave Rails. Relay tracks from North Falmouth to Woods Hole and Extend Cape Flyer Services to There for direct Ferry-Rail Transfer."

- Railroad Preservation and perhaps ease of use in terms of the whole system.
- Railroad availability can be marketed to reduce auto and truck traffic on the over trafficked cape roads. Cooperation between rail, ferry and bus transportation could make the difference. This could become an important commuter plan.
- Increased modality on cape cod
- Have a direct rail to ferry connection at woods hole.
- Tourist Friendly
- Looks good, clear and to the point.
- It is important to plan for a future whose only certainty is uncertainty. I'm especially concerned with trash removal off Cape. I feel that the plan to remove the RR track down to Joint Base Cape Cod and REPLACE it with a bike path would indicate a lack of foresight on the part of transportation planners.
- "Working at sea and returning to land gives you perspective into how inefficient our transportation networks are. The future of the capes transportation systems should be highlighted as follows: Trucks off the roads, running container systems to the islands instead of tractor trailers Expanding railroads on cape cod, taking back the rail trail and running dual railroad beds put to Orleans- running a year round south station/Logan connector Making roads more walkable and replacing strip malls with conservation lane. Zoning out these strip malls thus pushing businesses closer to main town centers and keeping traffic into these centers minimum thus reducing accident prone areas (ex. bell tower mall) Rebuild old wharf at end of old colony rd. and replace old colony road with single bed railway for fuel/container/cargo movement. "
- Communication
- Equity should be a standalone goal.
- Save the Falmouth branch line railroad and bring the commuter rail down to at least Hyannis. Also bring a cape flyer like train to woods hole to ease congestion *doesn't even have to be year-round* as the parking lots in communities like Cataumet are taking up unnecessary space due to a lack of public transport. Remove and halt the progress of rail trails as they are seasonal and cater to a handful of people most of which are tourist/non-residents which would benefit from a rail service.
- Keep the cape's historic rail lines alive, keep the rail trails way side of the tracks or don't have them at all. Also, year round MBTA service to Hyannis is a good addition as it could ease congestion permanently.
- accessibility for all no matter where they live on cape cod.
- Less traffic and congestion. More mass transit and bike options.
- Stop building businesses...too congested in Yarmouth, not enough space.
- Focus on better public transportation.

- Looks good to me!
- Increase recreational opportunities.
- Circular dependency needs specifics.
- Better Outer Cape service for seasonal workers.
- Gerson Rodrigues
- Make the Vision Statement published to the General Public Quarterly, outlying successes, failures, and the change in the goals.
- Encourage public transportation. Continue the Cape Flyover Train beyond Hyannis. Encourage e-bikes and e-trikes.
- More options for travel, to and from Cape Cod. Rail travel should be available all year round. Taking up the tracks in favor of bicycles is not in the best interest to elevate auto congestion.
- Transportation Equity - providing people with transportation options that meet their needs.
- Reduce carbon emissions.
- None
- help meet the daily goals of an aging population, such as multiple roundtrips, 7 days a week to Cape Cod Hospital for treatment or visiting.
- family transport
- N/A
- As a senior previously in the home care field, I see the great need for affordable transport for home care workers to their patients on the outer Cape. I also can imagine a growing demand for door-to-door public transport for our ageing population.
- "I live in Hyannis. My doctors and friends and family are in Sandwich the accessibility just isn't there. I can't walk from where they go now to get to where I need to be. "
- Affordability
- Sidewalks for pedestrians
- Close the on-ramp to the Sagamore Bridge during construction times. Most of the people using the ramp or cutting through the Christmas Tree shop get off at exit 2. Will it inconvenience some Bourne residents, yes. Traffic would flow would increase if the ramp was shut down.
- Increase Railroad use for freight / passenger needs.
- Affordable
- What is your vision statement? This seems to be a high-level format.
- Financial aid (voucher, free days/time of day, books of 12 trips for price of 8) to lower income-families
- None
- Vision statement
- It's totally ridiculous to try to switch buses to electric power. All the meaningless virtue signaling aside, how are these large, heavy vehicles going to make round trips from Hyannis

to P'town or Hyannis to Woods Hole, several times a day, without spending hours being recharged by generators that run on DIESEL FUEL? Additionally, does anyone in a decision-making position even consider the damage done in the mining of lithium or in the amount of energy it takes to produce one lithium battery or the cost of purchasing and replacing the batteries (and disposing of them) or the CHILD LABOR used to mine the lithium? Pointless, expensive, and in the end, useless.

- Public transportation expansion
- none.
- Sustainable environmental and resilience are unclear- sustainable and resilient environmentally and economically?
- "Environmental and Sustainability" does not make sense from a grammatical standpoint.
- More reliable and comprehensive public transportation, in all seasons.
- The traffic is unbearable coming home or leaving the cape this work is to slow the light leaving is absolutely a Joe 4 cars at a time really.
- Make one bridge off cape, and one bridge off cape, anything is better than what we are going through now.
- Travel efficiency
- Discourage car trips.
- Year-Round Transportation / Express Service to Metropolitan Cities
- Are these GOALS hierarchical in nature? IS SAFETY the highest goal? If there is a conflict between "Environmental & Sustainability" versus "Livability & Economic Vitality," which goal takes precedence? The GOALS section gives no clues as to how potentially conflicting goals will be prioritized.
- Technically 'environmental' is an adjective so it needs a noun that it modifies, so something like 'environmental security' or 'environmental preservation/enhancement' would work better.
- "Converts everything but doesn't prioritize not make choices."
- Equity should be a goal.
- As a frequent user of CCRTA fixed route services (& also DART), I am frustrated by the constant expansion of the Flex route to include some senior housing developments. The route is already a long one from Harwich Port to Provincetown & the expansions are difficult for drivers AND passengers. Also, lack of service on 6A beyond Brewster. So maybe the revision should be: Route Changes/Additions for Improved Customer Service.
- Perhaps add a goal about reducing our transportation system's impact on climate change.... maybe cite the climate emergency...
- The vision of the local and regional transportation system should include community strengthening. In fact, it should be one of its core goals. Eventually, the public's transportation is made to facilitate people mobility for economic, social, health, cultural, emergency and many other reasons such as reducing the impact of individual

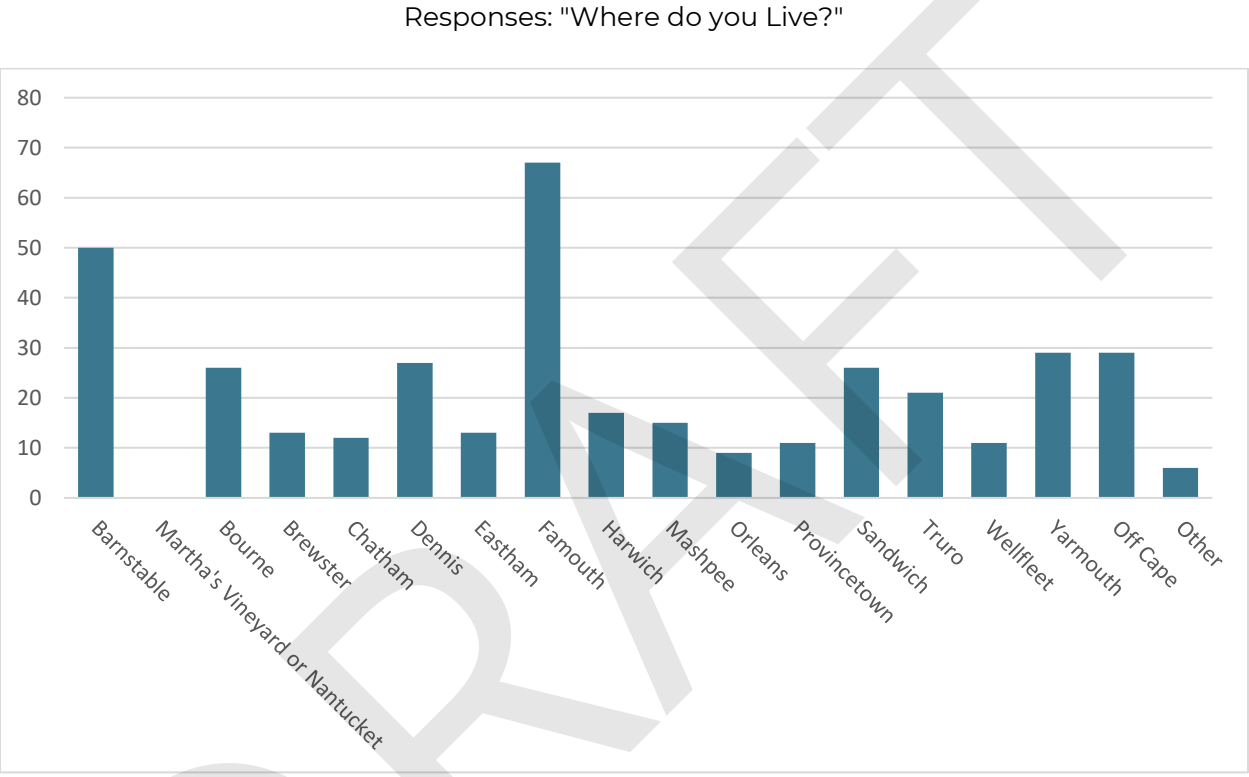
transportation on the environment. A well-integrated and efficient public transportation will strengthen intra-community connections, as well as open it to the outside world.

- Increased pedestrian mobility

QUESTION 2 – PLACE OF RESIDENCE

In question 2 respondents were asked "Where do you live?" There were 382 responses. All 15 Cape towns were represented with the highest frequency in Falmouth (67 responses) and Barnstable (50 responses).

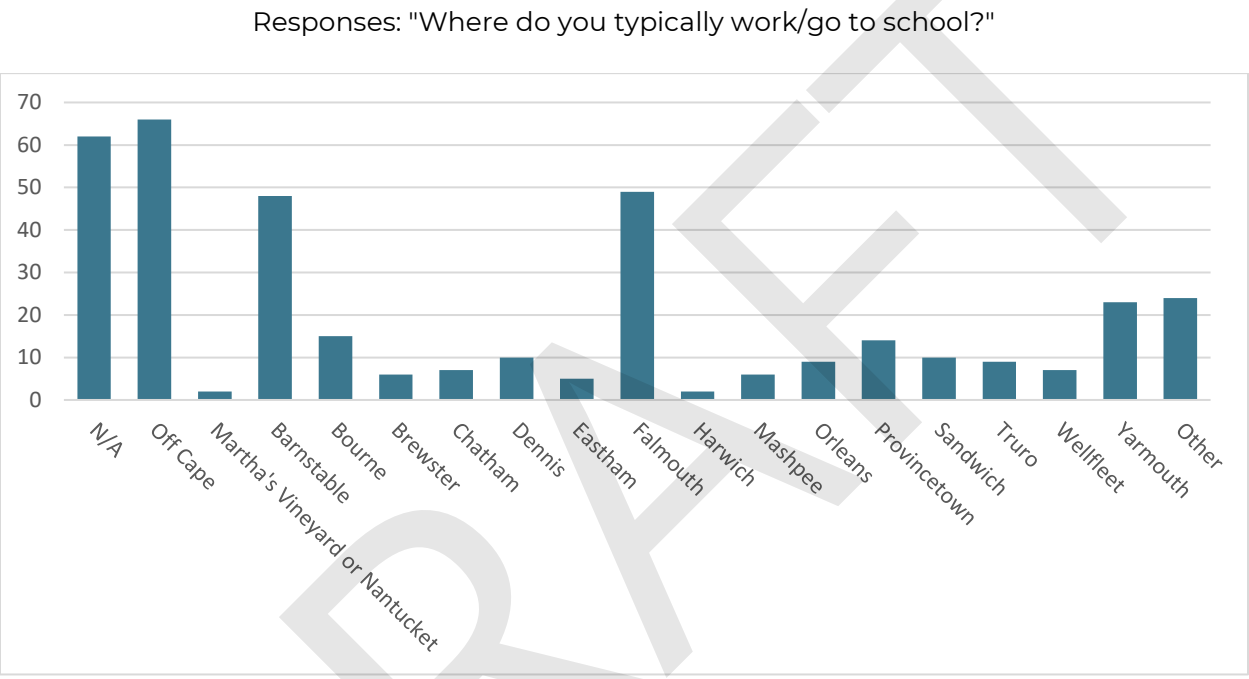
A distribution of responses is shown below in the following figure.



QUESTION 3 – PLACE OF WORK/SCHOOL

In question 3 respondents were asked "Where do you typically work/go to school?" Respondents were presented with a drop-down list of Cape Cod town names, "N/A", and "Other." There were 374 responses to this question with the largest frequency of respondents selecting Off Cape (66) and "N/A" (62).

A distribution of responses is shown in the following figure.

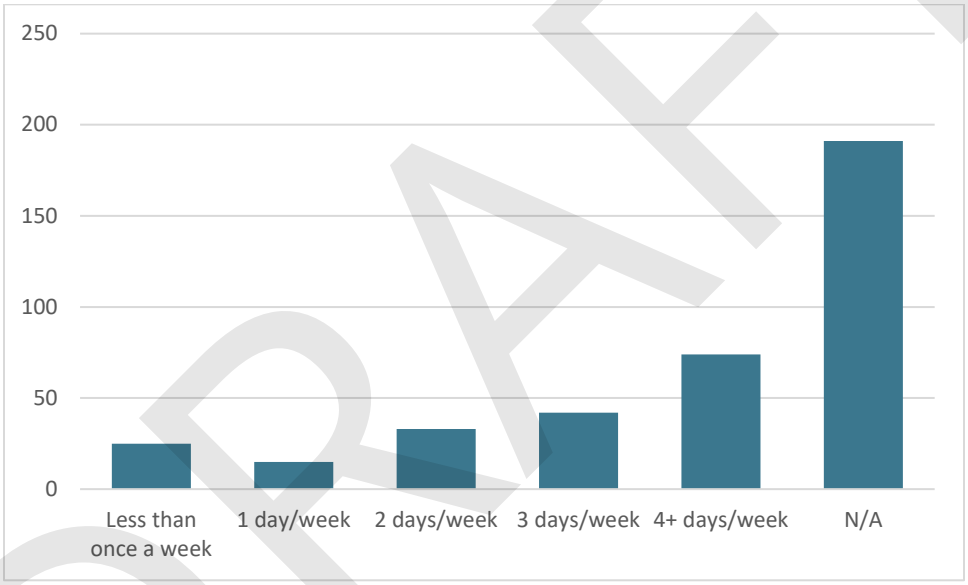


QUESTION 4 – IF YOU WORK IN A HYBRID MODE, HOW MANY DAYS DO YOU TYPICALLY WORK IN THE OFFICE?

In question 4 respondents were asked "If you work in a hybrid mode, how many days do you typically work in the office?" Respondents were presented with a drop-down list with a range of options from less than once a week to 4+ days/week. Respondents could also select "N/A" as an option. There were 380 responses to this question. The most frequent answers were "N/A" (191) and 4+ days/week (74).

A distribution of responses is shown below in the following figure.

Responses: "If you work in a hybrid mode, how many days do you typically work in the office?"

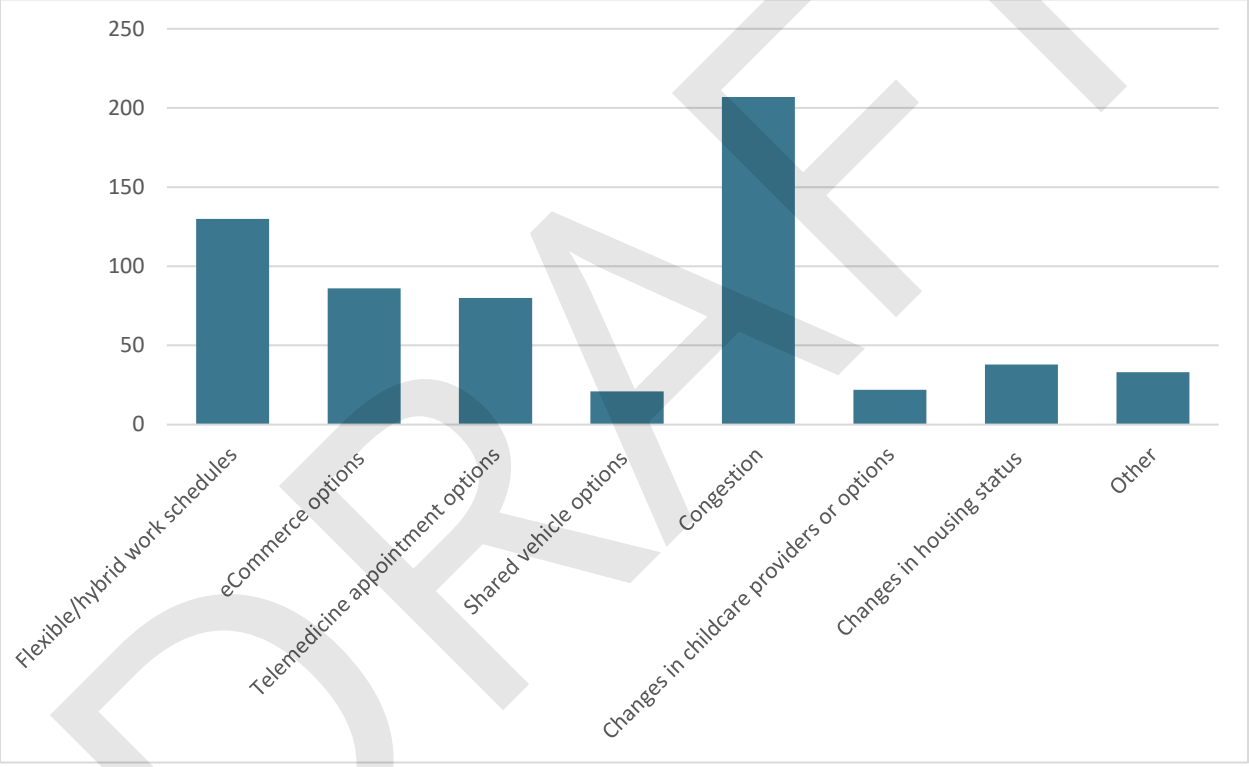


QUESTION 5 – HAVE ANY OF THE FOLLOWING CHANGES CAUSED YOU TO ADJUST THE WAY YOU TRAVEL?

In question 5 respondents were presented with a check list in which they were instructed to answer, "Have any of the following changes caused you to adjust the way you travel?" Respondents were instructed to check all that applied, in total there were 617 responses to this question. The most frequent answer was Congestion (207).

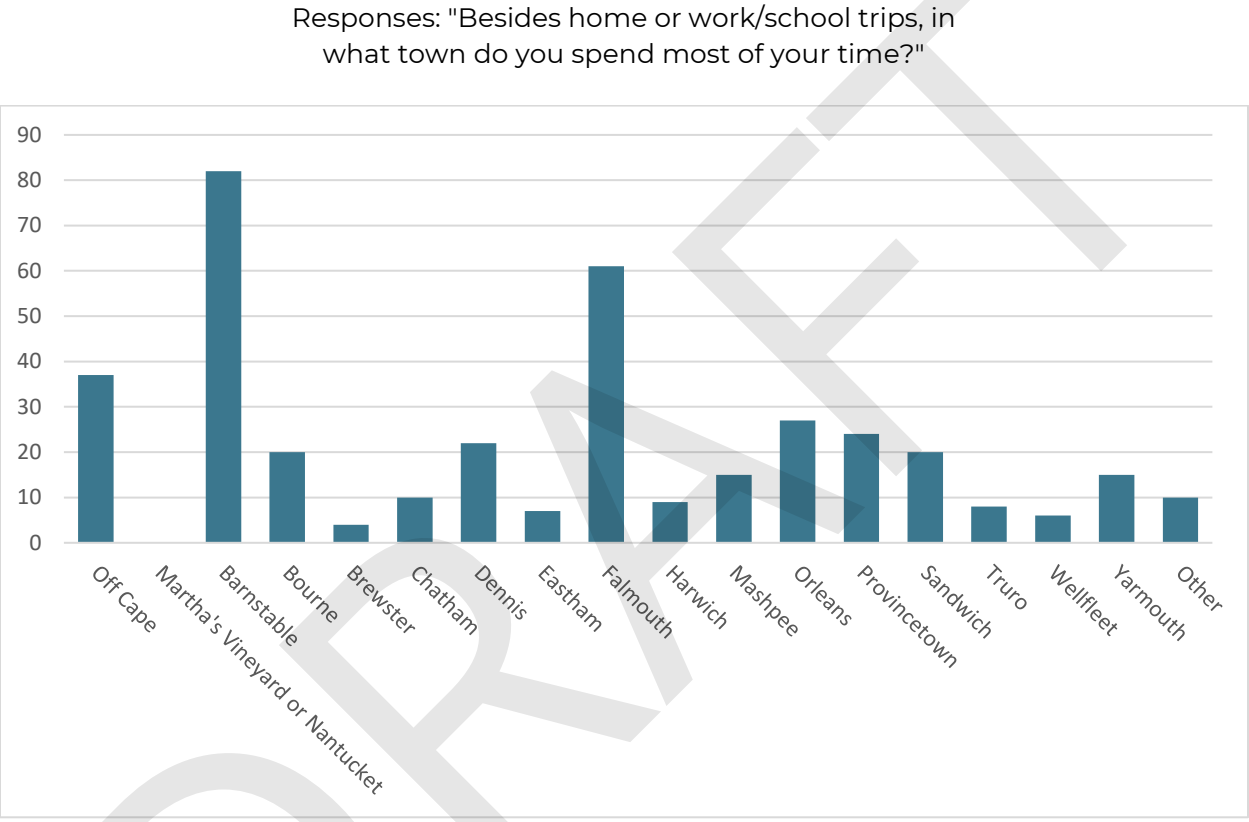
A distribution of responses is shown below in the following figure.

