# APPENDIX T: AIR QUALITY ANALYSIS

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# AIR QUALITY ANALYSIS TECHNICAL MEMORANDUM

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# 1.0 AIR QUALITY ANALYSIS

## 1.1 AIR QUALITY

### 1.1.1 Introduction and Regulatory Framework

The United States Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS) for atmospheric concentrations of pollutants that are considered harmful to public health as required under the Clean Air Act (CAA) of 1970 (as amended). The South Carolina Department of Health and Environmental Control (SCDHEC) Bureau of Air Quality is responsible for regulating and ensuring compliance with the CAA in South Carolina. The criteria air pollutants with concentration standards established under NAAQS include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. Criteria pollutant emissions from transportation projects contribute to concentrations of four of the six criteria air pollutants: ozone, carbon monoxide, particulate matter, and nitrogen dioxide.

#### 1.1.1.1 Transportation Conformity

The United States is divided into geographic areas classified as either in attainment or nonattainment of the NAAQS. Areas that have ambient concentrations of all six criteria pollutants below the NAAQS standards are in attainment. If an area exceeds the NAAQS levels for any of the six criteria pollutants, then it is in nonattainment. In nonattainment areas, the EPA requires states to develop or revise a state implementation plan (SIP) to improve air quality and ensure that the standards will be attained. Transportation Conformity, a program implemented to ensure highway and transit projects would be consistent with SIP air quality goals, is required for transportation projects in nonattainment areas.

Table 1-1: Criteria Pollutants Measured Under NAAQS

| Pollutant | Standard | | | Type of Standard[1] | Description | Possible Effects to Human Health |
|---|---|---|---|---|---|---|
| | Averaging Time | ppm | µg/m$^3$ | | | |
| Carbon Monoxide (CO) | 1 hour | 35 | 40,000 | Primary | CO is a result of incomplete combustion in fuel. It is an odorless and colorless gas and is formed primarily from vehicle exhaust. | Breathing CO reduces the body's ability to deliver oxygen to vital organs. It can affect heart, lung, and central nervous system function. Inhalation in excessive amounts can result in poisoning or death. |
| | 8 hours | 9 | 10,000 | Primary | | |

| Pollutant | Standard | | | Type of Standard[1] | Description | Possible Effects to Human Health |
|---|---|---|---|---|---|---|
| | Averaging Time | ppm | µg/m$^3$ | | | |
| Lead (Pb) | Rolling 3-month average | n/a | 0.15 | Primary & secondary | Pb usually is released into the environment due to the processing of metals by utilities, waste incinerators, and lead-acid battery manufacturers. | Neurological effects in children and cardiovascular effects (e.g., high blood pressure and heart disease) in adults are the most common health effects of Pb. |
| Nitrogen dioxide ($NO_2$) | 1 hour | 0.100 | 188 | Primary | $NO_2$ is an odorless and colorless gas that comes from various sources, including vehicle exhaust, industrial processes, and utility emissions. | A component of ozone that causes numerous respiratory problems. |
| | Annual | 0.053 | 100 | Primary & Secondary | | |
| Ozone ($O_3$) | 8 hours | 0.070 | 137 | Primary & Secondary | $O_3$ is created when nitrogen oxide compounds mix with volatile organic compounds in the presence of sunlight. | $O_3$ causes respiratory problems such as decreased lung function, asthma, wheezing, coughing, pain when breathing, and higher susceptibility to respiratory illnesses like pneumonia and bronchitis. |
| Particulate matter diameter less than or equal to 10 µm ($PM_{10}$) | 24 hours | n/a | 150 | Primary & Secondary | Particulate matter forms when small solid particles combine with liquid droplets to form dust, dirt, haze, soot, or smoke. These can be emitted from primary sources such as unpaved roads, construction sites, fields, or smokestacks. They also can be emitted from secondary | Particulate matter causes a variety of respiratory problems, from asthma and bronchitis to decreased lung capacity and function. If particulate matter is very small, it can be transferred to the cardiovascular system and cause irregular heartbeat and nonfatal heart attacks. |
| Particulate matter less than or equal to 2.5 µm ($PM_{2.5}$) | 24 hours | n/a | 35 | Primary | | |
| | Annual | n/a | 12.0 | Primary | | |

