4 Affected Environment, Environmental Consequences, and Mitigation

4.13 Air Quality

4.13.1 Introduction

This section assesses the potential short-term and long-term effects of the No Build Alternative and Build Alternative on air quality. The Build Alternative is expected to generate short-term construction-related emissions, which would be temporary and mitigated through standard best practices. Because the Cape Cod Bridges Program (Program) is in an area that meets federal air quality conformity requirements and is part of a conforming regional plan, it is not expected to degrade air quality over the long-term. Details supporting these findings are provided in the following sections, which describe the analytical methods used, the results of the short-term and long-term air quality assessments, and the mitigation measures to be implemented during construction.

4.13.1.1 Resource Descriptions

Air quality describes the degree to which the ambient air is pollution-free, which is assessed by the measured or calculated amount of air pollution the public is exposed to in the environment.

4.13.1.2 Regulatory Context

Clean Air Act – National Ambient Air Quality Standards

The Clean Air Act of 1970[1] is the primary federal law that regulates air quality in the United States and is administered by the U.S. Environmental Protection Agency (EPA). The Clean Air Act requires EPA to establish, and states to adopt, National Ambient Air Quality Standards (NAAQS) for major pollutants known as "criteria pollutants."[2] EPA regulates six criteria pollutants:

- Carbon monoxide (CO)
- Lead
- Nitrogen dioxide
- Particulate matter:
  - Particulate matter with a diameter less than or equal to 10 microns (PM10)
  - Particulate matter with a diameter less than 2.5 microns (PM2.5)
- Ozone
- Sulfur dioxide (SO2)

[1] 42 United States Code 7401 et seq
[2] 40 Code of Federal Regulations part 50

The NAAQS are two-tiered:

- First tier (primary) is intended to protect public health.
- Second tier (secondary) is intended to protect public welfare and prevent degradation of the environment.

Table 4.13-1 presents the primary and secondary NAAQS established by EPA for the six criteria pollutants.

Table 4.13-1. National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead		Primary and Secondary	Rolling 3-month average	0.15 µg/m3 [1]	Not to be exceeded
Nitrogen Dioxide		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and Secondary	1 year	53 ppb[2]	Annual Mean
Ozone		Primary and Secondary	8 hours	0.070 ppm[3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter (PM)	PM2.5	Primary[5]	1 year	9.0 µg/m3	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 µg/m3	Annual mean, averaged over 3 years
		Primary and Secondary	24 hours	35 µg/m3	98th percentile, averaged over 3 years
	PM10	Primary and Secondary	24 hours	150 µg/m3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		Primary	1 hour	75 ppb[4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: U.S. Environmental Protection Agency. 2025. NAAQS table. https://www.epa.gov/criteria-air-pollutants/naaqs-table.

Notes: ppm = parts per million; ppb = parts per billion; µg/m^3 = microgram per cubic meter

[1] In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m^3 as a calendar quarter average) also remain in effect.

[2] The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

[3] Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards are not revoked and remain in effect for designated areas. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O_3 standards.

[4] The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a State Implementation Plan call under the previous SO_2 standards (40 CFR 50.4(3)). A State Implementation Plan call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

[5] On January 27, 2023, EPA issued a proposed rule for "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter" (18 Federal Register 5558). At the time of preparation of this report, that rule has not been finalized. The NAAQS table presented here may be updated for particulate matter when the rule is finalized.

EPA has designated specific areas as NAAQS attainment or non-attainment areas. Attainment areas are those areas that meet all NAAQS criteria pollutant standards. Non-attainment areas are those areas that exceed the NAAQS for one or more criteria pollutants. If an area is designated as "non-attainment," a state or region must develop a State Implementation Plan to demonstrate how they will attain and maintain the NAAQS. Once an area has attained the relevant standard, EPA may redesignate the area as an attainment/maintenance area, which are typically referred to as "maintenance areas."