Responses: "Have any of the following changes caused you to adjust the way you travel?"



QUESTION 6 – LOCATION OF OTHER ACTIVITIES

In question 6 respondents were asked "Besides home or work/school trips, what town do you spend most of your time? (visit, shopping, entertainment …)" Respondents were presented with a drop-down list of Cape Cod town names, Off Cape, and "Other." There were 377 responses to this question. The most frequently selected towns include Barnstable (82), Falmouth (61) and Off Cape (37); these responses are shown in the following figure.

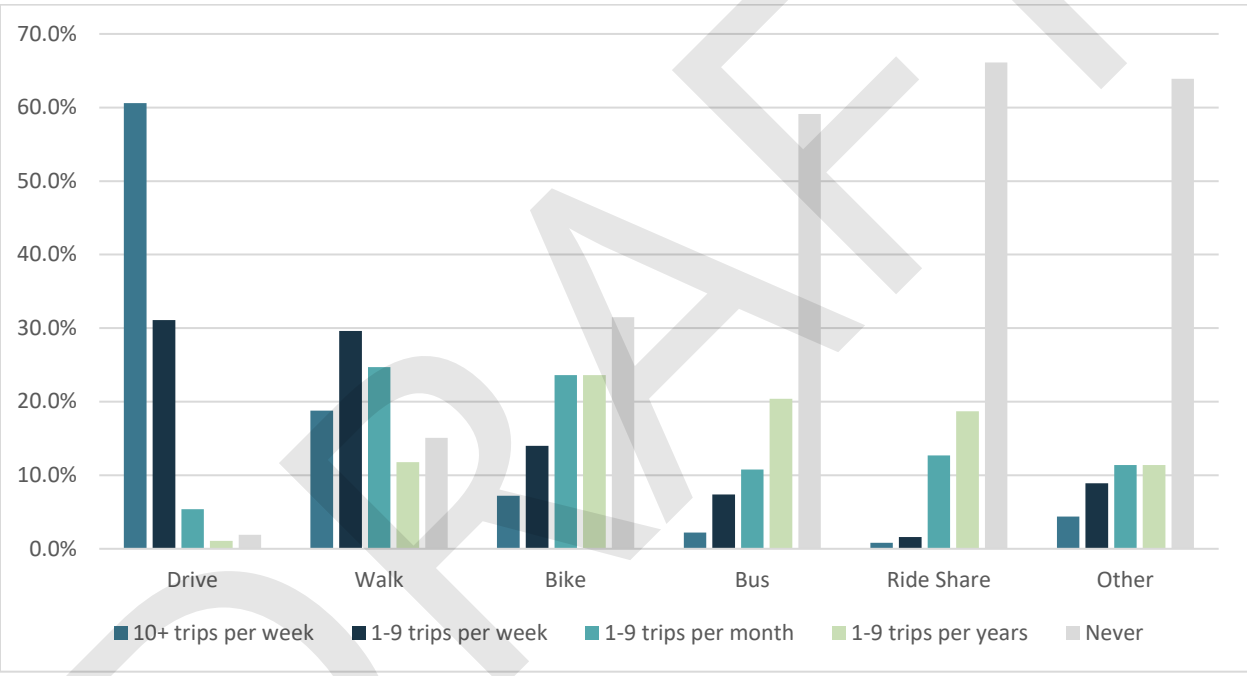


QUESTION 7 – MODE OF TRAVEL

In question 6 respondents were asked "How frequently do you travel by each of the following modes of transportation?" Possible choices included: Drive, Walk, Bike, Bus, Ride Share, Other. Choices of frequency included: 10+ trips per week, 1-9 trips per week, 1-9 trips per month, 1-9 trips per year, never.

As shown in the following figure, the most frequently used mode of travel is to drive. Walking was generally the second most popular travel mode, followed by using a bike. Using the bus as a means of transportation has also seen an increase in response since the last RTP survey.

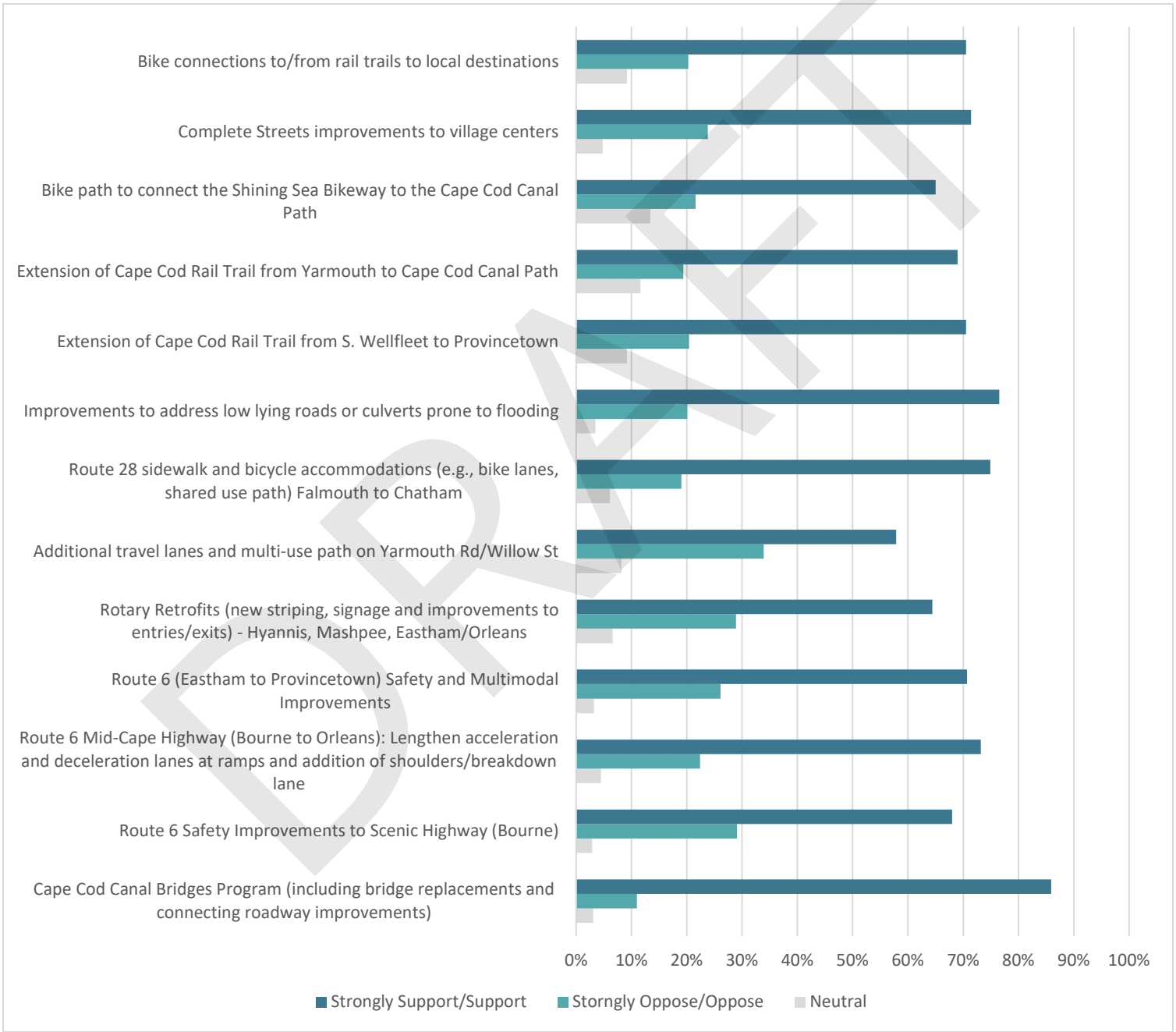
Responses: "How frequently do you travel by each of the following modes of transportation?"



QUESTION 8 – PROJECT SUPPORT

Respondents were asked to indicate their support for the several projects. For each project, respondents were offered the following choices: Strongly oppose, Oppose, Neutral, Support, Strongly Support. Responses are summarized in the following figure.

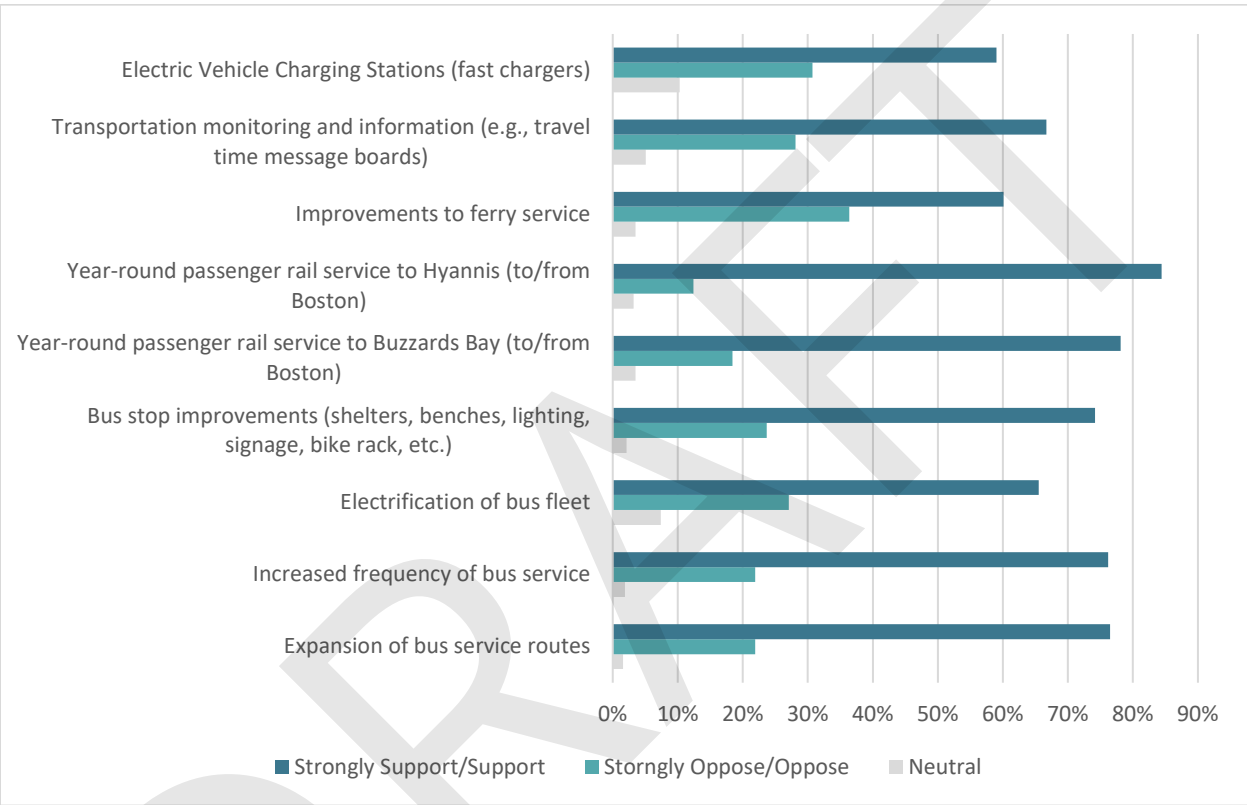
Level of Support for Potential Projects



QUESTION 9 – TRANSIT PROJECT SUPPORT

Respondents were asked to indicate their support for the several transit projects. For each project, respondents were offered the following choices: Strongly oppose, Oppose, Neutral, Support, Strongly Support. Responses are summarized in the following figure.

Level of Support for Potential Transit Projects



QUESTION 10 – OTHER PROJECT SUPPORT

In response to question 8 and question 9, respondents were asked "Are there any other project(s) would you support?" There were 183 responses to this question. Responses included:

- DOT needs to work with NPS to allow bike path within Seashore property and off of proposed Route 6.
- I support the Massachusetts Coastal railroad and their goal to keep the Falmouth Secondary a RAILROAD.
- Pedestrian and bike paths
- North / South Bike and walking trails from the sound to the bay… example: Looks beach in Cotuit, over Newtown Road, cross Race Lane to Great Hill Road to Chase Road to Old County to Carlton Drive to the bay.
- We need to connect all bus service to our community college. Students from most of the cape can't take public transportation there. Ferry rates for Cape Cod Residents not just islanders; and for those who travel back and forth for business.
- Please make a bus that goes to CCCC from towns other than Barnstable.
- Study the restoration of passenger rail to Falmouth and Woods Hole using the existing Falmouth Secondary and an extension down the original right of way.
- railway from South Station to Falmouth!
- Fast Cape cod rail to Falmouth from Boston
- Falmouth Secondary rail line repair project and commuter rail extension to the Cape.
- Connecting all Cape Cod bike paths to each other
- Addressing the lack of DART services in Wellfleet-Provincetown
- Electric bike chargers should be included at all electric car charging stations. Frequent express bus service is needed between the Outer Cape and Hyannis - it currently takes over 3 hours via the Flex bus from Provincetown to Hyannis. We desperately need a Cape-wide bike share system at transit hubs for last-mile trips.
- Extension of shared use path along Route 151 from Mashpee / Falmouth town line to the Shining Sea Bike Path as well as along Route 28 to Hyannis. Shared use path along Route 130 from Mashpee to Route 6A.
- The most important thing you can do is add/create/construct/make more Sidewalks. So that humans can safely travel by Foot/Bike/Wheelchair. Make it safe for anyone to walk, especially someone with any type of disability or uses a wheelchair or walker or cane or service animal.
- Emphasize expansion and frequency of buses especially from May 15 to Sept 15.
- lots of stuff regarding sidewalks and bike paths - separate from each other
- Winter ferry service Ptown to Boston
- YES! Widen Route 6 to four lanes with median between Orleans and Yarmouth (? where it becomes divided into four lanes). This is an enormous bottleneck and dangerous at all

times of year and it is unfathomable why it remains such a narrow 2 lane road with yellow markers down the middle.

- Continued push on safe bicycle/pedestrian East/West routes from the lower cape to mid-cape.
- safety improvements to Truro center/cobb archive area/ sidewalks
- Shankpainter bike lanes /rotary project
- The addition of multi-modal path and sidewalks to Route 28 is of paramount importance. Additionally, the bus service should make use of modern navigation systems to create an app that lets you know where the bus is and its approximate arrival time to your location. Lastly, there needs to be widespread installation of sidewalks on all roads and connecting bike/multimodal paths to commercial centers that separate bikes and people from cars using physical barriers.
- More speed limit signs, sidewalks, and a crosswalk at Popple Bottom Rd on Great Hill Rd. People drive 60mph on that road routinely (motorcycles even faster in the summer). The speed limit is 30mph but there are NO speed limit signs between the highway and Farmersville Road. Kids cross the road and walk down the road to their bus stops in the dark and I'm surprised none of them have been killed yet in doing so.
- Electric skateboards, electric scooters, electric bikes need separate path. Too dangerous for travel along rt 6, but too fast for the existing bike/walking/dog walking paths.
- In addition to more fast chargers, more Level 2 chargers on town and state properties. The Park and Ride is a good location and could even include level 1 (standard 110v plugs) for commuters who park for more than a day. Level 2 chargers at walking, hiking, biking and multi-purpose trails are also helpful.
- Please build a bike path along Sandwich Road in Falmouth (north of Brick Kiln Road). There are dozens of people who walk or bike to work along Sandwich Road every day, even through the winter, and Sandwich Road frequently has car crashes (at least three around Deepwood Drive in the past two years alone, including another only a month ago) because drivers so regularly exceed the speed limit by 10-20 mph. A bike lane would enable the literal thousands of people living in communities along Sandwich Road to reach the center of town without driving, thereby reducing congestion, carbon emissions, and collision risk. If the Town of Falmouth also plans on building the proposed 900 units of affordable housing on Sandwich Road, this makes non-car travel options even more critical for reducing congestion around peak travel times.
- Finding some way to help relieve the insane traffic on route 28 between Falmouth and Yarmouth, especially, would be helpful. Also, while I strongly support projects that improve the climate resilience of the Cape, I would really like to see ones that are realistic and permanent fixes, rather than the constant patch jobs that I tend to see. Some streets (for one, Surf Drive in Falmouth) seem impossible to preserve in the long term and already demand constant up-keep. This is a massive waste of resources and is really the oppositive

of sustainable/environmentally friendly. So, being realistic about the magnitude of change that needs to happen to make roads/infrastructure usable and effective is critical.

- Surf Drive in Falmouth should really be a boardwalk & bike path only. It is costly to sweep the sand back every winter, and it floods every storm. Better to let the system return to sand dunes and leave it for walkers & bikers.
- Passenger rail service to Falmouth/Woods Hole since it's as well a ferry destination (similar to Hyannis); Ferry connection between Woods Hole and New Bedford to alleviate the housing crisis and connect the communities.
- painted bike lanes on surface roads
- moving ferry freight traffic out of residential Falmouth and to more appropriate venues such as New Bedford.
- "I would love to see the bike trail extended from Wellfleet to Provincetown. I am also upset by and opposed to closing the old county rd around Mill pond area. That beautiful road connects Wellfleet to Truro and is a wonderful way to bike safely and stop and support the merchants in both towns. I have been biking that roadway for thirty years and it's heartbreaking to think runners, cyclists, and those of us who love long walks may lose this special and precious amenity."
- In the Falmouth area in particular, protected bike path connections from shining sea through the shopping centers in Teaticket and especially up Sandwich Road
- Rail to Provincetown; year-round ferries to Provincetown; Frequent Bus routes to Boston; frequent bus routes throughout the outer cape; free transit trips for residents
- Rail access to Boston from the Cape, not just to the Cape from Boston
- Yarmouth - Route 28 reconstruction. The area currently has very little pedestrian or bike accommodations.
- Yes. provide sidewalks around Sturgis School and Greenwood Ave. Add cameras to catch the speeding vehicles in town and leave our streets the way they are. Stop the State from destroying the Hyannis village environment by dumping their problems on our village and putting us all at increased crowding and health risk.
- "Extension of bus routes in the summer for all the seasonal workers and bike lanes. It's not safe for them to bike on the roads and they are young adolescents, mostly in their 18s or early 20s. It's not right. Buses should connect rural areas to the main hubs where restaurants and hotels are. There are no lights either on some of these busy roads I'm always hearing about people getting hit every year. As a driver it's nerve racking because it can happen to any of us. It's so dark. Don't waste your time with any more safety or signage. Focus on the bigger projects that are going to cost more and will have more impact. Increasing traffic lanes, the bridges, rail service to and from Boston and providence daily, fast EV charging stations, lengthening bike trails and adding bike lanes to roads. Rail/more buses should connect to providence too as so many people come from NYC. Providence connects to NYC via Amtrak. Bus stations- there should be a tracker on it so on my phone I

can go to the website and see where the bus is, and I can plan to leave mt home. This way I know it's coming and I'm not waiting hopelessly. Don't waste your time with signs and hardware that will only break or get damaged. Invest in technology that can be accessed on your phone. For example, google any bus in NYC. I used to use the q100 or q69 bus all the time. I could see the bus moving to each stop. https://bustime.mta.info/m/?q=Q69"

- COMMUTER RAIL FROM MIDDLEBORO/BOSTON!! Want to ease the road congestion - there's your answer.
- Stop the ferry municipal building from being built. No need for waterfront offices.
- I believe that the Cape is becoming like the eastern end of Long Island, NY, a geography from where people commute into NYC regularly, many daily. The Cape is becoming a place that people want to make their permanent residence. That does not mean the tourist business is going to slow down; it's an acknowledgement that there are increasingly more year-around folks residing on this Island.
- review of each village center to ensure growth is in keeping with current needs and economic success.
- More specific complete streets improvements in village centers. The Complete Streets plans for each community are great, but they need to be continually implemented and updated.
- "Biking options from Mashpee and Cotuit to connect to the Shining Seas bike path or just in these areas. Biking is a nightmare right now. Also, more SAFTY pedestrian crossing areas across route 28 in Mashpee AND COTUIT."
- "Steamship Authority Ferry service for trucks from New Bedford to MV and Nantucket. I am increasingly very concerned about safety issues of fuel trucks along Falmouth and Woods Hole streets. Just yesterday, I was nearly hit by an enormous flatbed truck transporting TREES at the corner of Locust Street and Main Street in Falmouth. The truck could not make the turn and veered into my lane. It was terrifying. Noonan Fuel trucks speed along Locust Street to Woods Hole all the time. We really need help. "
- "The Ride" options...
- I cannot express an opinion on the above projects without further information on project scopes, costs, benefits, impacts.
- Moving ferry services to the Islands to the mainland will reduce congestion on Cape Cod roads thereby improving safety for all road users.
- Bridge replacement is a once-in-a-century opportunity to remake the Cape's transportation system; the project should be designed and built for 2050 and 2075 more than 2025, with a very broad scope in mind - all services and all modes, encompassing every Cape town plus the Islands.
- Buses into the evening for local youth, especially on Fridays and weekends
- "No Idling Campaign - regulatory signage and education Wider engagement with the Safe Routes to School program Encourage school bus ridership to help alleviate school-related traffic and improve safety."