| Pollutant | Standard | | | Type of Standard[1] | Description | Possible Effects to Human Health |
|---|---|---|---|---|---|---|
| | Averaging Time | ppm | µg/m$^3$ | | | |
| | | | 15 | Secondary | reactions of gases released from automobiles and industrial plants. | |
| Sulfur dioxide ($SO_2$) | 1 hour | 0.075 | 196 | Primary | $SO_2$ is formed when fuel-like coal and oil are burned and sulfur is released into the atmosphere and mixes with oxygen. Main sources of SO2 include fuel-burning utility plants, petroleum refineries, large ships and locomotives, and metal processing plants. | $SO_2$ can cause respiratory illnesses like asthma, decreased lung function, and susceptibility to other illnesses like pneumonia and bronchitis. It also can aggravate existing heart diseases. |
| | 3 hours | 0.5 | 1,300 | Secondary | | |

Source: EPA, *Criteria Air Pollutants*, https://www.epa.gov/criteria-air-pollutants, accessed July 7, 2022.

µg/m$^3$ = micrograms per cubic meter
mg/m3 = milligrams per cubic meter
n/a = not applicable
ppm = parts per million

[1] Primary standards are set to protect public health. Secondary standards are designed to protect public welfare.

### 1.1.1.2 Mobile Source Air Toxics

Controlling air toxics emissions became a national priority with the passage of the CAA amendments in 1990, whereby Congress mandated the EPA to regulate 188 air toxics, also known as hazardous air pollutants. EPA has assessed this list in its latest rule on the Control of Hazardous Air Pollutants from Mobile Sources[1] and identified a group of 93 compounds emitted from mobile sources that are now listed in the EPA Integrated Risk Information System.[2] The EPA refers to these compounds as Mobile Source Air Toxics (MSAT). In addition, the EPA identified nine compounds with significant contributions from mobile sources that are among the national- and regional-scale cancer risk drivers from the EPA 2011 National Air Toxics Assessment.[3] These are acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel particulate matter, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter. While the Federal Highway Administration (FHWA) considers these the priority MSAT, the list is subject to change and may be adjusted to consider future EPA rules.

[1] Federal Register, Vol. 72, No.37, page 8430, February 26, 2007.
[2] EPA. *Integrated Risk Information System*. Accessed July 7, 2022, https://www.epa.gov/iris.
[3] EPA. *Summary of Results for the 2011 National-Scale Assessment*. Accessed January 19, 2023, https://www.epa.gov/sites/default/files/2015-12/documents/2011-nata-summary-results.pdf

## 1.1.2 Methodology

### 1.1.2.1 Transportation Conformity

The EPA *Nonattainment Areas for Criteria Pollutants (Green Book)* was reviewed in July 2022 to determine the region's current attainment status. According to the EPA Green Book, Charleston County was in attainment for all criteria pollutants and thus and is not subject to federal transportation conformity regulations (40 CFR 51, 40 CFR 93).[4]

### 1.1.2.2 Mobile Source Air Toxics

A standard qualitative assessment of the likely MSAT emission impacts of this project was developed for this analysis. Available technical tools do not enable prediction of the project-specific health impacts of the emission changes associated with the alternatives in this analysis. Because of these limitations, the following discussion is included per Council of Environmental Quality (CEQ) regulations (40 CFR 1502.21(b)) regarding incomplete or unavailable information.

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes because of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, the public and other agencies expect FHWA to address MSAT impacts in its environmental documents. The FHWA, EPA, Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this emerging field.

In the FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

## 1.1.3 Existing Conditions

Although Charleston County has no mandated requirements to develop air quality plans, the Berkeley-Charleston-Dorchester Council of Governments (BCDCOG) has developed an early action plan in partnership with the SCDHEC Bureau of Air Quality to proactively ensure continued compliance with the ozone NAAQS.[5] Table 1-2 summarizes the latest available ambient air quality monitoring data for Charleston County and demonstrates that ambient concentrations are less than the NAAQS for each pollutant; carbon monoxide monitoring data is not available in the project area.

[4] EPA. *Nonattainment Areas for Criteria Pollutants (Green Book)*. Accessed July 19, 2022, https://www3.epa.gov/airquality/greenbook/anayo_sc.html.
[5] BCDCOG. *Air Quality*. Accessed July 7, 2022, https://bcdcog.com/air-quality/.