EPA promulgated a Transportation Conformity Rule pursuant to requirements of the Clean Air Act.[3] The rule applies only in EPA-designated non-attainment or maintenance areas.[4]

4.13.1.3 Methodology and Study Areas

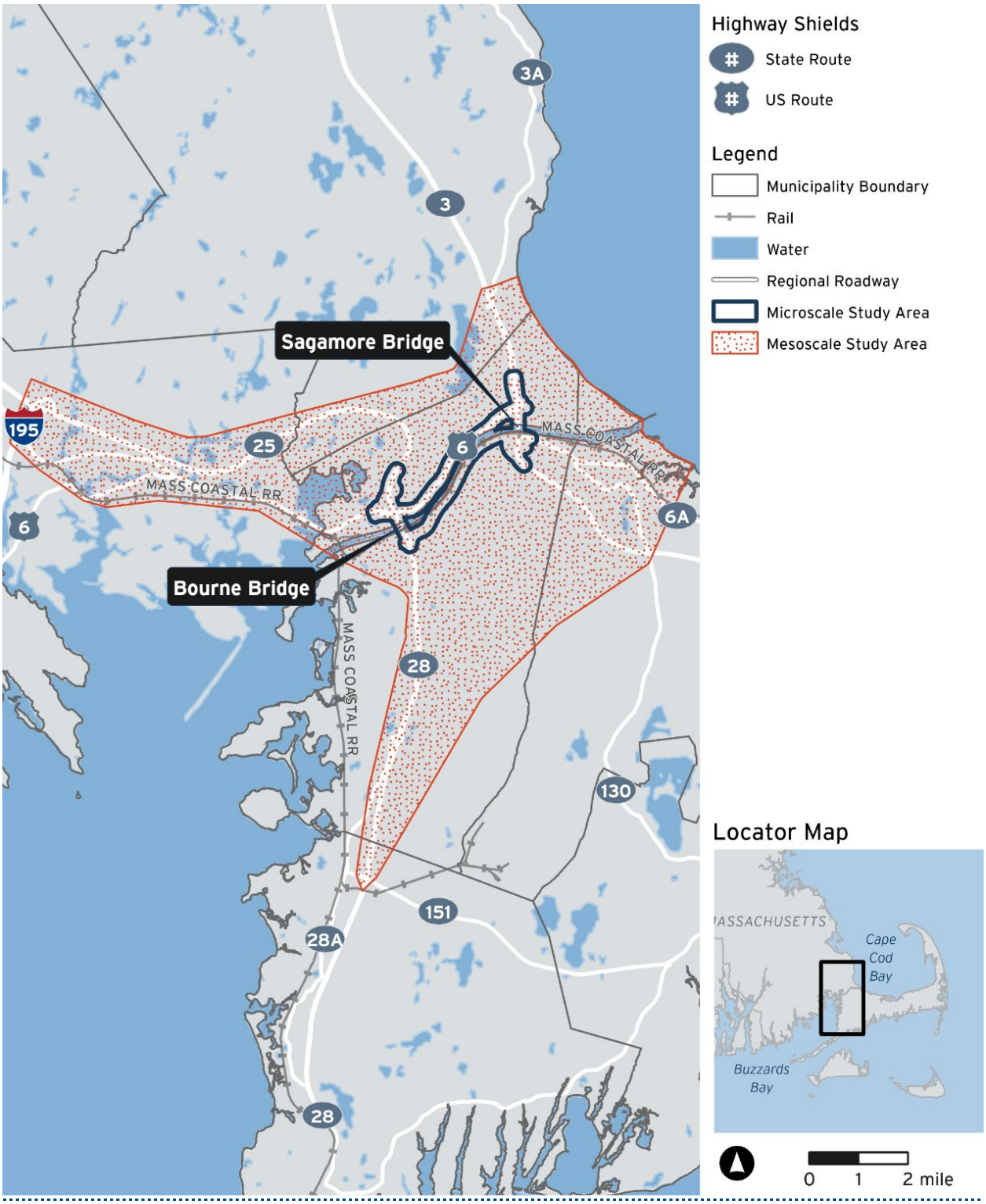
Air Quality Study Areas

A Microscale Study Area and a Mesoscale Study Area are defined to assess air quality impacts at both localized roadway locations and across the broader regional transportation network (**Figure 4.13-1**). The Microscale and Mesoscale Study Areas match the Traffic Focus Area and the Regional Study Area presented in **Section 4.2, Transportation, Traffic, and Safety**.

[3] 40 Code of Federal Regulations Parts 51 and 93

[4] 40 Code of Federal Regulations 93.102(b)

Figure 4.13-1. Microscale and Mesoscale Air Quality Study Areas



Source: Massachusetts Department of Transportation, 2026

Microscale (Localized) Carbon Monoxide Analysis

EPA project-level ("hot-spot") transportation conformity requirements for CO do not apply because the Cape Cod Bridges Program (Program) is in a region that is in attainment of the NAAQS. However, a qualitative analysis was conducted to evaluate potential CO impacts from the Build Alternative compared to the No Build Alternative.