- Year-round passenger rail service to Providence, timed to connect to Amtrak heading south -- and also just to visit Providence. Ideally, we would get Amtrak to come to Hyannis -- that would be my dream!!
- Town centers should become pedestrian zones. No cars, deliveries at scheduled times (prob. AM). Parking areas nearby. I bet shopping would increase. I see the current bike trail as recreation, after all it is shared with pedestrians. So, I am uneasy about the survey questions that seem to assume it can become a bike highway. What I have seen of 'complete streets' elsewhere seems to be focused on reducing travel lanes to provide slightly more parking and pretending to provide save bike lanes. But the bike lanes are still too close to both parked and moving cars for safety. Again, pedestrian only zones, with cars and bikes going around, not through town centers.
- Conwell street improvement to put cobble stone sidewalks and speed bumps going in both directions to slow down traffic and improve safety.
- Public transportation will ease the traffic and will get more people to their destinations in a more affordable way.
- Separated bike lanes on as many arterial roads as possible.
- Attention needs to be paid to the amount of traffic coming on-cape to the Bourne Bridge in the AM and going off-cape in the afternoon. It can take up to an hour to travel 4-5 miles to get either on or off cape for several hours in the AM and PM. With JBCC acting as a barrier, there are no "alternate routes."
- bike lanes or shared use lanes on major roads like Woods Hole Road
- Expansion of DIAL to ride services.
- Regular Bus service from Barnstable House of correction connection to all Rail and bus service all over cape cod and off cape.
- Please refer to my discussion under the vision statement which includes a response to this question. Step back from small issues, embrace a multi-model transportation system centered into Bedford, replace the steamship Authority with a creative fleet of diverse private carriers separating the movement of freight from passenger transportation needs. People should move quickly and efficiently from Nantucket, Martha's Vineyard, Cape Cod's south shore to New Bedford for connecting with the South Coast Rail, bus and air service. Separate maritime licensing from service and invite private carrier competition. The Steamship Authority is a dinosaur headed for extinction. Thank-you - Bill Hallstein/SMARTCitizensTaskforce.org
- increased bus service to the outer cape year-round
- Bike Ways /Paths in Mashpee on the current Dirt Roads to connect Bikers to town center and beach staying off 28 and 151.
- The train should be like on the old days as transportation, the beautiful train station it's there in Falmouth and the owner John has done a beautiful job , especially during the summer with flowers etc.

- "Can the weekend train to Hyannis run during the year, not just in the summer? A Plymouth and Brockton bus ticket to Boston, one-way, is $30.00 - expensive! The large, expensive bus station in Hyannis is not open early mornings or evenings when I am commuting. Thanks for asking for opinions and comments. "
- RTS Oversight over impact of landside Steamship Authority transit issues, especially trucks
- I would like daily train service to Boston. I would like daily bus service from all park and rides to the Kingston commuter rail that *synchronizes with the train schedule*. As part of the arrangement to do business in the state, all private bus services should be required to stop at Kingston MBTA (or Plymouth (synchronizing with the train schedule) on the way and way back from Boston. Increase bus service to connect to Park and ride parking lots. PLEASE put a respectable, safe, and easily accessible bicycle path across the bridges. There should be a local bus service to all beaches to reduce the need for parking lots at the beaches. Increase separated bicycle infrastructure on roadways that go to stores where I shop. Require stores to provide bike racks in the closest parking space to the store Cycling is for transportation, not just exercise. If you are afraid to let your 10-year-old ride to school, we've failed them. One shouldn't need a police cruiser escort to have a bike to a school day. There should be no bike to school day, it should be bike to school life. Require police to enforce speeding rules and hold them accountable. Link neighborhoods that are cul-de sacs so bicycles can get through. No more cul-de-sacs as they damage everyone else's ability to get around. Change the zoning laws so we can build 2, 4, 6-unit complexes so we can build enough housing for young folks. Sewer the cape, otherwise the water is ruined. (Thanks for listening).
- I support a moratorium on building. No more building should ever be done on Cape Cod. I also support the tearing down of many newer buildings and homes. They never should've been put there in the first place. Replace these useless monstrosities with life-giving trees, the life-giving trees that were torn down all in the name of money. Give the animals their homes back. If people continue building and destroying Cape Cod, it will soon become a small disgusting Boston. We already have murders here now. Don't you see it? Don't you get it? I totally support bringing the beauty and the glory of Cape Cod back! Leave it the way it was, it was just perfect. And we used to have an off-season... How I miss that!
- Better scheduled air service to the airport in Hyannis.
- Continued rail use of the Falmouth Secondary rail line to Otis and to study passenger rail to Falmouth and/or Woods Hole
- Rail service down towards Falmouth
- We need more frequent daily summer train service to Boston and New York
- Please prioritize rail, and do not allow the need for bike infrastructure to supersede that. Both rails and trails can - and will need to - coexist. The Cape's communities have been viewing these resources as mutually exclusive for too long, and we are lacking bike and rail

infrastructure. Please strongly engage rail in master planning, especially for freight, as trucks traffic must also be reduced.

- Daily passenger train service between Boston/Hyannis/Wood Hole. You read that right. Put the train back to Woods Hole and get that automobile traffic out of Bourne.
- Extend rail back to Woods Hole
- "If there is a bike path, do not sacrifice an Active RR. Rails w/Trails Extend the Tracks back down to Woods Hole."
- Extend tracks on Falmouth line to Woods Hole. And provide commuter service from Boston directly to the ferries at Woods Hole.
- Stop rail trails. Preserve more rail routes for either full trains or trolley/LTA systems.
- Sidewalks everywhere!
- Increased rail services to Boston and Providence
- Train service to Falmouth
- "I would strongly support adding a second track to the cape main line. Part of the reason we have so much congestion on roads is due to people traveling to the city in their car, not on a train."
- Get off the rail trail stuff. Stick with the rails AND trails to benefit the commerce of the entire Cape.
- Trolley like service from parking areas to downtowns, beaches, and picnic areas
- Year-round ferry service between Provincetown and Boston. Extended CapeFlyer to Falmouth
- Love to see route 6 through Wellfleet replaced. I ride motorcycles and its road conditions are so dangerous for us bikers through Wellfleet.
- Woods Hole is not an appropriate location for freight service to Martha's Vineyard. New Bedford was at one time used for this purpose and should be again. The Steamship Authority retains too much anti-competitive power and that should be changed via the Legislature. South Coast Rail should team up with the SSA or another carrier to encourage day trips to Martha's Vineyard via New Bedford.
- "Old colony road wharf rebuild/ old colony rd rail rebuilding. Move hazardous waste to separate shipping center. Crosswalk projects, reduction of speed limits and get large tractor trailers off local roads. Remove strip malls. "
- Redevelop the Canal Generating Plant into a secure, free parking facility with its own exit off route 6, express CCRTA service, and a fast ferry to Wellfleet and Provincetown.
- Any improvement to the commuter population on and off Cape I would whole heartedly support. It would create housing competition for rentals. The cost off Cape (specifically new Bedford area) is so much less expensive eventually entry level persons will all just move there and the Cape which is already suffering will be worse.
- Attention to school transportation needs … including incentives for busing and walkability to/from school(s)

- Bus schedule on the Outer Cape (Orleans to Ptown) that supports workers in the restaurant and hospitality sectors getting to/from work much more easily. Earlier and later and more frequent service
- I strongly support any bike related infrastructure improvement project.
- Improvements to major connector roads. This could help residents access destinations by bike from their home safely, instead of having to drive to a bike path to start a bike trip. I would love to be able to bike from my home (on Hayway Road, E Falmouth) to a main road (like 28 or 151) if the main road had a bike path or safe, sheltered bike lane. I do see people biking on my road, but I don't think it's safe and do not feel comfortable.
- A project to revitalize Cape Cods railroads, increasing speeds, industry, and accessibility.
- Commuter rail to cape cod and keeping the cape's existing railroads.
- expansion of DART fleet. Expansion of ADA to more than 3/4 of a mile from fixed routes.
- Bring back passenger rail service to Falmouth! It's insane that so many people drive to the Steamship parking lot and clog up roads on the Cape. Rail corridors should be better utilized for Shared use / public benefit. The wide right of ways should be rail, bike, walking and utility ways. Bigger highways only create more traffic. Stop incentivizing car use at the detriment of local residents. More frequent, year-round rail service to the Cape is the only sustainable long-term solution. Stop subsidizing more car dependency and think about future generations. Rail and bike corridors must work together.
- More rail (train) service to all Cape Cod locations. This will decrease traffic congestion and provide more affordable, environmentally safe travel options. Adding more roads and traffic lanes is senseless and foolish, demonstrating poor awareness of travel efficiency. Cape Cod roads are already crowded enough, making room for more cars is a very bad idea. Responsible future planning should follow the examples of many other countries that use rail services responsibly and efficiently.
- I support these projects and would like to see them completed.
- New cape cod train Bridge
- Extension of the SmartDART service throughout the Cape; ferry from Hyannis to New York City; create bridge over Route 6 from West Road in Orleans to avoid having to ride bicycle on the street (cars go fast there and it is often congested in the summer from Skaket Beach traffic); rail service from Hyannis to Providence (to make rail access to NYC easier)
- "I support removing the scantily used railroad tracks in order to build the Bourne Rail Trail. I support off-Cape freight service to the islands. "
- I use Shining Sea Bikeway for commuting most days. Would be great to see more of Falmouth and Bourne connected by bike paths.
- We need MANY Faster (DC, or Level 3) fast chargers on the Cape! Not just adding one or two on Route 6!!
- Early morning and late-night bus routes on the Outer Cape to support the seasonal workers commuting needs

- Working with the state to reduce the delivery cost of electricity to the Cape so we can benefit from the EV options in the future.
- I know Hyannis is a village in Barnstable, but it should have been listed separately under what other town do you travel to most - people go to Hyannis more than Barnstable center, for example.
- Establish a toll for non-resident use of the canal bridges to fund their maintenance and encourage multi-occupant vehicles.
- Daily train service from cape to Boston
- The top priority of our failed congressional delegation is to secure funding for one or more bridges over the canal. The delegation had two years under the Biden Administration to secure the funding but failed to secure the funding. Why can't there be funding secured for one bridge at a time?
- RAIL. RAIL. RAIL. This would dramatically alter traffic in the region along with good, reliable bus service.
- improved signage for bicycle safety, letting cars know that they need to share the road with bikes in places where the shoulders are narrow etc. More sidewalks. Also, more crosswalks, especially where there are sidewalks only on one side of the street.
- I suggest Main Street in Hyannis to be at least partially pedestrian only traffic. North Street and South Street to be one way in each direction.
- Keeping Beaches clean and monitored
- Increased frequency of bus pick-ups in lower/outer cape - DART? door to door service is infrequent.
- Concurrent with transportation and transit investments, towns should adopt zoning that enables development of more moderate and lower cost housing. Could include ideas like accessory dwelling units.
- Don't jump into electrification until all aspects of this proposal have been properly addressed.
- Improvement in construction planning for bridge work - this puts an immense strain on commuters who live off Cape that have to waste time in traffic during commuting hours. Are there alternatives to closing lanes on the bridges during daytime hours? Can work be scheduled overnight with all lanes reopening during the daytime hours? There may be obvious reasons when this cannot be accomplished (I.e. the roads may not be suitable for travel and there can't be temporary structures placed over work areas) but I think that should be the goal.
- rumble strips installed before the rotaries to make traffic slow down upon entering rotaries, especially at the Otis Rotary. Cameras installed on County Road to catch motorists running the red light at Barlows. Also speed cameras/radar to ticket motorists speeding, particularly on the bridges as well as installing no passing lane markers on the bridges. Dunkin Donuts

at Bourne Bridge is a calamity every single day. Towing oversized boats on local roads should include time of day restrictions as well as fees for using local roads this way.

- fill in the cape cod canal...
- Leave Bourne Railroad tracks in place for future!!!
- Sidewalks in Dennis between Rt 28 and road to police station.
- "Buy electric buses! Tons of research done on them."
- MEDICAL TRANSPORTATION FOR THOSE IN NEED
- A monorail from Hyannis to South Station, Boston down center strip of Xpressway
- A solution to the congestion at the bridges. Rt 28 from Falmouth to Hyannis needs 2 lanes in each direction. Route 151 needs 2 lanes in each direction. REPAVE THE ROADS AFTER ROAD WORK! Address crater sized potholes.
- yes, hydrogen fueling stations are lacking, I think people are diving head first into electric before we have fully shaken out the BEST alternative
- Routes benefiting the seasonal workforce.
- more senior travel buses
- Ferry service to and from Boston from Sandwich or Hyannis
- Sidewalks for people
- Recreational off-roading locations. A place for the younger generations to legally enjoy operating all-terrain vehicles and explore nature.
- Freight needs to be shipped to the Cape by Rail to reduce truck traffic congestion on our highways and bridges. MassDOT has been rehabilitating all of the Cape's Rail infrastructure for several years now to increase its expanded use into the future and needs to be put to good use.
- Lights on major roads and all intersections
- Depending on your budget, there is my opinion. One thing that needs to be done, needs to be done. Well, it needs to be done tomorrow. That is to fix the bridges and to add a bridge. 100% focus should go to that project everything else is irrelevant if we can't fix getting on and off the Cape. It's reached critical mass.
- Expanding suicide alley to accommodate the number of daily commuters than summer traffic.
- Occasional "Tourists-Concierge" buses (small or vans) picking up and bringing back home, for a few hours of visiting highlights of the Cape.
- IMPROVE THE OUTDOOR WAITING AREA SHELTER AT BARNSTABLE PARK & RIDE BY PROVIDING DOORS AND OVERHEAD HEATING. THE CURRENT CONDITION OF THE SHELTER IS INEXCUSABLY UNCOMFORTABLE FOR BUS PASSENGERS, PARTICULARLY IN WINTER.
- Pedestrianization of high-density shopping districts
- More bike lanes

- "1) Tourism tax to pay for housing for seasonal employees. 2) Tourism tax to pay for limited income/elderly housing."
- "Do we have to have canal bridges replaced? Couldn't we eliminate bridges and go with different ideas? "
- "Purchase tickets from a person at the station Bus station is closed for buses at 5:30 am"
- Build the new Sagamore bridge before taking down present. Or repair present to become one-way lanes.
- Lower speed limits on 6A
- CCRTA needs to update and enhance many systems. GPS tracking of buses is inconsistent, some buses just do not show up in an app. when they make an error like not reviewing and then misprinting schedule errors on the Flex bus, they need to fix it right away, not tell passengers it will stay wrong until the next schedules are printed. That is not how a public entity serves the public. There are a lot of good things about the CCRTA, but it needs to be pushed forward to meet needs here.
- The on ramps onto route 6 are a nightmare. They aren't long or wide enough. People merging onto the highway cut off cars on the highway, going 50 - 55 mph, almost causing accidents, & slowing the flow of traffic down to 40 mph. People either don't know what "yield" means, or they ignore it. There should be stop signs at the end of the on ramps, forcing people to look before they cut off existing traffic & cause an accident and/or more traffic backup. Maybe the police should be parked at them so they can ticket people for failure to yield the right of way.
- Improvement in air options to Provincetown. Service to New York at seasonally.
- Expand parking at Sagamore bus stop.
- Anything that can prevent me from being stuck in a 45 minute back up at the Bourne Bridge- monitoring, a sign on 195 east, a warning about bridge work ahead of time, recommendations about summer traffic, ANYTHING!
- More bike paths, or bike lanes made.
- Vision 88 connection from Cape Cod Canal Path to the to be completed Multi-Use Path on the Service Road in Sandwich
- "Road diet plan in Eastham as recently described. Reduction from 4 to 2 lanes between Brackett Rd and Wellfleet. And continue that into to Wellfleet Main St intersection."
- None
- As someone that relies on two feet, biking, and public transit, I would be interested in a shuttle service between the beginnings and ends of the bike paths. A bus route that goes directly from Downtown Bourne to Downtown Falmouth and Downtown Sandwich would be nice since it is more efficient than changing buses in Mashpee. I would also like CCRTA to do digital fares on the bus as the VTA does already.
- Learn how to control traffic if there was ever an emergency, we would never get off Cape.

- Reliable, regular, fast, and cost-effective train service to Hyannis. Or even to Sagamore. The current public transport options are expensive, unreliable and have unsuitable timetables for Cale Cod commuters.
- Direct rail service from Hyannis to Grand Central Terminal or Penn Station New York City, and direct rail service to Providence, Rhode Island.
- "Expansion to the Cape Cod bike trails WITHOUT REMOVAL of the railroad tracks. Regular year-round train service for Cape Cod residents. Establishment of a train station at the former North Falmouth train station with regular service off Cape "
- Daily train to and from Boston
- Increased air travel from Hyannis to Boston / NYC / Philadelphia. Hyannis is perfect for being the transportation hub of Cape Cod!
- "Dense housing in downtowns/commerce centers Elimination of any existing parking minimum requirements Street tree promotion Native plant and habitat conservation More stop signs and less traffic signals"
- Sidewalk and/or bike lanes on 6A between Barnstable & Sandwich
- Expanding bike and rail transportation is KEY.
- addressing traffic congestion Orleans to Wellfleet
- Bring back the trains to and from Boston year-round.
- multi-use paths and protected bike lanes that do not come with expanded roads. more paths that are not right next to cars. pedestrian bridges over the canal. restoration of local trains.
- We need an easy way of using the Bourne bridge as an alternative to the Sagamore - that allows a real Highway connection to Rt6 that isn't impacted by traffic from the Sagamore (East Sandwich, Marston Mills)
- Encouraging development of denser housing near rail/bus/other transit hubs
- Better signage in Falmouth & woods hole about parking for the ferry. It's not clear coming down 28 where the lots are for the ferries & that parking in woods hole is all metered. WHOI lots get used by tourists & parking can be terrible in the summer. Also, employees of WHOI & MBL should not have to pay for metered parking if there's no space in the lots because tourists park inappropriately. It would be nice to be able to get a pass or a rebate.
- a year-round passenger rail for locals on Cape Cod to travel and commute to Boston. Multiple trains a day including late night and early morning trains for people who are traveling and especially those who work in an industry where their work schedule requires them to be at work / get out at odd hours such a public safety workers and medical staff. The price for parking and options for people are so limited and it will cut down on the number of vehicles on the road commuting and improving environmental ramifications by decreasing the amount of people driving back and forth to Boston and decreasing the cost of the individuals as well.

- Any projects that strengthen transit or active transportation, particularly for non-seasonal residents and/or visa workers.
- none - you've listed all the important ones.
- We need a railroad option to access Boston and Providence. As a retiree I have stopped driving and would like to be able to access Boston or Providence by train.
- Boat shuttles - for example - Wellfleet to Provincetown to get cars off of Route 6.
- "Expand ferry routes to/from Boston, and ferry routes between Cape towns. Preferably with low emissions ships. Improve multi-modal transportation (e.g. bike/bus, bike/rail). Including parking near bus/rail stations. Develop car sharing in general, for regular commuters (e.g. home to workplace, or shopping centers, downtowns). Develop boat sharing system and community. Facilitate bus chartering for special events (e.g. concerts, town hall meetings, etc.). Increase and facilitate access to point-to-point mini-bus or individual car rides, especially to healthcare facilities year-round. Develop public transportation to farmers markets, parks, beaches, to promote healthy lifestyle and strengthen community. Develop bike sharing and bike rental in beach towns. Increase numbers of train connecting Cape Cod to Boston. Increase connection to New Bedford, Providence (bus, rail, ferry). Facilitate and promote businesses in the public transportation sector. Improve visibility to local airline and facilitate access to it. If people have to travel by air, can they avoid going to Logan and use a more local airport and airline; better for the environment, the local economy and more convenient for people. "
- ANYTHING to do with sidewalk and bicycle accommodations.
- "1. Canal bridges replacement. 2. Pedestrian overpass at Stotts Corner Rd/Rt. 6 in N. Truro"
- "Improve ride share options and bus transport to health care centers / doctors for everyone, especially elderly who cannot drive; enhance bicycle safety and educate drivers about sharing road space with bike riders and pedestrians. Explore bicycle share program. Review regulation of e bike rules / safety, etc. Improve bicycle access to buses and trains and other public transportation. "
- We need to promote more options that utilize the THIRD BRIDGE that we already have! TRAIN SERVICE!
- Replace canal bridges.

QUESTION 11 – BUDGET CHALLENGE

Recognizing that a limited amount of funding is available to address the transportation problems in the area, respondents were asked to indicate their level of support for the following strategies. For each strategy respondents could assign from 1 to 5 stars.