Mesoscale (Regional) Emission Analysis

The Massachusetts Department of Transportation (MassDOT) conducted a mesoscale analysis to evaluate the potential regional air quality effects of the Build Alternative from motor vehicles as a measure of the total daily emissions of volatile organic compounds (VOC), nitrogen oxides, CO, PM10, and PM2.5, and SO2. Mobile-source emission calculations were performed for nearby affected roadway segments utilizing the traffic data and roadway speeds, and EPA Motor Vehicle Emissions Simulator (MOVES, latest version of MOVES4) emission factors.

Mobile-Source Air Toxics

MassDOT conducted a qualitative assessment of mobile-source air toxics (MSAT) impacts in accordance with the Federal Highway Administration's Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents.[5] According to this guidance, the Program would qualify as a "Project with Low Potential MSAT Effects" because design year traffic is projected to be less than 140,000 to 150,000 annual average daily traffic.

Construction Emissions

MassDOT completed a quantitative assessment of mobile source construction emissions, focusing on diesel truck traffic and marine vessel operations.

Diesel Truck Emissions

The analysis assumes 103 daily round trips over the 10-year construction period. Daily trips are multiplied by a conservative 14-mile routing distance within the Mesoscale Study Area to derive daily and annual vehicle miles traveled (VMT). These VMT values are paired with emission factors from the EPA MOVES 2019 model to calculate annual criteria pollutant emissions.

Marine Vessel Emissions

The analysis assumes 7,300 annual trips by tugs and launches to support work at the Sagamore and Bourne Bridges. For each trip, the analysis uses an 8-hour operating day to represent the time vessels spend traveling, maneuvering, and supporting construction activities. Total operating hours are then paired with EPA marine engine emission factors to estimate annual emissions.

[5] https://www.fhwa.dot.gov/environMent/air_quality/air_toxics/policy_and_guidance/msat//fhwa_nepa_msat_memorandum_2023.pdf

4.13.2 Affected Environment

4.13.2.1 Air Quality Attainment Status

The Microscale (Localized) and Mesoscale (Regional) Air Quality Study Areas are in Plymouth and Barnstable Counties, which are designated as attainment areas for all criteria pollutants with EPA NAAQS.[6]

4.13.2.2 Project Status in a Regional Transportation Plan and Program

Federal conformity requirements at 40 Code of Federal Regulations (CFR) 93.114[7] and 40 CFR 93.115[8] (as incorporated by reference into the Massachusetts conformity State Implementation Plan) apply because the area in which the Program is located is subject to a federal court decision that affects all former maintenance areas nationwide for the 1997 ozone NAAQS.[9] Accordingly, there must be a currently conforming transportation plan (i.e., Long Range Transportation Plan) and Transportation Improvement Program (TIP) at the time of issuance of the National Environmental Policy Act Record of Decision, and the project (Cape Cod Bridges Program) must come from a conforming plan and TIP or otherwise meet the criteria specified in 40 CFR 93.109(b).[10] As of the date of the Record of Decision, the Cape Cod Bridges Program (replacement of the Sagamore and Bourne Bridges) is included in the currently conforming Federal Fiscal Year 2026-2030 Transportation Improvement Program Amendment 3 as developed by the Cape Cod Metropolitan Planning Organization.[11] In addition, as of the date of the Record of Decision, both phases of the Program (replacement of Sagamore and Bourne Bridges) are included in the currently conforming Long Range Regional Transportation Plan.[12]

4.13.2.3 Ambient Air Quality Data and Trends

Massachusetts Department of Environmental Protection (MassDEP) issues an annual report summarizing air quality monitoring data for the previous year, covering criteria pollutants (those for which EPA has established NAAQS) and other pollutants, including air toxics. The 2023 annual report was reviewed for the criteria pollutants, and the monitoring results show that ambient pollutant concentrations measured by MassDEP are below the NAAQS. In addition, the trends over the past 10

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[6] https://www3.epa.gov/airquality/greenbook/anayo_ma.htm

[7] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-93#93.114

[8] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-93#93.115

[9] Per a 2/16/2018 court decision (South Coast Air Quality Management District v. EPA), all areas in the country that were in nonattainment or maintenance for the 1997 eight-hour ozone NAAQS before its revocation by EPA in 2015 were again made subject to conformity for that standard. This decision in part affects "orphan areas" (as defined in the ruling), which in Virginia include Fredericksburg, Richmond/Tri-Cities, and Hampton Roads. https://law.justia.com/cases/federal/appellate-courts/cadc/15-1115/15-1115-2018-02-16.html

[10] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-93#93.109

[11] https://acrobat.adobe.com/id/urn:aaid:sc:US:a8dfff78-a1c1-4d6d-8820-5629d867e5d0

[12] https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/tr/Transportation%20Plans/RTP/2024_RTP/Report/FINAL%20PDF/Cape%20Cod%202024%20Regional%20Transportation%20Plan_Endorsed%2007242023%20With%20Appendix.pdf

years show that ambient concentrations have been decreasing. This decrease is primarily attributed to the implementation of more stringent vehicle emissions and fuel quality standards.