Level of Support for Strategies

STRATEGIES CATEGORIES	AVERAGE LEVEL OF SUPPORT (STARS)
Roadway projects to correct safety issues	3.90
Roadway projects to reduce congestion/improve air quality	3.76
Roadway pavement maintenance	3.95
Bicycle/pedestrian improvements	3.78
Transit service	3.92
Intelligent transportation systems (e.g., travel time message boards, real-time traffic monitoring)	2.94
Climate Adaptation (Resiliency projects including addressing low lying roads)	3.18
Climate Mitigation (e.g. Electric vehicle charging stations, electric buses)	3.19

OTHER COMMENTS

A final text box was provided for respondents to provide any additional comments or suggestions. Responses included:

- The Seashore is a wonderful amenity to have for enjoyment; however, there is no reason why NPS can't allow use of a small portion of parkland to allow bikeways/pedestrian paths away from Route 6.
- Support Mass Coastal and it's rails on Cape Cod, they are not specifically for sightseeing and we already have Cape Cod Central trains for that reason. Removing Cape Cods last existing rails would be a total mistake and would only cause more emissions. Removing the Rails would also cost millions and probably billions just to rip them up, removing a huge part of Cape Cods history.
- return the railway to Woods Hole
- We need more rail and service everywhere, and sidewalks.
- The rail trail projects are degrading to local transport and industry and need to be stopped.
- I didn't see anything about reducing car trips in this survey. That is much more effective than any kind of "climate mitigation". Fewer car trips means less congestion, less wear and tear on roads, and safer roads.
- I do not think public EV charging stations should be a priority. The Cape is not so large that people cannot charge their vehicle at home and get through their day. A comprehensive shared use path network is a relatively inexpensive goal that has a large amount of support among the community.
- "Please the most important thing you can do is add/create/construct/make more Sidewalks. So that humans can safely travel by Foot/Bike/Wheelchair. Make it safe for anyone to walk, especially someone with any type of disability or uses a wheelchair or walker or cane or service animal. Many roads need sidewalks. Area of significant need is between Route 130 / Dale Terrace and Route 130 /Route 6A. There is even a sidewalk and crosswalk at Dale Terrace that crosses Route 130 into someone's house bush. This is a recent extension as there are ADA part of the sidewalk. And it was instilled between 2011-2018 and never finished. This would allow safe access to Heritage Museum and Gardens, St Peters Cemetery, Freeman Cemetery, Bay View Cemetery, Shawme Crowell State Forest Campground, American Legion, please help make this happen as it would benefit many citizens in the community. Thank you. Sincerely."
- "Year-round ferry service between Boston and Provincetown would reduce auto emissions and congestion. Year-round Cape Air flights to Manhattan would reduce auto emissions and congestion. "
- Thanks for asking.
- Electric bikes are a game-changing transportation option, with prices falling rapidly, batteries improving, and new models (such as cargo and family options) coming onto the

market. They are 1/20 the cost of electric cars, putting them in reach of a lot more people. However, there is NO safe bicycling infrastructure on the Cape besides recreation-oriented rails-to-trails. There needs to be a lot of installed bike lanes that are physically separated from car traffic via concrete/trees/plantings to make it safe to use bikes for everyday transportation. Simply slapping down some paint for worthless "sharrows" or giving bikes two feet of the road shoulder with only paint protecting them from multi-ton vehicles traveling at 50 mph will do nothing to increase use of bicycles as a means of transportation.

- In summary, more bike paths and EV chargers!!
- Bus routes need to be more frequent, have a variety of routes, some direct along rt 6, some weaving in and out of towns, need easier access getting to main ports like Provincetown, Hyannis, and Boston. It would be nice to see local busses going back and forth to Worcester/Providence daily or bi-weekly as well.
- I think many of the "problems" addressed by the previous page's priorities would be obviated by improving the prospect of non-car travel options. This would reduce congestion and road wear, and therefore reduce the cost of long-term upkeep. Falmouth has prioritized car travel and parking (despite studies showing that small businesses perform better when the area is more walkable, rather than having more parking), leading to miserable walking and biking options unless you're lucking enough to live in the very center of town. All the proposed vehicular transportation options wouldn't be necessary if people could just walk and bike. Thank you for your time, and for helping make the Cape a more sustainable place to live.
- Harwich Exits are a great hazard.
- Questions 12-18 were nearly impossible to answer without at the very least a definition, e.g., what is "transit" in this context?, and additional information to make an informed reply... poor, survey construction that will undoubtedly yield biased results.
- A lot of students around my area have cars because they are necessary. It would be so nice to have nice cycling infrastructure and transit so that a car isn't necessary for basic needs. And it would result in less cars on the road too!
- Route 6 from Eastham to Provincetown is in rough shape in many places, especially through Wellfleet and Truro. We are hoping that resurfacing is planned for the near future!
- I would love to see year-round ferry service for those of us who live in Provincetown during the winter and need to get to Boston for work travel. Short of that, it would be great to see a rail service that extends to Provincetown or at least more frequent direct bus service to Logan Airport.
- "Protect our endangered migratory wildlife Corridors. Halt high density development of our Hyannis Village. "
- Bridge maintenance and road pavements should be separate questions. Road pavement is important but bridges I think are way more important to get funding for now. They're not going to last forever and we spend so much each year trying to maintain them. Please don't

increase taxes. Property taxes just doubled here for everyone as did electric and HOA fees and everything out. You'll kill us. Do some fundraising. I'd give a few dollars here and there when I'm out shopping. Get some grants from the mega rich who vacation here. Add bricks to the walls or something or some kind of plague with their names on it.

- Safety for pedestrians and biking, please.
- Retired
- Improving bike infrastructure (separated bike lanes, not paint on the road) a huge priority. Also improving public transit so it's frequent and widespread enough to actually be convenient. Once/hour and unreliable at that does not cut it. Work with bus lines (Peter Pan and P&B) to stagger route times. Buses from Logan to Falmouth or Hyannis leave within minutes of each other, then there is a long gap. Split the difference!
- There needs to be a way to convince parents that it is safe for their children to take the bus to places like the YMCA or the boys and girls club from school.
- Thank you for your outreach. Addressing and encouraging active transportation options will benefit all.
- Big fan of Amtrak and other train services, especially given our aged population; the more ways we can get around without driving, the better for everyone.
- "We can't expect State and Federal money to pay for all of this so the towns will have to contribute also. Will be difficult to get through Town Meeting. Re pedestrian town centers: all of Europe does this, we can too. "
- More police enforcement to slow down traffic on town roads in Provincetown.
- Would love to see more money spent on our communities to improve public transportation, more sidewalks for people to feel "welcome " to walk around town .
- I work with young adults who have a variety of disabilities. I work with students who are transitioning from child services to adult services. My main role is to help prepare them for the work force. I have been doing this work for nearly 5 years now and our biggest and most consistent barrier is transportation to and from work. Most of the young adults I work with rely on public transportation or other varieties of transport such as Uber/Lyft. It is disheartening and upsetting when a young adult finds a job that works for them, however, they aren't able to get there due to the services offered being so limited. For example, if a young adult needs to be at work by 9am, in our experience we have been told it isn't possible with DART. We then look at other options like fixed route. The fixed route ends up not working more often than not due to the timing. It could get them there by 9:49 maybe but not by 9. We then look at Uber and the Uber maybe 40dollars one way. With individuals looking to enter the work force who rely on others for transportation and are on a fixed income it leaves our options for employment limited. At the end of the day to have transportation be the reason an individual can't work or work where they would like to is deeply upsetting.

- "More information and Data available at SMARTcitizenstaskforce.org This organization has been working for many years to make sense out of regional transportation with the region defined by a line drawn from Providence to Boston and all the municipality south including Cape Cod, Nantucket and Martha's Vineyard. "
- increase bus service to outer cape year-round.
- Mashpee deserves a bike path to get people safely to town without the use of sidewalks and the congested roads. It is not okay that the sidewalks are advertised as bike paths as that is dangerous and illegal. People end up biking way to fast at people with strollers or walking and it becomes a dangerous situation.
- work harder and get jobs done faster.
- Can't wait to see all the improvements. Especially in Falmouth/Woods Hole (the cape) so touristy on the summers that the improvements will be amazing.
- Priority is to improve transportation in an environmentally sensitive way for the people who live and work on the Cape. We should not make improvements that encourage more people to come by getting here more quickly. I.e. to building infrastructure needed for only 10-12 weeks of the year.
- Build more higher density housing, public transit and pedestrian and cycling infrastructure (to Stores not random places) Link cul-de-sac neighborhoods with ped/cycling paths. Daily train service to Boston. Require private bus companies to link to Kingston MBTA. Safe, comfortable separated bike lanes. Do not increase car lanes, it just makes the traffic problem worse. regular (once an hour is not usable for most), reliable bus service to beaches/stores. Change zoning laws to allow for more density and link those places with bike/ped and public transport while at the same time restriction # of parking spaces. Safe and comfortable bike lane on new bridges. Do not increase car infrastructure.
- There is nothing wrong with our roadways. They do not need to be widened, nor do we need to have sidewalks. We just need to have limits, and intelligence. These are our roadways. We live here, not the tourists. Please, I urge you, to think about the inhabitants of Cape Cod before the worshiping of the Almighty tourist dollar. We need breathable air again. We need to be able to drive in the off-season in a normal amount of time. We need the noise to stop. We need beautiful Cape Cod and we need our peace of mind back. Again I urge you to think and care about all of the inhabitants of Cape Cod first and foremost. We mean a lot more than any amount of money ever possibly mean. We are worth it and so is Cape Cod.
- Please don't spend to much money on electronic traffic signs. Most everyone has an App on their phone today (as example Waze) that tells them what the traffic is like.
- Stop trying to "fix" traffic and proceed to eliminate railroad connections on cape cod
- My interest is in traveling to the cape to visit from elsewhere in Massachusetts.

- Focus on rail and bike concurrently! Parking across the CAPE in towns is difficult and there needs to be minor transport from a remote parking area to town shops, stores, attractions, beaches
- Thanks for the survey. Hope it helps.
- Good survey! Believe in cape coda future. Reduce congestion for us full timers and keep the cape the cape!
- Rename the CCRTA to the "Sea Creatchah"
- Please pay attention to needs of populations on-Cape ... especially needs of youth (schools) and young workers
- Think about the people who have to commute everyday not just the handful of bike riding and power walking tourist. Support our local industry and railroad Mass Coastal.
- I think with success of South Coast Rail that MassDot and the CCRTA should "see sense" and quit wasting infrastructure for a rail trail that could and should be used for rail service 'as railroads were intended to be used'.
- I am looking to volunteer Falmouth Hospital. I am working to establish consistent regular transportation to and from the hospital. I am finding that as an individual who lives in west Falmouth, does not drive and has a disability that my biggest challenge is securing transportation to Falmouth hopsital. I have explored the DART and it won't get me there till 10 i need to be there at 9. I have explored the fixed route sealine however the nearest stop to my house is the hospital and is 4 miles away, i have explored the ADA paratransit however, live too far from the fixed route to meet the eligiabilty of 3/4mile from fixed routes. It is beyond frustrating that transportation is what is limiting me from volunteering. Options like uber or taxi can be financially burdensome particularly on a fixed income. I sit here writing this wondering how am i supposed to get out there and be a part of the community and society if i can't get anywhere.
- More Trains and Bikes. Less car dependency. Shared Rail and Bike corridors. Build bike paths along side rail lines. More year round trains. Stop subsidizing cars.
- Replacing the Canal bridges should be the highest priority for the Cape
- Please follow the examples of other countries and be pioneers for expanded rail services. Countries like the Netherlands, Germany, Italy, and many others rely on train service. Trains are efficient, better for the environment, reduce traffic congestion and pollution, and provide a relaxing way to travel. More Americans should use this excellent way to travel.
- Funding always seems to be a issue however, other states seem to have better infrastructure for half the money we pay here.
- "I would gladly replace my private car with public transit and biking/walking if local transit options made this feasible. I intentionally moved to a walkable community (downtown Orleans) with a bus stop that connects my home to my workplace. I only work two towns away and my driving commute is 25 minutes, but using the bus would increase my commute time to almost two hours each way (that's four hours daily!), which is just not

reasonable. Additionally, the bus doesn't run on Sundays, which is a workday for me and many other Cape residents. The bus service needs to have more routes and quicker point-to-point transit times in order to increase ridership. Travel to and from major cities like Boston, Providence, and New York is difficult without a personal car. Improved rail and ferry access on and off Cape would alleviate car congestion. The bus options that currently exist are not ideal because the riding conditions can be unpleasant and they often sit in traffic with the cars. Car-sharing options that are affordable, convenient, and flexible would also allow those of us who don't really want a personal automobile but have one anyway because of weekly trips (grocery, transfer station, etc.) get those cars off the roads. I'd much rather borrow a car for a couple hours or a day to run errands, then return the car so someone else can use it. Zipcar does not appear to be available on the Cape and it's a costly service to use. UBER is also expensive and doesn't have as much flexibility because you have to negotiate your ride with a driver. A local, subsidized car-sharing service would make a huge difference for those of us who are willing to give up personal vehicles but need car access on occasion. "

- "Tens of thousands of trucks go through Bourne each year from off-Cape to Martha's Vineyard. The freight they carry should be shipped from New Bedford. Keeping the rail in place through Bourne would kill the prospects for the the mixed use path. That path would be much more valuable than is the old railway."
- The importance of road surface quality, road safety infrastructure, and year round rail transportation have been ignored far too much in the Barnstable County area.
- More bike infrastructure people can actually use to commute!
- Please - many more EV fast charging stations at shopping destinations and the beach (places where people would naturally spend an hour or more). Also, please - more transit. I'm fine driving (now), but most Cape residents are older, and there needs to be a robust transit system for those who aren't comfortable (or shouldn't be) driving.
- Thank you for working on this issue.
- Concerning your questions involving future initiatives you should have included an answer indicating lack of support for that initiative. When someone is against a question posed, there should have the option to say “NO” and not NEUTRAL. Secondly why hasn’t there been a study for one bridge over the Cape Cod Canal on the vicinity of the “ high tension lines”? There are sandpits on the Scenic Highway side and the Military Reservation on the Sandwich Road Side. Access to and from the bridges to Rte 6 and Rte 28 (Falmouth) through the base. The same can occur with access roads from Rtes 3 and 25 through the sandpits.
- One question that was not asked. Are you a year round resident. This is very important because of the impact of the non resident summer resident.

- Affordable, reliable, entire year bus service should reduce congestion, improve air quality, allow workers to access more affordable housing wherever they may work. This is a key element to address the affordable housing crisis.
- Transportation investments must be coordinated with housing, education and health care issues. Equity requires that we recognize the legitimate needs of all people.
- Thank you for all of the work that you do and for providing us the opportunity to participate in this survey!
- There are roadways/places where increasing biking is inappropriate and unsafe. Also moving toward electric vehicles sounds good in theory but do we have the electricity bandwidth to actually do so? Seems that needs to be addressed before making any significant investment. Increasing train access--if the metal can do so--would be a great help to commuters and vacationers
- "Route 28 from Bourne to Falmouth could easily have a bike lane installed in the median. A foot bridge could be constructed for access to this. Also a traffic signal at Waterhouse Road merge onto MacArthur could help alleviate both accidents and back ups. "
- why replace the bridges with all the cost and future maintenance that is associated with it. I say fill in the canal make the larger ships that use it go around and plan a roadway system that will work. I'm sure the cost will be less to do than replacing the bridges and in the long run road maintenance will be less cost then bridge maintenance.
- Making automobile transportation easier is not going to help. The easier it is to use cars, the more cars there will be on the roads. The bridges do need replaced but making them 3 or 4 lanes in each direction is absurd. 2 lanes 12' wide in each direction along with bicycle and pedestrian ways in each direction is all we should be building.
- Any improvement should be made with the year-round population as a priority.
- Living here is amazing. I've lived here my whole life. If year round traffic is this bad, and where is a miles long back up every day due to bridge work and road work, the summer will be impossible. People who visit here should not be allowed to bring a car onto The Cape. Our roads are being ruined, they were not built for this. Maybe tourists who are staying here should have to pay a fee when they book their reservations, and that money could be used to improve the roads.
- talk to the people who ride the bus
- "Look at other states like Maine ... they have added new bigger bridges alongside existing bridges without disrupting service to highways ....smooth and there roads are much nicer use different pavement.... and they get worse weather. "
- All projects handicapped accessible
- Having a link from Shining Sea Bike Path to Canal Bike Path would be nice, but NOT if it means eliminating current rail line to MMR used by trash trains. Also, want to keep rail line to Pocasset, maybe find a way to extend further South towards Falmouth?

- Need to fully utilize the Railroad lines on Cape Cod to help reduce truck / car traffic congestion.
- Make it safe to walk or ride bikes
- Thank you for providing the opportunity to comment.
- Thank you for this thorough and easy to navigate survey.
- I would much rather take a bus to work in the morning or take a train to Boston than drive in Cape Cod traffic. It's safer, easier, and frees people up to focus on other things other than selfish drivers who do everything they can to cut a few seconds at the cost of everyone's safety.
- Rotary traffic is dangerous in the summer near the Hyannis airport. Large car transports should not be allowed
- This project of building 2 new bridges is way overdue.. Police traffic control should be included in the costs.
- I'll be looking for the tangible results of these efforts, thanks.
- Thank you for doing this survey!
- Need more crosswalks and traffic lights on streets like Quaker Meetinghouse. Streetllghts on major roads.
- The lack of public transport options on the Cape is shameful, particularly when the age of the population is taken into consideration.
- "Walking and biking needs to be made safer and more people will do it. Also higher density and mixed land use in village centers would allow more people the ability to substitute walking for car trips. Ending Stop And Shop's land covenants preventing grocery sales on property they have bought and sold would also allow better access to groceries while reducing car trips. Finally, more consideration should be given to how to move people on and off the Cape, especially at peak in-season times. There is no direct bus service from places like NYC, which leads to more cars entering and leaving the Cape. Rail-ferry connections don't always align. As more people will have the ability to work remotely most of the time, there will be an increased need to service the occasional trip to places like Boston, Providence, New Haven, and New York City -- those trips will likely be done by car if transit improvements aren't made. "
- "Cape Cod needs more transportation options for those with low income and those who do not/ cannot drive. The current bus network is limited and the infrequent service hinders regular use for many people. With large increase of road traffic the current state of the two bridges is inadequate for the region and a major safety hindrance should there ever be a major evacuation of Cape Cod for any reason. Residents and Tourists need more ways to get on and off Cape Cod in a timely fashion. One example is more frequent train service. As it currently stands, the summer Cape Flyer train service only provides appropriate scheduling for those coming from Boston to Cape Cod and is mostly unusable for Cape Cod

residents. Recently Cape Flyer tried to get approval for additional trips during their summer service but was denied access to the railroad bridge by the Army Corps. Of Engineers."

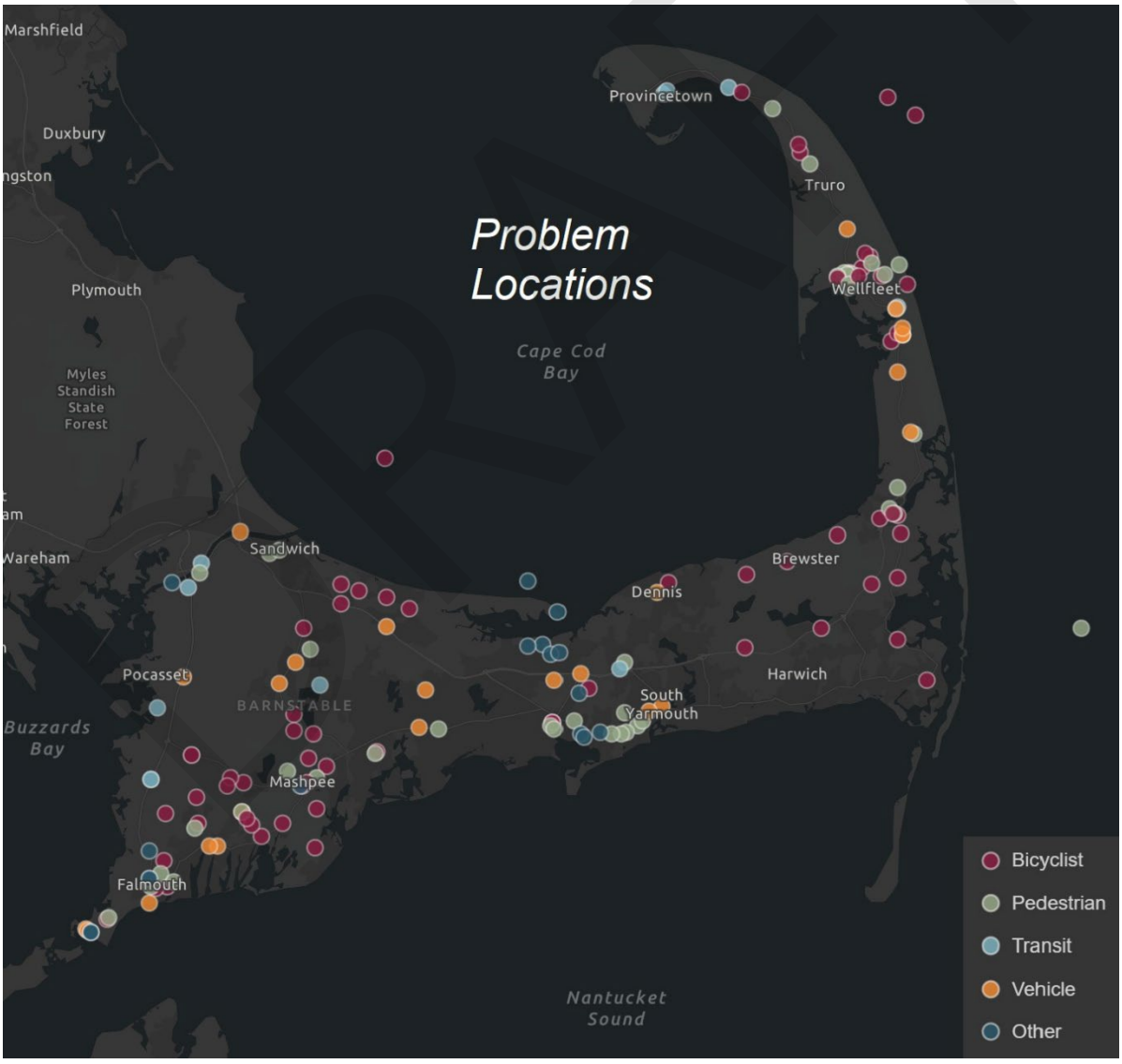
- Thank you!
- Bring back the trains to and from Boston year round
- Need to focus on mode shift. Expanding the bridges will increase car pressure on local roads. Should not increase car capacity on cape. When thinking about climate - subsidizing EVs is not a good investment - again, focus on mode shift. make biking, walking, and public transit better.
- Please design pedestrian paths separately from bicycle paths
- The bridge traffic & safety issues are the most important items to address. I think better signage & travel times would be economical & easy ways to improve traffic & parking issues. There is definitely not enough information or signage on route 6 or 28. Also driving down 28 from Falmouth to Hyannis is the worst. I would go over the bridge to do shopping or make doctors appointments just to avoid having to make that drive down 28. The Bourne bridge might have a lot of traffic but I've worked my weekend plans off Cape around when there will be traffic.
- Thank you for this opportunity to weigh in. I hope the decision makers listen to the input. However, I'm not sure that you will get a representative sample Cape-wide as many folks may not have access to this survey - so the results may be skewed toward those with more education & income. Just sayin'.
- A railway option is needed for Cape Cod.
- I think its imperative that we focus our transportation improvement policies and programs on expanding transit and bicycle/pedestrian transportation, given our climate emergency state and Cape Cod's traffic congestion. We should be as focused on that - and spending as much - as we do on the bridges. Im also concerned that the future bridge projects will induce more car travel to the Cape. ... Also, electric bikes are great for some, and the Cape LIght Compact subsidy has been helpful, but I worry that we're ignoring the benefits of regular bicycles, which are cheaper and better for the environment. Why not provide a subsidy program for non-electric bikes too? ... And thank you Cape Cod Commission for all our good work!
- "I would like to see more information about access to public transportation, not only locally, but also regionally (MBTA). Thank you for putting together a great survey!"
- Please consider adding sidewalks along Sandwich Road between Sandwich and the Bourne Rotary. We are stuck here.
- "Improving public transportation options, expanding the bike trails and making them safe, improving pedestrian safety and encouraging the use of e bikes and electric cars are all excellent projects. "
- Railway from Hyannis should help with bridge traffic over the canal if connected to Boston.

SURVEY MAPPING EXERCISE

Following the survey questions, respondents are taken to the mapping exercise. Cape Cod Commission GIS staff prepared an online mapping tool to help respondents identify specific locations under the following classifications:

- Traffic safety problems
- Traffic congestion
- Bicycle/Pedestrian trouble spots
- Other issues that impact daily transportation needs

Identified Problem Locations - RTP Online Survey



The responses gathered in this exercise are being formatted into an online map that will be shared with local Departments of Public Works Departments, MassDOT, the CCRTA, and other agencies. Written comments included in the mapping submission are listed here by location, type of problem, description of problem, and additional comments (written comments may be missing inputs in some of these fields).

Responses included are as follows:

- Shore Road – Transit - Improve transit service on Shore Rd - Low lying road and a priority area in town.
- Bicyclist - Need BIKE PATH
- Wellfleet to Provincetown – Bicyclist - Lack of bike infrastructure - Build a bike path.
- Vehicle - long frequent back-ups at intersection - makes turning left from 130 onto Pimlico Pond difficult and stressful.
- Route 6 – Bicyclist - Lack of bicycle and pedestrian accommodation
- Route 6 @ Stott's Crossing – Bicyclist - No safe crossing for people on bikes or walking - Extremely dangerous to cross.
- Orleans – Pedestrian - Lack of sidewalks from bay to ocean - need bike lane and/or sidewalk across town, not just in a few different areas.
- Orleans – Pedestrian - sidewalk from bay to ocean - lack of sidewalk or shared use bike path consistent across town Main Street from ocean to bay/rock harbor.
- Provincetown – Transit - infrequent service - It takes over 3 hours to get to Hyannis by Flex bus. We need an express service that doesn't stop every 10 feet.
- Town centers – Transit - No bike share system - CCRTA need to implement a Cape-wide bike share system to enable last-mile and short trips from bus stations/stops in town centers.
- Hyannis Transportation Center – Bicyclist - Need a bike share system for trips from the HTC around town - No way to get to destinations from the HTC without a car.
- Hyannis Transportation Center – Bicyclist - No secure bike parking - Need secure, indoor bike parking.
- Hyannis Transportation Center – Bicyclist - No secure bike parking - Need secure, indoor bike parking.
- Route 130 – Bicyclist – Safety - Share use path stops along road with medium daily vehicle traffic.
- Route 151 – Bicyclist – Safety - Share use path stops along road with high daily vehicle traffic.
- Sandwich Road - Bicyclist – Safety - No protected bicycle lane along road with medium daily vehicle traffic
- Gifford Road – Bicyclist – Safety - No protected bicycle lane along road with medium daily vehicle traffic at high speed

- Route 28 – Bicyclist – Safety - No shared use path along road with high daily vehicle traffic at high speed
- Quinaquisset Road – Pedestrian – Safety - No sidewalk along road with vehicle traffic near shopping center
- Mashpee Rotary – Bicyclist – Safety - No pedestrian or cyclist accommodations
- Old Barnstable - Pedestrian – Safety - No sidewalk along road with medium vehicle traffic
- Route 6A – Safety - No shared use path along road with medium daily vehicle traffic
- Mashpee Commons – Bicyclist – Facilities - Lack of bicycle parking
- Mashpee Pickleball Courts – Bicyclist – Facilities - Lack of bicycle parking
- Goodwill Park – Bicyclist – Facilities - Lack of bicycle parking
- Route 130 (Between Route 6A and Dale Terrace) – Pedestrian - No Sidewalk (No room to safely travel by Foot/Bike/Wheelchair) - No Sidewalk (No White Lines on Either Side of Road Yellow Center Line Faded, Some Areas Not Visible At All Depending On Weather Or Time Of Day One Is Forced To Walk/Ride/Wheel In Road Risking Life)
- Route 6A (Between 65 Route 6A Stop & Shop and the Route 6A Sandwich / Bourne Town Lime (Sagamore Inn Restaurant)) - Pedestrian - No Sidewalk (No room to safely travel by Foot/Bike/Wheelchair) - No Sidewalk (No White Lines On Either Side Of Road Yellow Center Line Faded, Some Areas Not Visible At All Depending On Weather Or Time Of Day One Is Forced To Walk/Ride/Wheel In Road Risking Life)
- Union St. (Between Whites Path Rd. and Route 6A) - Pedestrian - No Sidewalk (No room to safely travel by Foot/Bike/Wheelchair) - No Sidewalk (No White Lines on Either Side of Road Yellow Center Line Faded, Some Areas Not Visible At All Depending On Weather Or Time Of Day One Is Forced To Walk/Ride/Wheel In Road Risking Life)
- Orleans - Merge of two roads difficult to see (many bike/car crashes)
- Winslow Gray Rd. (Between Buck Island Rd. and 80 Winslow Gray Rd. (Joshua Baker Rd.)) – Pedestrian - No Sidewalk - No room to safely travel by Foot/Bike/Wheelchair - No Sidewalk - One Is Forced to Walk/Ride/Wheel in Road Risking Life
- Rt 28 & Cross Road – Bicyclist - no way to safely ride a bike towards town without rerouting either south to the bay or far north - Rt 28 needs bike lanes.
- Rt 151 & Boxbury – Bicyclist - high crash area, only a blinking light - Falmouth data shows this area is high for crashes and it is very dangerous for cyclists. 151 needs a bike lane and this intersection needs a stop light.
- Route 28 - 931-975 Route 28 Yarmouth (In front of and between Moonshine, Skull Island, Brentwood Motor, Pancake Man) - Pedestrian - Sidewalks Without Ramps of No Use to Those in Wheelchair Those in Wheelchair unable to use sidewalk and forced to travel in road risking life. - No Sidewalk Ramps (One Is Forced to Walk/Ride/Wheel in Road Risking Life)
- In Front of Seafood Sams Route 28 – Pedestrian - Fire Hydrant Blocking Sidewalk (Making It Non-Accessible to Those in Wheelchair) - Fire Hydrant Blocking Sidewalk (Making It Non-

Accessible To Those In Wheelchair One Is Forced To Walk/Ride/Wheel In Road Risking Life - No Room To Safely Travel Move Fire Hydrant A Few Feet Allowing Safe Travel)

- Corner Of Seaview Ave. / Route 28 / Moose Lodge – Pedestrian - Sidewalks Without Ramps (Of No Use to Those in Wheelchair - Those in Wheelchair unable to use sidewalk and forced to travel in road risking life.) - No Sidewalk Ramps (One Is Forced to Walk/Ride/Wheel in Road Risking Life)
- Route 28 - Across Street From (Peir 7 Condominiums 711 Route 28) - Just Before Parkers River – Pedestrian - Utility Pole Blocking Sidewalk (Making It Non-Accessible to Those in Wheelchair) - Utility Pole Blocking Sidewalk (Making It Non Accessible To Those In Wheelchair - One Is Forced To Walk/Ride/Wheel In Road Risking Life - No Room To Safely Travel - Move Utility Pole A Few Feet Allowing Safe Travel)
- Between (573 Route 28 Mariner Resort) to (615 Route 28 Past Time Cards) - Including Though Not Limited To In Front Of Mobile/Great Island Plaza/West Yarmouth Post Office/ Scallys Irish House/Sharkys Beach Shop – Pedestrian - Sidewalks Without Ramps (Of No Use To Those In Wheelchair - Those in Wheelchair unable to use sidewalk and forced to travel in road risking life.) - No Sidewalk Ramps (One Is Forced to Walk/Ride/Wheel in Road Risking Life. Please Fix.)
- Otis Rotary – Vehicle - Unsafe approach - People on 28 approach this rotary at highway speeds and assume right of way to enter as though there was no rotary present. New signage did not help. Need bolder signage and rumble strips on the approaches.
- Sandwich Road, between Teaticket and Rt. 151 – Bicyclist - Bike Lane - A bike lane from Teaticket to 151 is a perfect way to connect the center of town to nature trails and create an artery for non-car travel for both safety and decreasing congestion.
- Surf Drive- Vehicle - Frequent flooding, sand hazard - This road is heavily impacted by water and sand to the point of being difficult to use during storms and requiring frequent bulldozing of sand. It is also unsafe for the cyclist and pedestrians who use it heavily. Can't this be solved more permanently?
- Sandwich Rd – Pedestrian - Sidewalks needed - Too many people walking or biking along Sandwich Rd. It's dangerous. We need a sidewalk or a bike path.
- Around 685 Main St, Falmouth – Bicyclist - Bike path towards the East gets really narrow and doesn't accommodate bikers anymore; this creates a very dangerous situation where bicyclists slowly need to enter the street which is easy to miss for car drivers; so, bikes and cars regularly get very close.
- Tom Landers - Bicyclist - safer biking - wider road, multiuse path, or defined bike lane
- Route 28 – Pedestrian - Extremely poor sidewalks
- 6a & Hope – Vehicle - Congestion and dangerous crossing for vehicles - Congestion and dangerous crossing for vehicles
- Pedestrian - Unsafe ped crossing
- Pedestrian - Unsafe crossing

- Route 6 in Eastham – Pedestrian - Unsafe for pedestrians and bikes on Route 6
- Route 6 in Eastham – Vehicle - Speeding cars
- Barnstable P&R – Transit - Not enough parking spaces - Without confidence that spaces are available to catch bus, people are more likely to drive. Expansion of lot might be part of canal bridge replacement program, reducing vehicle trips during construction.
- Independence Road – Vehicle - Consider extension parallel to Mid-Cape to provide new E-W connection.
- Commerce Rd – Other - low-lying area - floods out in storms
- Barnstable Harbor Bridge on Millway - low lying so floods out.
- Indian Trail/ Mary Dunn Rd/Rt 6A – Other - low vehicle visibility - many car accidents here
- Woods Hole Rd – Bicyclist - Need for bike lane/shared use lanes.
- Woods Hole Rd – Pedestrian - Need for pedestrian path / multiuse lane.
- Main Street – Bicyclist - Lacking safe bicycle connection from Shining Sea Bikeway to businesses on main street - Adding protected bike lanes to connect the Shining Sea Bikeway to the center of Falmouth along Main Street would both increase safety and encourage cyclists to patronize the small businesses along Main Street
- East Falmouth – Vehicle - Cars turning left into Dunkin - congested area in summer, backs up Rte 28
- Acapesket Rd. and Rte 28 – Vehicle - Cars turning/exiting - Road junction is misaligned and very busy. North and south intersection should be aligned.
- Rte 28 and Osterville-West Barnstable Rd – Vehicle - Frequent back-ups with vehicles leaving from dump and companies at start and end of workday … heading to Osterville / from Osterville - programming of signals?
- Race Lane & Osterville-West Barnstable Rd – Vehicle - Unsafe crossing - speed and visibility issues on Race Lane inhibit crossing for Osterville-West Barnstable Rd
- Sagamore Bridge – Vehicle - Backups with Construction - Light signal at entry from 6A during construction needs better timing and sensor … if construction is 24 hours a day, it should have crews 24 hours per day … economic damage is significant for workers supporting economy.
- Wood Rd & Rte 28, South Yarmouth – Vehicle - Speed on Rte 28 inhibits access from Wood Rd to take left onto Ret 28 - Light with sensor?
- Hayway Road – Vehicle - Cars go too fast - Cars and trucks use this as a connector road, and often driveway over the 30-mph speed limit - dangerous and uncomfortable for pedestrians. But this road is also heavily used for bicyclists.
- Hayway Road connecting to other roads – Pedestrian - trucks/cars go too fast on this connector road - Unpleasant and dangerous for pedestrians.
- Hayway joining Sandwich Road – Bicyclist - Bicyclists connecting to 151 to reach the shining sea bike way deal with vehicle traffic on sandwich road - create bike lane access connecting Hayway-Sandwich Rds - 151 - shining sea bikeway.

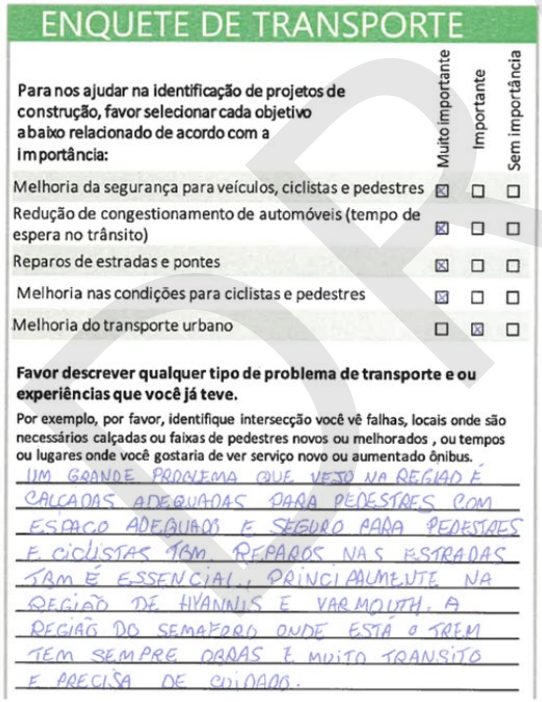
- near bandshell - Other - increase vehicle charging stations there are only 2 stations here and are in constant use. would be great to add more, even if they require payment.
- All along Great Neck Road South – Bicyclist - Great bike route and can connect to 151 at Commons; however cars drive way too fast - create dedicated bike lane and narrows the road to slow down drivers.
- Cataumet on Falmouth Secondary – Transit - Falmouth Secondary at risk of removal - potentially reopen existing stations or at least preserve the right of way for active rail service.
- Cape Cod Canal – Other - Cross-Canal Water Taxi - Main Street, Town Hall, Community Building, Park, Marine Life Center residents and visitors on one side. Schools, Library, Athletic fields, medical district, museums, ice arena, residences, bike paths and all of Cape Cod on the other side.
- Bourne Bridge – Transit - overnight parking - Provide car parking as is available at the Sagamore Park & Ride.
- West Road – Bicyclist - Rail Trail on Street - The Rail Trail in this location requires bikers and pedestrians to transfer to a busy road to cross Route 6. A designated Rail Trail bridge over Route 6 would be safer and more convenient.
- Jones Road at Gifford St – Pedestrian - no crosswalk on Jones on east side of gifford, so if coming from the from the east and turning left, you must cross 3 streets instead of one - dangerous and slows traffic because you must use the pedestrian button 3 times instead of one. This is especially bad for the seniors at Atria.
- Falmouth ferry parking - Other - Inadequate signage for ferry parking & to not park in woods hole - It should be more clear in this area & on rte 28 where the ferry parking lots are & to not park in woods hole.
- Rte 28 – Transit - Inadequate signage of location of ferry parking lots - Add clear signs on 28 at Thomas Landers & brick kiln that there are ferry parking lots there to reduce traffic in town. Also offer transit around town from these lots especially down to woods hole.

COMMENT CARDS

To further public outreach opportunities among limited English proficiency communities, comment cards in both English and Portuguese were disseminated and collected at the IPR Church of Cape Cod in Hyannis on Sunday, May 20, 2023. Feedback received from over the 140 comment cards ranged from reducing congestion, constructing new sidewalks and increasing frequency and connections for public transit service.

The comment cards consisted of a series of five questions along with an open-ended response opportunity to identify problem locations or areas of concern for the transportation network. To help the CCC select priority projects, the public was asked to choose how important (very important, important, or not important) the following five goals are.

- Improve safety for vehicles, bicyclists, and pedestrians
- Reduce vehicle congestion (time waiting in traffic)
- Repair roads and bridges
- Improve road conditions for bicyclists and pedestrians
- Improve bus service



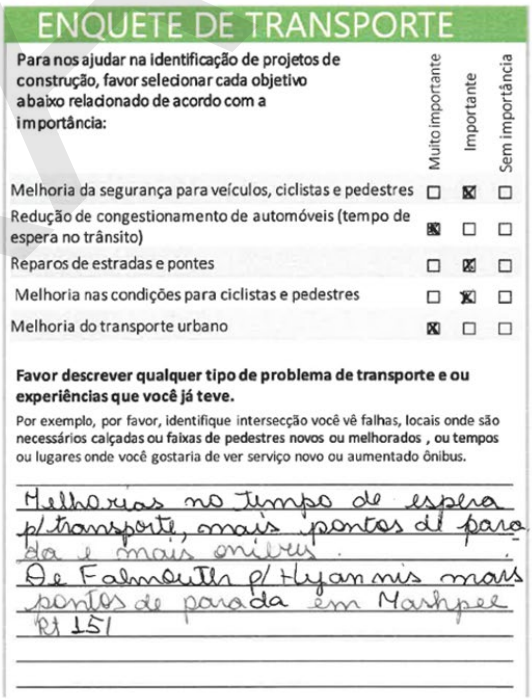
ENQUETE DE TRANSPORTE

Para nos ajudar na identificação de projetos de construção, favor selecionar cada objetivo abaixo relacionado de acordo com a importância:	Muito importante	Importante	Sem importância
Melhoria da segurança para veículos, ciclistas e pedestres	☒	☐	☐
Redução de congestionamento de automóveis (tempo de espera no trânsito)	☒	☐	☐
Reparos de estradas e pontes	☒	☐	☐
Melhoria nas condições para ciclistas e pedestres	☒	☐	☐
Melhoria do transporte urbano	☐	☒	☐

Favor descrever qualquer tipo de problema de transporte e ou experiências que você já teve.

Por exemplo, por favor, identifique intersecção você vê falhas, locais onde são necessários calçadas ou faixas de pedestres novos ou melhorados , ou tempos ou lugares onde você gostaria de ver serviço novo ou aumentado ônibus.

UM GRANDE PROBLEMA QUE VEJO NA REGIÃO É CALÇADAS ADEQUADAS PARA PEDESTRES COM ESPAÇO ADEQUADO E SEGURO PARA PEDESTRES E CICLISTAS TAM. REPAROS NAS ESTRADAS TAM É ESSENCIAL, PRINCIPALMENTE NA REGIÃO DE HYANNIS E VARMOUTH. A REGIÃO DO SEMÁFORO ONDE ESTÁ O TREM TEM SEMPRE OBRAS E MUITO TRANSITO E PRECISA DE CUIDADO.



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Melhoria da segurança para veículos, ciclistas e pedestres	☐	☒	☐
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Reparos de estradas e pontes	☐	☒	☐
Melhoria nas condições para ciclistas e pedestres	☐	☒	☐
Melhoria do transporte urbano	☒	☐	☐

Favor descrever qualquer tipo de problema de transporte e ou experiências que você já teve.