4.13.3 Environmental Consequences

4.13.3.1 Microscale (Localized) Carbon Monoxide Analysis

The Build Alternative is expected to substantially improve traffic operations compared to the No Build Alternative within the Microscale Study Area Intersections, expressway mainline, and merging-diverging segments within the Microscale Study Area are expected to operate at improved levels of service during the fall weekday PM peak hour. Travel times between major origin-destination points along major routes within the Microscale Study Area are also estimated to improve for the Build Alternative compared to the No Build Alternative. The Build Alternative model recorded less total travel time (2,126 hours) in the Microscale Study Area roadway network than the No Build Alternative (2,879). Improved traffic operations and mobility within the Microscale Study Area for the 2050 Build Alternative are anticipated to reduce CO emission rates compared to the 2050 No Build Alternative. Refer to **Section 4.2, Transportation, Traffic, and Safety,** and the supporting **Appendix 4.2, Traffic Engineering Technical Report,** for detailed information on the traffic analyses conducted for the 2019 Base Year and 2050 Design Year.

4.13.3.2 Mesoscale (Regional) Emission Analysis

Table 4.13-2 presents the 2050 forecast VMT and vehicle hours traveled (VHT) for the No Build and Build Alternatives within the Mesoscale Study Area. **Table 4.13-3** presents the projected daily pollutant emissions for the 2050 No Build and Build Alternatives. The 2050 Build Alternative is expected to decrease daily VMT and VHT compared to the 2050 No Build Alternative, leading to reduced daily pollutant emissions of CO, nitrogen oxide, and particulates (PM10 and PM2.5) in the Mesoscale Study Area.

Table 4.13-2. 2050 Projected Daily Vehicle Miles Traveled, and Vehicle Hours Traveled (Mesoscale Study Area)

Category	2050 No Build Alternative	2050 Build Alternative	Difference (No Build vs. Build)
Daily Vehicle Miles Traveled	3,476,000	3,416,153	-59,847
Daily Vehicle Hours Traveled	94,715	86,788	-7,927

Source: Massachusetts Department of Transportation, 2025

Table 4.13-3. Projected Daily Pollutant Emissions (tons per day) (Mesoscale [Regional] Air Quality Study Area)

Category	2050 No Build Alternative	2050 Build Alternative	Change (No Build to Build)
Carbon Monoxide	3.24	2.99	-0.25
Volatile Organic Compounds	0.07	0.07	-0
Nitrogen Oxides	0.11	0.10	-0.01
Sulfur Dioxide	0.004	0.004	0
PM10	0.18	0.14	-0.04
PM2.5	0.03	0.02	-0.01

Source: Massachusetts Department of Transportation, 2025

PM10/PM2.5 = particulate matter with a diameter less than or equal to 10/2.5 microns

4.13.3.3 Mobile-Source Air Toxics

Technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of the Build Alternative. While it is possible that localized increases in MSAT emissions may occur as a result of the Build Alternative, emissions in the 2050 Build Alternative would likely be lower than present levels as a result of EPA's national control programs that are projected in Federal highway Administration guidance (2023) to reduce annual MSAT emissions by 76% between 2020 and 2060 even as VMT increases nationally by 31%. Although local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates (and local control measures), the magnitude of EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the Microscale (Localized) and Mesoscale (Regional) Air Quality Study Areas are likely to be lower in the future in nearly all cases.

4.13.3.4 Construction

Table 4.13-4 presents the estimated construction vehicle emissions of criteria air pollutants expressed in tons per year, based on average annual construction vehicle activity over the 10-year construction period. An annual VMT of 529,980 miles was applied as the basis for estimating diesel truck emissions.

Table 4.13-4. Projected Annual Diesel Truck Emissions

Pollutant	Annual Emissions (tons/year)
Carbon Monoxide	1.50
Volatile Organic Compounds	0.11
Nitrogen Oxides	2.89
Sulfur Dioxide	0.004

Pollutant	Annual Emissions (tons/year)
PM10	0.14
PM2.5	0.08

Source: HMMH, 2026

Table 4.13-5 presents annual criteria pollutant emissions estimates for marine transport vessels expected to operate within the Cape Cod Canal during the construction period.