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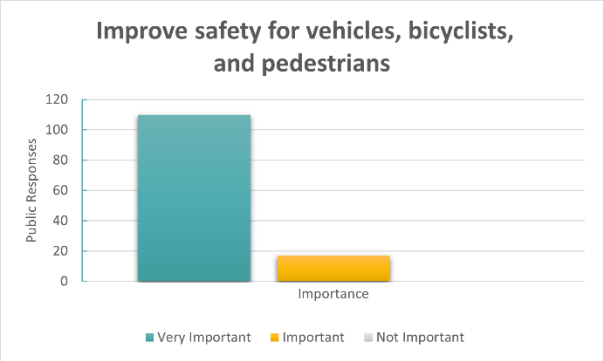
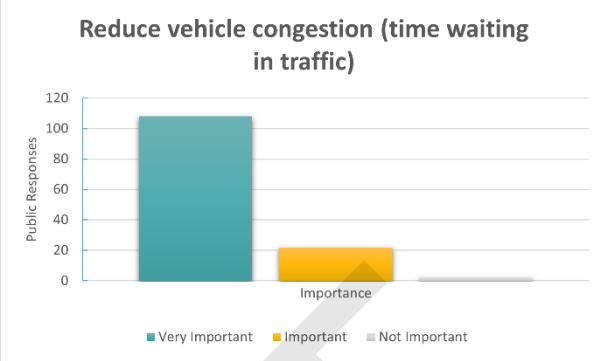
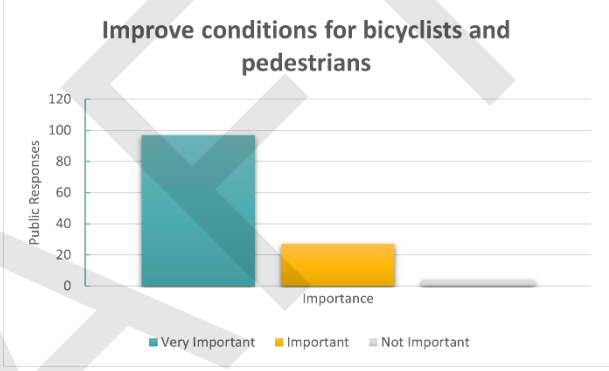
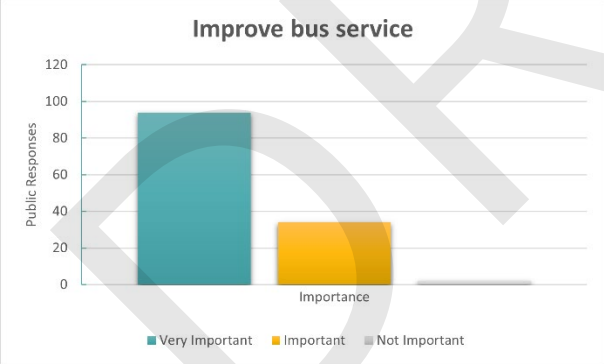
Melhorias no tempo de espera p/ transporte, mais pontos di para da e mais onibus.
De Falmouth p/ Hyannis mais pontos de parada em Marhpee
Rt 151

A completed Portuguese comment card









Based on the answers received, importance of these goals are as follows: (1) reducing vehicle congestion, (2) improve safety {for vehicles, bicyclists, and pedestrians}, (3) improve bus service, (4) improve road conditions for bicyclists and pedestrians, and (5) repair roads and bridges.

A text box was provided for respondents to provide any comments or suggestions. Responses included:

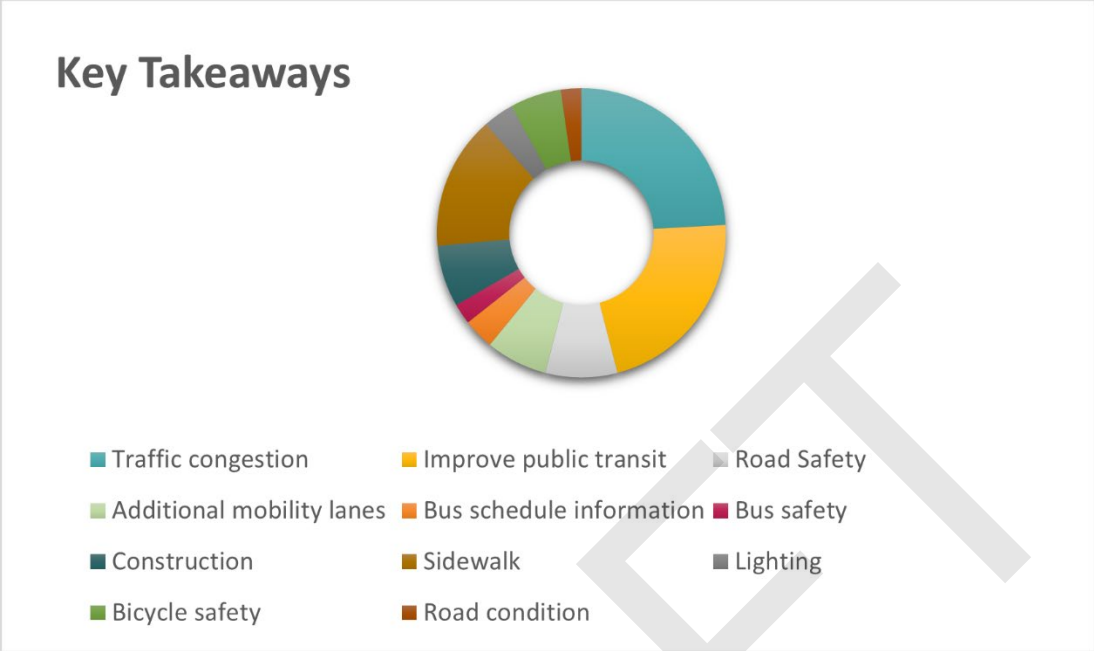
- There are lots of traffic jam near the High School on West Main Street - Hyannis, during time of dropping off the kids. Also, Willow Street, exit to Dennis is very chaotic.
- Wait time for the traffic lights are very long for pedestrians. We need more pedestrian and cyclists' lanes.

- Very important please: The entrance for the Restaurant 99 on Route 28 in Centerville, cars coming from Cotuit. It is very dangerous maneuver; I believe that it is necessary to better the access.
- I live in Martha's Vineyard and I would like to have a bus service from the cruise line to IPR.
- My dream is to see route 28 with duplicated lanes for more mobility.
- Seat belts on Scholar buses
- Too much traffic on summertime. road works takes too long. not to work on all roads at the same time. Pavement on Jasper Road.
- Traffic jam
- Full preference on green traffic lights to turn left, waiting for opportunity to turn.
- More sidewalks for pedestrians and traffic improvements on rush hour.
- All improvements are important, but traffic jam reduction would be an excellent solution.
- More public transportations and sidewalks
- Improvements on the bus schedules on Route 28. Today is every hour, we need it with more frequency and later schedule.
- Sidewalks along the rotary. sidewalks on Pitchers Way. Sidewalks on Independency Way. also, on Route 132 and Route 28 plus ped shing.
- More speed bumps on busy Streets and lighting.
- There are many street crossings where need to cut some trees and bushes, business or preservation lands. This obstructs the view with great chance of accidents. We also need more speed bumps urgently.
- The work on the roads is taking too long.
- Traffic jam on Camp Street. More bike lanes.
- I think it's very important to have pamphlets with bus schedules. I don't know if there are any but when I needed the services i had some difficulties in find the information on it.
- Seat belts on Scholar buses.
- Sometimes, for some reason, one does not have a car and cannot move around. Uber is not an easy way either depending on the time of the day it is hard to find availability, therefore, I think that the public transportation needs to be improved.
- In general, it is just the time to move from one place to another due to traffic.
- More schedules and mores buses, sidewalks and bicycle lanes.
- It is necessary information on buses schedule.
- More public transportation to diminish the number of cars.
- Do not work on the Sagamore Bridge during the day.
- More public transportation.
- I would like to have public transportation in Forestdale, there is none.
- Route 28, exiting Yarmouth towards Barnstable, maybe a traffic light on Camp Street on West Yarmouth, Route 28.

- Improvements on Buses Schedules, more buses, more stops. From Falmouth to Hyannis, more stops in Mashpee, Route 151.
- Cape Cod is a wonderful place, but we need more Public Transportation
- It would be very important to have more public transportation, sometimes people don't have a good financial situation to have a car.
- Road work on the summertime. Centerville has poor lighting.
- Poor lighting on the streets.
- Very important to have more sidewalks for pedestrians and bicycle lanes. Reduction of traffic jam is considered urgent. Bikers do not respect the traffic on the roads, each one in its own turn.
- More availability on public transportation, more bicycles lanes and improvement on the roads.
- I think we need more public transportation on the main roads.
- Better sidewalks and bicycle lanes on Main Street.
- Bus stops. There are many good things, but it can get better.
- Bus service on 404 Great Marsh Road, Centerville, MA.
- Bus service on 404 Great Marsh Road to better serve the children in Centerville.
- Think about alternatives to decrease traffic on the summer.
- Route 28 - Hyannis; Willow Street - Lincoln Street.
- The traffic on Willow Street is very slow, just two-way traffic. Duplicate the main roads on the Cape
- The road work on the main roads have been very slow. the traffic has been disturbed a 100%. It is awful to move on Route 28 going to Hyannis.
- Thank you from offering us the opportunity to give our opinion on such important issues.
- more sidewalks for pedestrians and bicycle lanes, Thank you.
- More sidewalks for pedestrians and cyclists.
- Better public transportation.
- Better public transportation with more stops, especially on the towns there are distant from Hyannis.
- What I see as a big problem is lack of suitable sidewalks for pedestrians and bicycle lanes with enough spaces for safety. Improvements on the roads is also essential, especially around Hyannis and Yarmouth. The region near the traffic light on the railroad is always having road work and lots of traffic issues and it needs to be taken care of.
- Iyannough Road is a Road that would benefit of a cement sidewalk along the road because despite that is a straight road, many people make turns from left to right causing constant accidents near Toyota. Christmas Tree, MacDonalds.
- Some places on 28 and 132 need more sidewalks for safety in Osterville on 28.
- We need more space for pedestrians; cyclists; skaters. Be a cyclist in Barnstable is not a safe option. Thank you all for the support.

- The intersection where old stage merges into race lane near service Rd getting onto exit 5. There is always an accident or almost.
- Just the works on Phinney's Ln and Willow St. too long. I hope they finish fast. Thank you so much.
- Rt 28 & Yarett Rd precise Phinney's lane.
- Route 28, close "Gol supermarket" need another way for follow traffic.
- Rt 28 needs to be expanded. The road to Falmouth is terrible.
- A lot of traffic in the summer. Jasper rd. needs to be paved again. Rt 28 by the airport has too much traffic in the summer.
- On race lane with old Falmouth Road in Marston mills is very dangerous with people trying to turn. Something should be done there before more accidents happen.
- No repairs on the bridges during the day on weekends/summer. How about during the overnight and less busier months.
- The road 28 has not been finished for about two years we waited a long time because of the traffic.
- Set of lights in the intersection on Rt 28 with Pitcher's Way. It opens both ways at the same time.
- 6A Bicycles are dangerous.
- Pleasant St. - bus service to ferries the road is in terrible condition & sidewalks - tourists (if they fall in the street) will get injured or killed.

The pie chart below depicts the key transportation topics from the comment card responses that participants would like improved on Cape Cod.


Key Takeaways
Traffic congestion
Improve public transit
Road Safety
Additional mobility lanes
Bus schedule information
Bus safety
Construction
Sidewalk
Lighting
Bicycle safety
Road condition

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CAPE COD COMMISSION

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CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix P: Statewide Tables

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Technical Appendix P: Statewide Tables

STATEWIDE PROJECTIONS

To assist the MPOs in preparing their RTPs, MassDOT provided population projections for each region. The MassDOT projections are largely based on the forecast work of the UMass Donahue Institute (UMDI) with adjustments made by the MassDOT Office of Transportation Planning.\

The estimated population, household, and employment projections from this effort are presented in this appendix.

ESTIMATED AVAILABLE HIGHWAY FUNDS

In early 2023, the Massachusetts Department of Transportation (MassDOT) provided estimated available funds by region from Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) including the state matching funds. A summary of the funds for the Cape Cod region are presented in Chapter 5 along with a description of the funding programs. The funding tables for all programs are presented in this appendix.

BRIDGES RATINGS

Bridge data is presented for state-owned and municipal bridges on Cape Cod as well as the Bourne and Sagamore Bridges (owned by the Army Corps of Engineers. The data is from MassDOT or, where newer data was available, the National Bridge Inventory.

STATEWIDE POPULATION PROJECTION

RPA	Census 2010	Census 2020	Population 2030	Population 2040	Population 2050	% Change '10-'20	% Change '20-'30	% Change '20-'50
BRPC	131,219	129,026	125,223	122,454	120,612	-1.7%	-2.9%	-6.5%
CCC	215,888	228,996	220,135	199,836	176,123	6.1%	-3.9%	-23.1%
CMRPC	556,698	604,631	617,353	624,210	621,469	8.6%	2.1%	2.8%
FRCOG	71,372	71,029	67,382	60,666	52,999	-0.5%	-5.1%	-25.4%
MAPC (97)	3,087,975	3,357,194	3,487,271	3,587,535	3,678,402	8.7%	3.9%	9.6%
MRPC	236,475	250,531	248,447	241,239	229,206	5.9%	-0.8%	-8.5%
MVC	16,535	20,600	21,072	20,316	19,226	24.6%	2.3%	-6.7%
MVPC	333,748	369,889	386,484	398,746	403,707	10.8%	4.5%	9.1%
NMCOG	286,901	310,009	320,695	322,799	316,493	8.1%	3.4%	2.1%
NPEDC	10,172	14,255	15,968	17,579	19,434	40.1%	12.0%	36.3%
OCPC	362,406	393,249	400,662	402,915	398,695	8.5%	1.9%	1.4%
PVPC	621,570	628,133	623,393	604,384	580,865	1.1%	-0.8%	-7.5%
SRPEDD	616,670	652,375	661,261	660,403	650,730	5.8%	1.4%	-0.3%
Massachusetts	6,547,629	7,029,917	7,195,346	7,263,082	7,267,961	7.4%	2.4%	3.4%

STATEWIDE HOUSEHOLD PROJECTION

RPA	Census 2010	Census 2020	Households 2030	Households 2040	Households 2050	% Change '10-'20	% Change '20-'30	% Change '20-'50
BRPC	56,091	57,015	55,707	54,542	53,536	1.6%	-2.3%	-6.1%
CCC	95,755	103,368	100,263	91,633	80,107	8.0%	-3.0%	-22.5%
CMRPC	210,870	232,512	246,644	253,007	253,914	10.3%	6.1%	9.2%
FRCOG	30,462	31,323	30,989	28,700	25,426	2.8%	-1.1%	-18.8%
MAPC (97)	1,216,543	1,315,775	1,382,277	1,438,429	1,480,340	8.2%	5.1%	12.5%
MRPC	89,816	96,886	99,315	99,195	95,833	7.9%	2.5%	-1.1%
MVC	7,368	8,932	9,085	8,733	8,092	21.2%	1.7%	-9.4%
MVPC	123,577	136,603	153,271	161,020	164,896	10.5%	12.2%	20.7%
NMCOG	104,022	112,764	122,509	125,842	125,065	8.4%	8.6%	10.9%
NPEDC	4,229	5,478	6,026	6,509	7,023	29.5%	10.0%	28.2%
OCPC	129,490	141,739	149,896	152,703	152,473	9.5%	5.8%	7.6%
PVPC	238,629	246,804	245,637	241,158	231,275	3.4%	-0.5%	-6.3%
SRPEDD	240,223	260,026	269,111	271,459	268,310	8.2%	3.5%	3.2%
Massachusetts	2,547,075	2,749,225	2,870,730	2,932,930	2,946,290	7.9%	4.4%	7.2%

STATEWIDE EMPLOYMENT PROJECTION

RPA	Employment 2010	Employment 2020	Employment 2030	Employment 2040	Employment 2050	% Change '10-'20	% Change '20-'30	% Change '20-'50
BRPC	60,161	58,150	55,393	54,362	54,108	-3.3%	-4.7%	-7.0%
CCC	88,596	98,368	90,863	83,427	77,593	11.0%	-7.6%	-21.1%
CMRPC	224,054	246,773	252,518	254,076	255,275	10.1%	2.3%	3.4%
FRCOG	25,684	24,276	23,312	21,550	19,541	-5.5%	-4.0%	-19.5%
MAPC (97)	1,823,522	2,136,537	2,203,400	2,259,475	2,320,600	17.2%	3.1%	8.6%
MRPC	77,198	83,885	83,175	81,169	78,189	8.7%	-0.8%	-6.8%
MVC	7,731	8,133	7,330	6,815	6,509	5.2%	-9.9%	-20.0%
MVPC	145,373	149,439	154,869	158,128	160,110	2.8%	3.6%	7.1%
NMCOG	119,332	130,509	136,010	136,686	136,372	9.4%	4.2%	4.5%
NPEDC	5,699	7,598	7,085	7,425	8,144	33.3%	-6.8%	7.2%
OCPC	140,571	150,729	147,808	146,727	145,572	7.2%	-1.9%	-3.4%
PVPC	252,151	281,080	284,215	278,575	274,589	11.5%	1.1%	-2.3%
SRPEDD	229,388	257,890	258,974	255,677	251,983	12.4%	0.4%	-2.3%
Massachusetts	3,199,460	3,633,367	3,704,952	3,744,092	3,788,585	13.6%	2.0%	4.3%

2024 RTP Highway Financials

	Base OA in today's dollars w/ 2% increase starting in 2029	August redistribution	Base OA + August Redistribution	GANs repayment	Funding less GANs repayments	Funding w/ non-federal match	Statewide Items	Funding available for MPOs	Cape Cod
								MARPA formula ►	*4.5851%*
2024	$ 753,409,685	$ 50,000,000	$ 803,409,685	$ 93,985,000	$ 709,424,685	$ 886,780,856	$ 582,717,759	$ 304,063,097	$ 13,941,597
2025	$ 768,478,798	$ 50,000,000	$ 818,478,798	$ 122,185,000	$ 696,293,798	$ 870,367,248	$ 571,469,513	$ 298,897,735	$ 13,704,760
2026	$ 783,849,292	$ 50,000,000	$ 833,849,292	$ 133,620,000	$ 700,229,292	$ 875,286,615	$ 583,701,455	$ 291,585,160	$ 13,369,471
2027	$ 799,527,245	$ 50,000,000	$ 849,527,245	$ -	$ 849,527,245	$ 1,061,909,056	$ 700,859,977	$ 361,049,079	$ 16,554,461
2028	$ 815,517,790	$ 50,000,000	$ 865,517,790	$ -	$ 865,517,790	$ 1,081,897,237	$ 714,052,177	$ 367,845,061	$ 16,866,064
								1st five years ►	$ 74,436,354
2029	$ 831,828,146	$ 50,000,000	$ 881,828,146	$ -	$ 881,828,146	$ 1,102,285,182	$ 727,508,220	$ 374,776,962	$ 17,183,898
2030	$ 848,464,709	$ 50,000,000	$ 898,464,709	$ -	$ 898,464,709	$ 1,123,080,886	$ 741,233,385	$ 381,847,501	$ 17,508,090
2031	$ 865,434,003	$ 50,000,000	$ 915,434,003	$ -	$ 915,434,003	$ 1,144,292,503	$ 755,233,052	$ 389,059,451	$ 17,838,765
2032	$ 882,742,683	$ 50,000,000	$ 932,742,683	$ 15,000,000	$ 917,742,683	$ 1,147,178,354	$ 757,137,713	$ 390,040,640	$ 17,883,753
2033	$ 900,397,536	$ 50,000,000	$ 950,397,536	$ 10,000,000	$ 940,397,536	$ 1,175,496,921	$ 772,437,663	$ 403,059,258	$ 18,480,670
								2nd five years ►	$ 88,895,177
2034	$ 918,405,487	$ 50,000,000	$ 968,405,487	$ 30,000,000	$ 938,405,487	$ 1,173,006,859	$ 770,801,404	$ 402,205,455	$ 18,441,522
2035	$ 936,773,597	$ 50,000,000	$ 986,773,597	$ 30,000,000	$ 956,773,597	$ 1,195,966,996	$ 785,888,874	$ 410,078,122	$ 18,802,492
2036	$ 955,509,069	$ 50,000,000	$ 1,005,509,069	$ 30,000,000	$ 975,509,069	$ 1,219,386,336	$ 801,278,094	$ 418,108,243	$ 19,170,681
2037	$ 974,619,250	$ 50,000,000	$ 1,024,619,250	$ 30,000,000	$ 994,619,250	$ 1,243,274,063	$ 816,975,098	$ 426,298,965	$ 19,546,234
2038	$ 994,111,635	$ 50,000,000	$ 1,044,111,635	$ 30,000,000	$ 1,014,111,635	$ 1,267,639,544	$ 832,986,042	$ 434,653,503	$ 19,929,298
								3rd five years ►	$ 95,890,227
2039	$ 1,013,993,868	$ 50,000,000	$ 1,063,993,868	$ 30,000,000	$ 1,033,993,868	$ 1,292,492,335	$ 849,317,205	$ 443,175,130	$ 20,320,023
2040	$ 1,034,273,745	$ 50,000,000	$ 1,084,273,745	$ 30,000,000	$ 1,054,273,745	$ 1,317,842,182	$ 865,974,991	$ 451,867,191	$ 20,718,563
2041	$ 1,054,959,220	$ 50,000,000	$ 1,104,959,220	$ 30,000,000	$ 1,074,959,220	$ 1,343,699,025	$ 882,965,933	$ 460,733,093	$ 21,125,073
2042	$ 1,076,058,405	$ 50,000,000	$ 1,126,058,405	$ 35,000,000	$ 1,091,058,405	$ 1,363,823,006	$ 896,189,719	$ 467,633,287	$ 21,441,454
2043	$ 1,097,579,573	$ 50,000,000	$ 1,147,579,573	$ 35,000,000	$ 1,112,579,573	$ 1,390,724,466	$ 913,867,095	$ 476,857,371	$ 21,864,387
								4th five years ►	**$ 105,469,500**
2044	$ 1,119,531,164	$ 50,000,000	$ 1,169,531,164	$ 25,000,000	$ 1,144,531,164	$ 1,430,663,955	$ 940,111,967	$ 490,551,989	$ 22,492,299
								5th five years ►	$ 22,492,299
							$ 24,707,093,625	*Total* ►	**$ 387,183,556**