Table 4.13-5. Projected Annual Pollutant Emissions (Tons Per Year) for the Marine Vessel Trips

Activity	Trips Per Year	Carbon Monoxide	Volatile Organic Compounds	Nitrogen Oxides	Sulfur Dioxide	PM10	PM2.5
Tugs	4,380	2.24	0.30	3.16	0.01	0.07	0.07
Launches	2,920	1.07	0.41	2.52	0.41	0.17	0.16
Total Emissions		**3.31**	**0.71**	**5.68**	**0.42**	**0.24**	**0.23**

Source: HMMH, 2025

Table 4.13-6 presents the projected annual combined emissions from construction-related diesel truck trips and marine vessel activity. These annual emissions were compared to EPA's *de minimis* thresholds to evaluate the potential for significant air quality impacts. **Table 4.13-6** identifies that annual emissions for all evaluated pollutants remain well below EPA's *de minimis* thresholds for each pollutant, demonstrating that construction-related diesel truck traffic and marine vessel activity are not expected to result in significant air quality impacts.

Table 4.13-6. Projected Annual Construction Mobile Source Emissions Compared to EPA Thresholds

Pollutant	Annual Emissions (tons/year)	EPA *de minimis* Threshold (tons/year)13	Below Threshold?
Carbon Monoxide	4.80	100	Yes
Volatile Organic Compounds	0.82	100	Yes
Nitrogen Oxides	8.57	100	Yes
Sulfur Dioxide	0.42	100	Yes
PM10	0.39	50	Yes
PM2.5	0.32	100	Yes

Source: HMMH, 2026

[13] EPA *de minimis* thresholds represent emission quantities of a NAAQS-regulated pollutant or its applicable precursors that, if exceeded, may cause or contribute to a new or continued violation of the NAAQS in a nonattainment or maintenance area. EPA de minimis tables accessed on January 15, 2026. https://www.epa.gov/general-conformity/de-minimis-tables

Other sources of construction-phase emissions can also contribute to short-term air quality impacts. During active work periods, site preparation and roadway reconstruction can lead to temporary increases in particulate matter (airborne dust) from activities such as land clearing, demolition, excavation, grading, compaction, roadway removal, and paving. In addition to airborne dust, the use of diesel-powered off-road construction equipment can contribute to short-term emissions of CO, nitrogen oxides, and VOCs.

4.13.4 Mitigation

4.13.4.1 Operational Effects

No air quality mitigation is proposed for the operational phase of the Build Alternative as projected emissions are lower than the No Build Alternative due to reduced VMT and VHT.

4.13.4.2 Construction Effects

Several environmental protection and public communication measures will be implemented during construction to mitigate air quality impacts and ensure transparent coordination with the community.

Diesel emissions will be controlled in accordance with MassDOT's Diesel Emission Control Specification, which requires the use of cleaner fuels, verified emission control technologies, and strict idling limits for construction equipment. An Environmental Health and Safety Plan will be prepared and implemented to identify, evaluate, and control health and safety hazards associated with any potential on-site chemical contamination present in air or other environmental media during construction and establish appropriate emergency response procedures. Fugitive dust will be managed in accordance with MassDOT's Dust Control Specification, which requires proactive measures, such as regular watering of exposed soils, covering loads, cleaning paved surfaces, and following an approved Dust Control Plan.

The Design-Builder will be required to comply with MassDOT's Standard Specification for all demolition and work involving painted steel. This specification requires the Design-Builder to develop a site-specific plan to protect workers and surrounding receptors from potential exposure to airborne contaminants. The plan must identify standards for air quality monitoring, which include baseline monitoring, high-volume ambient air monitoring, and targeted monitoring of lead levels in total suspended particulate matter. If any identified thresholds are exceeded, the Design-Builder must suspend operations until adequate containment is implemented and verified. The Design-Builder must maintain all monitoring results, inspection logs, and compliance documentation, which will be made available to the Town of Bourne Health Department and other authorities upon request.

MassDOT and the Design-Builder will establish a clear system for receiving and tracking comments, complaints, and questions from the public and project stakeholders during construction. This system will include a dedicated project hotline, managed by the Design-Builder, and a dedicated email address managed by MassDOT's Public Affairs staff. Information on these communication channels will be provided in construction notices, on the Program website, and through posted signage at the job sites. Both channels will be activated prior to the start of major construction. All inquiries received through the hotline or email will be logged, responded to, and tracked through resolution.