Apply 2% growth rate (consistent increase from BIL) beginning in FFY 2028	August Redistribution (assumed $50m) to 2044	Loaded federal amount	GANs repayment schedule TBD	FA - GANS	FA + NFA (Total)	MARPA targets Total	Approx. 1/3 of Total	MPO Targets by MARPA formula ←

2024 RTP Highway Financials - Statewide Bridges

	Base OA in today's dollars w/ 2% increase starting in 2029	August redistribution	Base OA + August Redistribution	GANs repayment	Funding less GANs repayments	Funding w/ non-federal match	Funding available for MPOs	Statewide Programs	Statewide Bridges
									Bridges
2024	$ 753,409,685	$ 50,000,000	$ 803,409,685	$ 93,985,000	$ 709,424,685	$ 886,780,856	$ 304,063,097	$ 582,717,760	$ 183,898,219
2025	$ 768,478,798	$ 50,000,000	$ 818,478,798	$ 122,185,000	$ 696,293,798	$ 870,367,248	$ 298,435,130	$ 571,932,117	$ 176,617,938
2026	$ 783,849,292	$ 50,000,000	$ 833,849,292	$ 133,620,000	$ 700,229,292	$ 875,286,615	$ 300,121,903	$ 575,164,712	$ 183,898,219
2027	$ 799,527,245	$ 50,000,000	$ 849,527,245	$ -	$ 849,527,245	$ 1,061,909,056	$ 364,111,780	$ 697,797,276	$ 255,592,933
2028	$ 815,517,790	$ 50,000,000	$ 865,517,790	$ -	$ 865,517,790	$ 1,081,897,237	$ 370,965,410	$ 710,931,827	$ 282,726,401
							1st five years ►		
2029	$ 831,828,146	$ 50,000,000	$ 881,828,146	$ -	$ 881,828,146	$ 1,102,285,182	$ 377,956,113	$ 724,329,069	$ 288,380,929
2030	$ 848,464,709	$ 50,000,000	$ 898,464,709	$ -	$ 898,464,709	$ 1,123,080,886	$ 385,086,630	$ 737,994,255	$ 294,148,548
2031	$ 865,434,003	$ 50,000,000	$ 915,434,003	$ -	$ 915,434,003	$ 1,144,292,503	$ 392,359,758	$ 751,932,746	$ 300,031,519
2032	$ 882,742,683	$ 50,000,000	$ 932,742,683	$ 15,000,000	$ 917,742,683	$ 1,147,178,354	$ 393,349,270	$ 753,829,083	$ 306,032,149
2033	$ 900,397,536	$ 50,000,000	$ 950,397,536	$ 10,000,000	$ 950,397,536	$ 1,187,996,921	$ 407,345,310	$ 780,651,611	$ 312,152,792
							2nd five years ►		
2034	$ 918,405,487	$ 50,000,000	$ 968,405,487	$ 30,000,000	$ 968,405,487	$ 1,210,506,859	$ 415,063,611	$ 795,443,248	$ 318,395,848
2035	$ 936,773,597	$ 50,000,000	$ 986,773,597	$ 30,000,000	$ 986,773,597	$ 1,233,466,996	$ 422,936,278	$ 810,530,719	$ 324,763,765
2036	$ 955,509,069	$ 50,000,000	$ 1,005,509,069	$ 30,000,000	$ 1,005,509,069	$ 1,256,886,336	$ 430,966,398	$ 825,919,938	$ 331,259,040
2037	$ 974,619,250	$ 50,000,000	$ 1,024,619,250	$ 30,000,000	$ 1,024,619,250	$ 1,280,774,063	$ 439,157,121	$ 841,616,942	$ 337,884,221
2038	$ 994,111,635	$ 50,000,000	$ 1,044,111,635	$ 30,000,000	$ 1,044,111,635	$ 1,305,139,544	$ 447,511,658	$ 857,627,886	$ 344,641,905
							3rd five years ►		
2039	$ 1,013,993,868	$ 50,000,000	$ 1,063,993,868	$ 30,000,000	$ 1,063,993,868	$ 1,329,992,335	$ 456,033,286	$ 873,959,049	$ 351,534,743
2040	$ 1,034,273,745	$ 50,000,000	$ 1,084,273,745	$ 30,000,000	$ 1,084,273,745	$ 1,355,342,182	$ 464,725,347	$ 890,616,835	$ 358,565,438
2041	$ 1,054,959,220	$ 50,000,000	$ 1,104,959,220	$ 30,000,000	$ 1,104,959,220	$ 1,381,199,025	$ 473,591,248	$ 907,607,777	$ 365,736,747
2042	$ 1,076,058,405	$ 50,000,000	$ 1,126,058,405	$ 35,000,000	$ 1,126,058,405	$ 1,407,573,006	$ 482,634,468	$ 924,938,538	$ 373,051,482
2043	$ 1,097,579,573	$ 50,000,000	$ 1,147,579,573	$ 35,000,000	$ 1,147,579,573	$ 1,434,474,466	$ 491,858,552	$ 942,615,914	$ 380,512,512
							4th five years ►		
2044	$ 1,119,531,164	$ 50,000,000	$ 1,169,531,164	$ 25,000,000	$ 1,169,531,164	$ 1,461,913,955	$ 501,267,118	$ 960,646,837	$ 388,122,762
							5th five years ►		
							Total ►	*$*	*6,457,948,108*

Total	MARPA Targets	Total - MARPA targets	SW Program Total

2024 RTP Highway Financials - Interstate Pavement

	Base OA in today's dollars w/ 2% increase starting in 2029	August redistribution	Base OA + August Redistribution	GANs repayment	Funding less GANs repayments	Funding w/ non-federal match	Funding available for MPOs	Statewide Programs	Interstate Pavement Lane Miles
2024	$ 753,409,685	$ 50,000,000	$ 803,409,685	$ 93,985,000	$ 709,424,685	$ 886,780,856	$ 304,063,097	$ 582,717,760	$ 42,748,349
2025	$ 768,478,798	$ 50,000,000	$ 818,478,798	$ 122,185,000	$ 696,293,798	$ 870,367,248	$ 298,435,130	$ 571,932,117	$ 42,748,349
2026	$ 783,849,292	$ 50,000,000	$ 833,849,292	$ 133,620,000	$ 700,229,292	$ 875,286,615	$ 300,121,903	$ 575,164,712	$ 42,748,349
2027	$ 799,527,245	$ 50,000,000	$ 849,527,245	$ -	$ 849,527,245	$ 1,061,909,056	$ 364,111,780	$ 697,797,276	$ 42,748,349
2028	$ 815,517,790	$ 50,000,000	$ 865,517,790	$ -	$ 865,517,790	$ 1,081,897,237	$ 370,965,410	$ 710,931,827	$ 42,748,349
							1st five years ►		
2029	$ 831,828,146	$ 50,000,000	$ 881,828,146	$ -	$ 881,828,146	$ 1,102,285,182	$ 377,956,113	$ 724,329,069	$ 43,603,316
2030	$ 848,464,709	$ 50,000,000	$ 898,464,709	$ -	$ 898,464,709	$ 1,123,080,886	$ 385,086,630	$ 737,994,255	$ 44,475,382
2031	$ 865,434,003	$ 50,000,000	$ 915,434,003	$ -	$ 915,434,003	$ 1,144,292,503	$ 392,359,758	$ 751,932,746	$ 45,364,890
2032	$ 882,742,683	$ 50,000,000	$ 932,742,683	$ 15,000,000	$ 917,742,683	$ 1,147,178,354	$ 393,349,270	$ 753,829,083	$ 46,272,188
2033	$ 900,397,536	$ 50,000,000	$ 950,397,536	$ 10,000,000	$ 950,397,536	$ 1,187,996,921	$ 407,345,310	$ 780,651,611	$ 47,197,631
							2nd five years ►		
2034	$ 918,405,487	$ 50,000,000	$ 968,405,487	$ 30,000,000	$ 968,405,487	$ 1,210,506,859	$ 415,063,611	$ 795,443,248	$ 48,141,584
2035	$ 936,773,597	$ 50,000,000	$ 986,773,597	$ 30,000,000	$ 986,773,597	$ 1,233,466,996	$ 422,936,278	$ 810,530,719	$ 49,104,416
2036	$ 955,509,069	$ 50,000,000	$ 1,005,509,069	$ 30,000,000	$ 1,005,509,069	$ 1,256,886,336	$ 430,966,398	$ 825,919,938	$ 50,086,504
2037	$ 974,619,250	$ 50,000,000	$ 1,024,619,250	$ 30,000,000	$ 1,024,619,250	$ 1,280,774,063	$ 439,157,121	$ 841,616,942	$ 51,088,234
2038	$ 994,111,635	$ 50,000,000	$ 1,044,111,635	$ 30,000,000	$ 1,044,111,635	$ 1,305,139,544	$ 447,511,658	$ 857,627,886	$ 52,109,999
							3rd five years ►		
2039	$ 1,013,993,868	$ 50,000,000	$ 1,063,993,868	$ 30,000,000	$ 1,063,993,868	$ 1,329,992,335	$ 456,033,286	$ 873,959,049	$ 53,152,199
2040	$ 1,034,273,745	$ 50,000,000	$ 1,084,273,745	$ 30,000,000	$ 1,084,273,745	$ 1,355,342,182	$ 464,725,347	$ 890,616,835	$ 54,215,243
2041	$ 1,054,959,220	$ 50,000,000	$ 1,104,959,220	$ 30,000,000	$ 1,104,959,220	$ 1,381,199,025	$ 473,591,248	$ 907,607,777	$ 55,299,548
2042	$ 1,076,058,405	$ 50,000,000	$ 1,126,058,405	$ 35,000,000	$ 1,126,058,405	$ 1,407,573,006	$ 482,634,468	$ 924,938,538	$ 56,405,539
2043	$ 1,097,579,573	$ 50,000,000	$ 1,147,579,573	$ 35,000,000	$ 1,147,579,573	$ 1,434,474,466	$ 491,858,552	$ 942,615,914	$ 57,533,649
							4th five years ►		
2044	$ 1,119,531,164	$ 50,000,000	$ 1,169,531,164	$ 25,000,000	$ 1,169,531,164	$ 1,461,913,955	$ 501,267,118	$ 960,646,837	$ 58,684,322
							5th five years ►		
							Total ►	*$*	*1,026,476,390*

Total	MARPA Targets	Total - MARPA targets	SW Program Total

2024 RTP Highway Financials - Non-Interstate DOT Pavement

	Base OA in today's dollars w/ 2% increase starting in 2029	August redistribution	Base OA + August Redistribution	GANs repayment	Funding less GANs repayments	Funding w/ non-federal match	Funding available for MPOs	Statewide Programs	Non-Interstate DOT Pavement Lane Miles
2024	$ 753,409,685	$ 50,000,000	$ 803,409,685	$ 93,985,000	$ 709,424,685	$ 886,780,856	$ 304,063,097	$ 582,717,760	$ 72,703,533
2025	$ 768,478,798	$ 50,000,000	$ 818,478,798	$ 122,185,000	$ 696,293,798	$ 870,367,248	$ 298,435,130	$ 571,932,117	$ 72,703,533
2026	$ 783,849,292	$ 50,000,000	$ 833,849,292	$ 133,620,000	$ 700,229,292	$ 875,286,615	$ 300,121,903	$ 575,164,712	$ 65,000,000
2027	$ 799,527,245	$ 50,000,000	$ 849,527,245	$ -	$ 849,527,245	$ 1,061,909,056	$ 364,111,780	$ 697,797,276	$ 72,703,533
2028	$ 815,517,790	$ 50,000,000	$ 865,517,790	$ -	$ 865,517,790	$ 1,081,897,237	$ 370,965,410	$ 710,931,827	$ 72,703,533
							1st five years ►		
2029	$ 831,828,146	$ 50,000,000	$ 881,828,146	$ -	$ 881,828,146	$ 1,102,285,182	$ 377,956,113	$ 724,329,069	$ 74,157,604
2030	$ 848,464,709	$ 50,000,000	$ 898,464,709	$ -	$ 898,464,709	$ 1,123,080,886	$ 385,086,630	$ 737,994,255	$ 75,640,756
2031	$ 865,434,003	$ 50,000,000	$ 915,434,003	$ -	$ 915,434,003	$ 1,144,292,503	$ 392,359,758	$ 751,932,746	$ 77,153,571
2032	$ 882,742,683	$ 50,000,000	$ 932,742,683	$ 15,000,000	$ 917,742,683	$ 1,147,178,354	$ 393,349,270	$ 753,829,083	$ 78,696,642
2033	$ 900,397,536	$ 50,000,000	$ 950,397,536	$ 10,000,000	$ 950,397,536	$ 1,187,996,921	$ 407,345,310	$ 780,651,611	$ 80,270,575
							2nd five years ►		
2034	$ 918,405,487	$ 50,000,000	$ 968,405,487	$ 30,000,000	$ 968,405,487	$ 1,210,506,859	$ 415,063,611	$ 795,443,248	$ 81,875,987
2035	$ 936,773,597	$ 50,000,000	$ 986,773,597	$ 30,000,000	$ 986,773,597	$ 1,233,466,996	$ 422,936,278	$ 810,530,719	$ 83,513,506
2036	$ 955,509,069	$ 50,000,000	$ 1,005,509,069	$ 30,000,000	$ 1,005,509,069	$ 1,256,886,336	$ 430,966,398	$ 825,919,938	$ 85,183,776
2037	$ 974,619,250	$ 50,000,000	$ 1,024,619,250	$ 30,000,000	$ 1,024,619,250	$ 1,280,774,063	$ 439,157,121	$ 841,616,942	$ 86,887,452
2038	$ 994,111,635	$ 50,000,000	$ 1,044,111,635	$ 30,000,000	$ 1,044,111,635	$ 1,305,139,544	$ 447,511,658	$ 857,627,886	$ 88,625,201
							3rd five years ►		
2039	$ 1,013,993,868	$ 50,000,000	$ 1,063,993,868	$ 30,000,000	$ 1,063,993,868	$ 1,329,992,335	$ 456,033,286	$ 873,959,049	$ 90,397,705
2040	$ 1,034,273,745	$ 50,000,000	$ 1,084,273,745	$ 30,000,000	$ 1,084,273,745	$ 1,355,342,182	$ 464,725,347	$ 890,616,835	$ 92,205,659
2041	$ 1,054,959,220	$ 50,000,000	$ 1,104,959,220	$ 30,000,000	$ 1,104,959,220	$ 1,381,199,025	$ 473,591,248	$ 907,607,777	$ 94,049,772
2042	$ 1,076,058,405	$ 50,000,000	$ 1,126,058,405	$ 35,000,000	$ 1,126,058,405	$ 1,407,573,006	$ 482,634,468	$ 924,938,538	$ 95,930,768
2043	$ 1,097,579,573	$ 50,000,000	$ 1,147,579,573	$ 35,000,000	$ 1,147,579,573	$ 1,434,474,466	$ 491,858,552	$ 942,615,914	$ 97,849,383
							4th five years ►		
2044	$ 1,119,531,164	$ 50,000,000	$ 1,169,531,164	$ 25,000,000	$ 1,169,531,164	$ 1,461,913,955	$ 501,267,118	$ 960,646,837	$ 99,806,371
							5th five years ►		
							Total ►	*$ 1,738,058,860*	

Total	MARPA Targets	Total - MARPA targets	SW Program Total

2024 RTP Highway Financials - Remaining Statewide Programs

	Base OA in today's dollars w/2.2% increase starting in 2025	August redistribution	Base OA + August Redistribution	GANs repayment	Funding less GANs repayments	Funding w/ non-federal match	Statewide Items	Remaining SW Programs MARPA formula ►
2024	$ 626,330,019	$ 50,000,000	$ 676,330,019	$ 93,985,000	$ 582,345,019	$ 727,931,274	$ 504,945,083	$ 205,594,982
2025	$ 641,988,270	$ 50,000,000	$ 691,988,270	$ 122,185,000	$ 569,803,270	$ 712,254,088	$ 515,165,433	$ 223,095,613
2026	$ 658,744,163	$ 50,000,000	$ 708,744,163	$ 133,620,000	$ 575,124,163	$ 718,905,204	$ 525,655,458	$ 234,008,890
2027	$ 676,662,005	$ 50,000,000	$ 726,662,005	$ -	$ 726,662,005	$ 908,327,506	$ 537,136,211	$ 166,091,396
2028	$ 689,684,333	$ 50,000,000	$ 739,684,333	$ -	$ 739,684,333	$ 924,605,416	$ 544,176,311	$ 145,998,028
2029	$ 704,857,388	$ 50,000,000	$ 754,857,388	$ -	$ 754,857,388	$ 943,571,735	$ 552,868,314	$ 146,726,465
2030	$ 720,364,251	$ 50,000,000	$ 770,364,251	$ -	$ 770,364,251	$ 962,955,314	$ 561,631,468	$ 147,366,783
2031	$ 736,212,264	$ 50,000,000	$ 786,212,264	$ -	$ 786,212,264	$ 982,765,330	$ 594,216,235	$ 171,666,256
2032	$ 752,408,934	$ 50,000,000	$ 802,408,934	$ 15,000,000	$ 787,408,934	$ 984,261,168	$ 607,967,039	$ 176,966,061
2033	$ 768,961,931	$ 50,000,000	$ 818,961,931	$ 10,000,000	$ 818,961,931	$ 1,023,702,413	$ 695,290,179	$ 255,669,181
2034	$ 785,879,093	$ 50,000,000	$ 835,879,093	$ 30,000,000	$ 835,879,093	$ 1,044,848,867	$ 709,652,675	$ 261,239,256
2035	$ 803,168,433	$ 50,000,000	$ 853,168,433	$ 30,000,000	$ 853,168,433	$ 1,066,460,542	$ 724,331,145	$ 266,949,458
2036	$ 820,838,139	$ 50,000,000	$ 870,838,139	$ 30,000,000	$ 870,838,139	$ 1,088,547,674	$ 739,332,542	$ 272,803,221
2037	$ 838,896,578	$ 50,000,000	$ 888,896,578	$ 30,000,000	$ 888,896,578	$ 1,111,120,722	$ 754,663,969	$ 278,804,062
2038	$ 857,352,303	$ 50,000,000	$ 907,352,303	$ 30,000,000	$ 907,352,303	$ 1,134,190,378	$ 770,332,688	$ 284,955,583
2039	$ 876,214,053	$ 50,000,000	$ 926,214,053	$ 30,000,000	$ 926,214,053	$ 1,157,767,567	$ 786,346,118	$ 291,261,471
2040	$ 895,490,762	$ 50,000,000	$ 945,490,762	$ 30,000,000	$ 945,490,762	$ 1,181,863,453	$ 802,711,844	$ 297,725,504
2041	$ 915,191,559	$ 50,000,000	$ 965,191,559	$ 30,000,000	$ 965,191,559	$ 1,206,489,449	$ 819,437,616	$ 304,351,549
2042	$ 935,325,773	$ 50,000,000	$ 985,325,773	$ 35,000,000	$ 985,325,773	$ 1,231,657,217	$ 836,531,355	$ 311,143,567
2043	$ 955,902,941	$ 50,000,000	$ 1,005,902,941	$ 35,000,000	$ 1,005,902,941	$ 1,257,378,676	$ 854,001,156	$ 318,105,612
2044	$ 976,932,805	$ 50,000,000	$ 1,026,932,805	$ 25,000,000	$ 1,026,932,805	$ 1,283,666,006	$ 871,855,293	$ 325,241,838
								5th five years ►
							$ 19,394,012,912	*Total ►*

Town	Dept. No.	Bridge Description	Year Built	Year Reconstructed	Bridge Owner	Structurally Deficient	Bridge Inspection Date	Deck Condition	Superstructure Condition	Substructure Condition
Barnstable	B01008	ST 6 A OVER WATER BRIDGE CREEK	2005	0	MassDOT	NO	2022/05/06	N	N	N
Barnstable	B01011	ST149 MTNG HSE WAY OVER US 6 WB (FIRST RESPONDERS APPRECIATION OVERPASS)	1950	0	MassDOT	NO	2022/06/21	N	7	7
Barnstable	B01016	ST149 MTNG HSE WAY OVER US 6 EB (FIRST RESPONDERS APPRECIATION OVERPASS)	1953	0	MassDOT	NO	2022/06/21	N	7	7
Barnstable	B01020	HWY DOWSES BCH OVER WATER PHINNEYS BAY	2005	0	Municipality	NO	2019/04/10	N	N	N
Barnstable	B01002	HWY BEACH RD OVER WATER CENTERVILLE RIVER	2002	0	Municipality	NO	2022/07/11	8	8	7
Barnstable	B01004	HWY MILLWAY RD OVER WATER MARASPIN CREEK	1936	1996	Municipality	NO	2022/09/29	7	7	5
Barnstable	B01006	HWY SCHOOL ST OVER WATER SANTUIT RIVER	2001	0	Municipality	NO	2022/07/20	7	8	8
Barnstable	B01012	HWY OAK ST OVER US 6 WB/MID CAPE HWY	1950	0	MassDOT	NO	2021/08/04	7	7	7
Barnstable	B01015	US 6 EB/MD CP HWY OVER HWY PHINNEYS LN (LOUIS KARRAS MEMORIAL BRIDGE)	1966	0	MassDOT	NO	2022/09/13	7	7	7
Barnstable	B01018	US 6 WB/MD CP HWY OVER HWY MARY DUNN RD	1953	0	MassDOT	NO	2022/05/10	7	7	6
Barnstable	B01018	US 6 EB/MD CP HWY OVER HWY MARY DUNN RD	1966	0	MassDOT	NO	2022/05/10	7	7	7
Barnstable	B01019	US 6 WB/MD CP HWY OVER ST132 (US Navy Seal Kevin A. Houston)	1966	0	MassDOT	NO	2023/02/17	7	6	7
Barnstable	B01019	US 6 EB/MD CP HWY OVER ST132 (U.S. Navy Seal Kevin A. Houston Vetrans Mem. Bridge)	1966	0	MassDOT	NO	2023/02/17	7	6	7
Barnstable	B01014	HWY OAK ST OVER US 6 EB/MID CAPE HWY	1950	0	MassDOT	NO	2021/08/04	6	6	7
Barnstable	B01015	US 6 WB/MD CP HWY OVER HWY PHINNEYS LN (LOUIS KARRAS MEMORIAL BRIDGE)	1953	0	MassDOT	NO	2022/09/13	6	7	6
Barnstable	B01001	HWY S MAIN ST OVER WATER BUMPS RIVER	1957	0	Municipality	NO	2022/07/05	5	5	6
Barnstable	B01003	HWY BRIDGE ST OVER WATER WEST-NORTH BAY (OYSTER HARBOR BRIDGE)	1946	0	Municipality	NO	2021/07/01	5	5	5
Barnstable	B01005	HWY KEVENEY LN OVER WATER MILL CREEK	1978	0	Municipality	NO	2021/10/13	5	5	7
Bourne	B17027	ST 3 NB OVER US 6 (Staff SGT. Matthew A. Pucino)	2006	0	MassDOT	NO	2022/11/15	8	7	8
Bourne	B17002	HWY SHORE RD OVER WATER BACK RIVER	1931	0	Municipality	NO	2022/08/23	7	5	6
Bourne	B17010	HWY PERRY AVE OVER RR MACRR	1993	0	MassDOT	NO	2022/09/23	7	7	7
Bourne	B17017	US 6/ST28 OVER WATER COHASSET NARROWS (WILLIAM DALTON MEMORIAL BRIDGE)	2014	0	MassDOT	NO	2022/12/20	7	7	8
Bourne	B17019	ST 28 BOURNE BR RD OVER US 6	1985	0	MassDOT	NO	2021/10/29	7	6	7
Bourne	B17025	HWY BOURNEDAL RD OVER ST 25 (SMAJ FRED B DOUGLASS)	1987	0	MassDOT	NO	2021/12/13	7	5	7
Bourne	B17027	ST 3 SB OVER US 6 (Staff SGT. Matthew A. Pucino)	2006	0	MassDOT	NO	2022/11/15	7	7	8
Bourne	B17001	HWY SHORE RD OVER WATER POCASSET RIVER	1939	0	Municipality	NO	2022/08/22	6	5	5
Bourne	B17006	HWY SHORE RD OVER RR MACRR	1923	0	MassDOT	NO	2021/09/22	6	5	6
Bourne	B17026	HWY BOURNE CR CN OVER ST 25 (JAMES J. COUGHLIN)	1985	0	MassDOT	NO	2022/11/28	6	6	6
Bourne	-	ST 3 OVER CAPE COD CANAL (SAGAMORE BRIDGE)	1935	1981	Army Corps	NO	September 2021	5	5	5
Bourne	-	ST 28 OVER CAPE COD CANAL (BOURNE BRIDGE)	1935	1981	Army Corps	YES	October 2020	5	7	4
Brewster	B22003	ST 6 A/ OVER OTHER CAPE COD RAIL TR	1850	0	MassDOT	NO	2022/04/07	N	N	N
Brewster	B22005	ST 6 A/MAIN ST OVER WATER STONY BROOK	2010	0	MassDOT	NO	2022/04/07	N	N	N
Brewster	B22002	HWY FREEMANS WAY OVER US 6 (LAWRENCE B. DOYLE)	1955	0	MassDOT	NO	2022/10/25	6	5	6
Chatham	C07005	ST 28 ORLEANS RD OVER WATER MUDDY CREEK	2016	0	MassDOT	NO	2022/05/18	8	8	8
Chatham	C07001	HWY BRIDGE ST OVER WATER MITCHELL RIVER	2016	0	Municipality	NO	2023/04/17	7	7	7
Dennis	D07014	HWY BRIDGE ST OVER WATER SESUIT CREEK	2008	0	Municipality	NO	2021/10/13	N	N	N
Dennis	D07001	HWY UPPER COUNTY OVER WATER SWAN POND RIVER	2014	0	Municipality	NO	2021/05/14	8	8	7
Dennis	D07006	ST 28 MAIN ST OVER WATER SWAN POND RIVER	2014	0	MassDOT	NO	2022/04/07	8	8	7
Dennis	D07003	HWY LORING AVE OVER WATER WEIR CREEK	1999	0	Municipality	NO	2021/06/10	7	7	7
Dennis	D07009	ST134 OVER US 6 WB/MID CAPE HWY	1955	2009	MassDOT	NO	2022/11/21	7	6	6
Dennis	D07009	ST134 OVER US 6 EB/MID CAPE HWY	1969	2009	MassDOT	NO	2022/11/20	7	6	6
Dennis	D07013	HWY LIGHTHSE RD OVER WATER WEIR CREEK (ROBT.W. & MARY P.STONE)	1995	0	Municipality	NO	2021/06/10	7	7	7
Dennis	D07005	HWY HIGHBANK RD OVER WATER BASS RIVER	1953	0	Municipality	NO	2021/07/12	6	6	6
Dennis	D07010	US 6 WB/MD CP HWY OVER WATER BASS RIVER	1954	0	MassDOT	NO	2021/08/26	6	6	5
Dennis	D07011	HWY OLD BSS R RD OVER US 6 MID CAPE HWY	1954	1970	MassDOT	NO	2022/10/27	6	6	7
Dennis	D07012	US 6 EB/MD CP HWY OVER WATER BASS RIVER	1970	0	MassDOT	NO	2021/08/18	6	6	5
Dennis	D07002	HWY LOWER COUNTY OVER WATER SWAN POND RIVER	1955	0	Municipality	NO	2021/06/09	5	5	6
Dennis	D07004	ST 28 MAIN ST OVER WATER BASS RIVER	1935	0	MassDOT	YES	2021/05/17	3	3	3
Dennis	D07007	OTHER CAPE COD RT OVER WATER BASS RIVER(GEORGE ALLAIRE MEMORIAL BRIDGE)	0	0	Municipality	NO	1899/12/30			
Dennis	D07015	OTHER CAPE COD RT OVER ST134	0	0	Municipality	NO	1899/12/30			
Eastham	E04003	US 6 OVER OTHER CAPE COD RAIL TR	1993	0	MassDOT	NO	2022/04/19	N	N	N
Eastham	E04001	HWY BRIDGE RD OVER WATER BOAT MEADOW BROOK	1999	0	Municipality	NO	2021/07/12	7	7	8
Falmouth	F03017	ST 28 WAQUOIT HWY OVER WATER QUASHNET RIVER	1928	0	MassDOT	NO	2022/05/24	N	N	N

Town	Dept. No.	Bridge Description	Year Built	Year Reconstructed	Bridge Owner	Structurally Deficient	Bridge Inspection Date	Deck Condition	Superstructure Condition	Substructure Condition
Falmouth	F03021	HWY MENAUHANT RD OVER WATER LITTLE POND INLET	1960	0	Municipality	NO	2022/05/12	N	N	N
Falmouth	F03008	HWY PALMER AVE OVER OTHER SHINING SEA BIKEWY	1896	2016	MassDOT	NO	2022/05/05	8	8	7
Falmouth	F03009	HWY CHAPOQUOIT OVER WATER W FALMOUTH HARBOR	2012	0	Municipality	NO	2021/11/02	8	8	7
Falmouth	F03014	HWY CHURCH ST OVER COMB ACC RD & BIKEPATH (Geofrey G. Whitney, Jr.)	2002	0	Municipality	NO	2023/01/19	8	8	7
Falmouth	F03002	HWY MENAUHANT RD OVER WATER GREEN POND	1995	0	Municipality	NO	2022/10/25	7	7	7
Falmouth	F03005	HWY WATER ST OVER WATER EEL POND (EEL POND)	1940	2009	Municipality	NO	2021/07/06	7	7	6
Falmouth	F03007	HWY PALMER AVE OVER RR BIKE PATH PREV RR	1991	0	MassDOT	NO	2022/09/01	7	7	7
Falmouth	F03011	HWY QUAKER RD OVER WATER HERRING BROOK	2000	0	Municipality	NO	2022/07/14	7	7	8
Falmouth	F03019	HWY MEADOWNCK RD OVER WATER MOONAKIS RIVER	2004	0	Municipality	NO	2022/07/15	7	8	8
Falmouth	F03025	ST 28 A/FALMTH HWY OVER RR MACRR (OTIS SPURR)	1941	0	MassDOT	NO	2022/09/17	7	7	7
Falmouth	F03029	ST 28 SB OVER HWY BRICK KILN RD	1959	0	MassDOT	NO	2021/06/24	7	7	7
Falmouth	F03034	OTHER BIKE PATH OVER HWY FAY RD	1850	1960	Municipality	NO	2021/10/09	7	7	7
Falmouth	F03004	HWY CRANE ST OVER OTHER STEAMSHP AUTH PKG	1953	0	MassDOT	NO	2023/04/10	6	6	5
Falmouth	F03010	HWY NASHAWENA ST OVER WATER W FALMOUTH HARBOR	1992	0	Municipality	NO	2021/10/18	6	6	7
Falmouth	F03012	HWY CURLEY BLVD OVER OTHER BIKE PATH PREV RR	1988	0	MassDOT	NO	2022/07/14	6	6	7
Falmouth	F03027	HWY MARTIN RD OVER WATER QUASHNET RIVER	1942	0	Municipality	NO	2022/05/24	6	6	6
Falmouth	F03030	ST 28 NB OVER HWY THOMAS LANDERS RD	1960	0	MassDOT	NO	2022/12/21	6	6	6
Falmouth	F03030	ST 28 SB OVER HWY THOMAS LANDERS RD	1960	0	MassDOT	NO	2022/12/21	6	6	7
Falmouth	F03031	ST 28 NB OVER RR MACRR	1960	0	MassDOT	NO	2021/11/17	6	6	5
Falmouth	F03032	ST 28 NB OVER ST151 NATHAN ELLIS HWY	1960	0	MassDOT	YES	2022/12/19	6	4	6
Falmouth	F03001	ST 28 WAQUOIT HWY OVER WATER CHILDS RIVER	1928	0	MassDOT	NO	2022/09/12	5	5	6
Falmouth	F03003	HWY MENAUHANT RD OVER WATER GREAT POND RIVER	1984	0	Municipality	NO	2022/06/14	5	5	6
Falmouth	F03006	HWY MENAUHANT RD OVER WATER BOURNES POND (George Souza)	1985	0	Municipality	NO	2022/06/15	5	5	5
Falmouth	F03016	ST 28 OVER WATER COONAMESSET RIVER (Lieutentant Raleigh D.Costa Memorial Bridge)	1953	0	MassDOT	NO	2022/07/14	5	5	6
Falmouth	F03026	ST151 NATHAN ELLIS OVER RR MACRR (OTIS SPUR)	1941	0	MassDOT	NO	2022/09/15	5	6	7
Falmouth	F03029	ST 28 NB OVER HWY BRICK KILN RD	1959	0	MassDOT	NO	2021/06/24	5	7	7
Falmouth	F03031	ST 28 SB OVER RR MACRR	1960	0	MassDOT	NO	2021/11/17	5	5	5
Falmouth	F03032	ST 28 SB OVER ST151 NATHAN ELLIS HWY	1960	0	MassDOT	NO	2022/12/19	5	5	5
Harwich	H10004	HWY MAIN ST OVER OTHER CAPE COD RAIL TR	1986	0	MassDOT	NO	2022/05/11	N	N	N
Harwich	H10017	US 6 MID CAPE HWY OVER WATER HERRING RIVER	1956	0	MassDOT	NO	2022/05/11	N	N	N
Harwich	H10010	OTHER PED@NORTH RD OVER WATER HERRING RIVER	1986	0	Municipality	NO	1996/11/01	8	8	8
Harwich	H10016	US 6 MID CAPE HWY OVER HWY DEPOT ST	1955	2003	MassDOT	NO	2021/07/14	8	7	7
Harwich	H10020	OTHER CAPE COD RT OVER US 6 MID CAPE HWY	2002	0	Municipality	NO	2021/10/11	8	7	7
Harwich	H10001	HWY LOWER COUNTY OVER WATER HERRING RIVER	1930	2003	Municipality	NO	2021/06/28	7	7	7
Harwich	H10003	HWY LOWER COUNTY OVER WATER DOANES CREEK	1955	0	Municipality	NO	2021/06/15	7	7	5
Harwich	H10011	HWY BELLS NCK RD OVER WATER HERRING RIVER	1986	0	Municipality	NO	2022/08/03	7	7	6
Harwich	H10015	HWY LOTHROP AVE OVER WATER HERRING RIVER	1953	0	Municipality	NO	2022/04/07	7	7	5
Harwich	H10002	ST 28 MAIN ST OVER WATER HERRING RIVER	1953	0	MassDOT	NO	2021/06/22	6	6	5
Harwich	H10014	ST137 BRWSTR CHTM OVER US 6 MID CAPE HWY	1955	0	MassDOT	NO	2022/01/21	6	5	6
Harwich	H10013	ST124 PLSNT LK AVE OVER US 6 MID CAPE HWY (US Navy LTJG Ralph Wallace Burns)	1955	0	MassDOT	NO	2022/11/18	5	6	6
Harwich	H10019	HWY AZALEA DR OVER WATER HERRING RIVER	1974	0	Municipality	NO	2022/05/04	5	5	7
Mashpee	M08003	HWY OLD BARNSTBL OVER WATER QUASHNET RIVER	1960	0	Municipality	NO	2022/05/13	N	N	N
Mashpee	M08005	ST151 NATHAN ELLIS OVER WATER QUASHNET RIVER	1941	0	Municipality	NO	2022/05/13	N	N	N
Orleans	O04006	OTHER CAPE COD RT OVER US 6 & ROCK HARBOR RD	2001	0	Municipality	NO	2012/12/07	8	8	8
Orleans	O04001	ST 28 S ORLEANS RD OVER WATER SALT MARSH CREEK	1954	0	MassDOT	NO	2021/07/12	7	7	6
Orleans	O04004	HWY WEST RD OVER US 6 MID CAPE HWY	1958	1986	MassDOT	NO	2022/10/27	7	7	7
Orleans	O04005	HWY ROCK HRBR RD OVER US 6 MID CAPE HWY	1958	1987	MassDOT	NO	2022/04/06	7	7	6
Orleans	O04003	US 6 MID CAPE HWY OVER ST 6 A/CRANBERRY HWY	1957	1987	MassDOT	NO	2022/04/08	5	6	7
Sandwich	S04006	US 6 WB/MD CP HWY OVER ST130 SANDWICH RD	1950	0	MassDOT	NO	2022/06/29	N	6	7
Sandwich	S04007	HWY QUKR MTNG HS OVER US 6 WB MID CAPE HWY	1950	0	MassDOT	NO	2022/06/01	N	7	7
Sandwich	S04008	HWY CHASE RD OVER US 6 WB MID CAPE HWY	1950	0	MassDOT	NO	2022/08/16	N	7	7
Sandwich	S04009	US 6 EB/MD CP HWY OVER ST130 SANDWICH RD	1953	0	MassDOT	NO	2022/06/29	N	6	7
Sandwich	S04010	HWY QUKR MTNG HS OVER US 6 EB MID CAPE HWY	1953	0	MassDOT	NO	2022/06/01	N	7	7

Town	Dept. No.	Bridge Description	Year Built	Year Reconstructed	Bridge Owner	Structurally Deficient	Bridge Inspection Date	Deck Condition	Superstructure Condition	Substructure Condition
Sandwich	S04011	HWY CHASE RD OVER US 6 EB MID CAPE HWY	1953	0	MassDOT	NO	2022/08/16	N	7	7
Sandwich	S04002	HWY OLD CNTY RD OVER RR MACRR	1890	1995	MassDOT	NO	2021/10/12	7	7	7
Sandwich	S04001	ST 6 A/CRNBRY HWY OVER WATER SCORTON RIVER	1926	0	MassDOT	NO	2021/06/25	6	6	6
Sandwich	S04003	ST 6 A/CRNBRY HWY OVER WATER MILL CREEK	1951	0	MassDOT	NO	2022/08/05	6	6	7
Truro	T08003	US 6 MID CAPE HWY OVER HWY S PAMET RD	1951	0	MassDOT	NO	2021/06/11	6	6	6
Truro	T08004	US 6 MID CAPE HWY OVER HWY HIGHLAND RD	1953	0	MassDOT	NO	2021/06/04	6	5	7
Wellfleet	W14007	HWY CHEQUSST NCK OVER WATER HERRING RIVER	1973	0	Municipality	NO	2022/06/16	N	N	N
Wellfleet	W14006	HWY LT ISLAND RD OVER WATER LOAGY BAY	1920	2005	Municipality	NO	2023/04/24	6	6	5
Wellfleet	W14008	HWY LNG PND RD OVER US 6 MID CAPE HWY (LEONARD A. PIERCE, SR.)	1949	0	MassDOT	NO	2021/11/04	5	6	7
Yarmouth	Y01017	HWY W YARMTH RD OVER OTHER GOLF COURSE ACCESS	1997	0	Municipality	NO	2022/05/05	N	8	7
Yarmouth	Y01002	ST 28 MAIN ST OVER WATER PARKERS RIVER	2021	0	MassDOT	NO	2021/11/03	8	8	8
Yarmouth	Y01012	US 6 EB/MD CP HWY OVER HWY UNION ST (Donald L. McKinnon Bridge)	1970	0	MassDOT	NO	2021/09/23	7	5	7
Yarmouth	Y01014	US 6 WB/MD CP HWY OVER RR MACRR	1971	0	MassDOT	NO	2021/10/28	7	7	7
Yarmouth	Y01005	US 6 EB/MD CP HWY OVER COMB WILLOW ST & MACRR	1966	1997	MassDOT	NO	2021/07/13	6	5	6
Yarmouth	Y01006	US 6 WB/MD CP HWY OVER HWY UNION ST	1954	0	MassDOT	NO	2021/09/23	6	6	6
Yarmouth	Y01007	HWY N DENNIS RD OVER US 6 MID CAPE HWY(Nicholas G. Xiarhos)	1954	1970	MassDOT	NO	2021/08/10	6	6	7
Yarmouth	Y01013	US 6 EB/MD CP HWY OVER RR MACRR	1970	0	MassDOT	NO	2021/10/28	6	7	7
Yarmouth	Y01015	HWY W YARMTH RD OVER US 6 EB (LANCE CORPORAL WILLIAM JOSEPH DONOVAN JR.)	1969	0	MassDOT	NO	2022/06/20	6	6	7
Yarmouth	Y01016	HWY W YARMTH RD OVER US 6 WB (LANCE CORPORAL WILLIAM JOSEPH DONOVAN JR.)	1969	0	MassDOT	NO	2022/06/20	6	6	6
Yarmouth	Y01005	US 6 WB/MD CP HWY OVER COMB WILLOW ST & MACRR	1953	1997	MassDOT	NO	2021/07/13	5	5	5
Yarmouth	Y01009	OTHER CAPE COD RT OVER HWY STATION AVE	2014	0	Municipality	NO	1899/12/30			

CAPE COD COMMISSION

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