Table 1-2: Air Quality Monitoring Data

| Pollutant | Averaging Period | Monitoring Results | | | NAAQS Primary | Violation Criteria |
|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2020 | | |
| $NO_2$ (ppb) | 1 hour | 35 | 35 | 33 | 100 | 98th percentile of 1-hour daily maximum concentrations averaged over 3 years |
| | Annual | 6.9 | 6.0 | 5.8 | 53 | Annual mean |
| $O_3$ (ppm) | 8 hours | 61 | 62 | 59 | 70 | Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years |
| $PM_{2.5}$ ($\mu g/m^3$) | 24 hours | 16 | 15 | 15 | 35 | 98th percentile, averaged over 3 years |
| | Annual | 7.2 | 7.0 | 6.9 | 12 | Annual mean averaged over 3 years |
| $PM_{10}$ ($\mu g/m^3$) | 24 hours | 42 | 38 | 43 | 150 | Not to be exceeded more than once per year on average over 3 years |
| $SO_2$ (ppb) | 1 hour | 13 | 14 | 12 | 75 | 99th percentile of 1-hour daily maximum concentrations averaged over 3 years |

Source: SCDHEC, *Air Monitoring Data (GIS)*. Accessed July 8, 2022, https://gis.dhec.sc.gov/monitors/.

$\mu g/m^3$ = micrograms per cubic meter
NAAQS = National Ambient Air Quality Standards
$NO_2$ = nitrogen dioxide
$O_3$ = ozone
$PM_{10}$ = inhalable particulate matter
$PM_{2.5}$ = fine particulate matter
$SO_2$ = sulfur dioxide
ppb = parts per billion
ppm = parts per million

## 1.1.4 Environmental Consequences

### 1.1.4.1 No-Build Alternative

#### Transportation Conformity

As discussed above in Section 1.1.3 Existing Conditions, the project area is currently designated as in attainment for all criteria pollutants. Although the No-Build Alternative would involve regional increase to vehicle miles traveled (VMT) in the study area relative to the existing conditions, regional air pollutant emissions associated with this activity would be expected to decrease as compared to the existing conditions. This decrease would be driven by improvements in engine efficiency and emission standards which would occur irrespective of the project. This, in combination with the implementation of Charleston County's early action plan as applicable, would be expected to maintain Charleston County's attainment of the NAAQS under the No-Build Alternative.

#### Mobile Source Air Toxics

As discussed above, improvements in engine efficiency and emission standards would be expected to offset emission increases associated with regional VMT growth relative to the existing conditions.

### 1.1.4.2 Build Alternatives

#### Transportation Conformity

While study area VMT would differ from that of the No-Build Alternative under each of the evaluated Build Alternatives, these VMT changes would be minor and the project under any evaluated alternative would have little effect on air quality for the region. Since Charleston County is in attainment with the

NAAQS, it is not subject to federal transportation conformity regulations (40 CFR 51, 40 CFR 93) and no further action is required.

## Mobile Source Air Toxics

For each alternative evaluated in this analysis, the amount of MSAT emitted would be proportional to the forecasted VMT if all other variables, such as fleet mix and average vehicle speed, remain the same. The study area VMT for each Build Alternative would differ slightly from the No-Build Alternative, with Alternatives 2, 3, and 6 resulting in reduced VMT and Alternative 1 resulting in slightly increased VMT. Additionally, the fleet mix and average vehicle speeds on project roadway segments would differ between the Build Alternatives, and thus emissions would differ slightly beyond the change attributable to the proportional changes to VMT. Overall, both VMT changes and emission rate changes associated with differing average speeds would be minor, therefore regional emissions of MSAT would not be expected to differ substantially between the No-Build Alternative or any of the evaluated Build Alternatives. Annual study area VMT under each Build Alternative are presented in Table 1-3.

Table 1-3: Change in Study Area VMT from the Build Alternatives

| Study Area | No-Build | Alternative 1a | Alternative 2 | Alternative 3 | Alternative 6 |
|---|---|---|---|---|---|
| Annual VMT | 114,574,595 | 114,960,035 | 112,515,630 | 112,556,145 | 111,355,660 |
| VMT Change vs No-Build | -- | 0.34% | (1.80%) | (1.76%) | (2.81%) |

As shown, the estimated VMT under each of the Build Alternatives are nearly the same, varying by 3 percent or less. Thus, no appreciable difference in overall MSAT emissions among the Build Alternatives would be expected. For any of the analyzed alternatives, emissions would be expected to be substantially lower than 2021 levels in the design year (2050) due to improvements in engine efficiency and emission standards which would occur irrespective of the project. Such improvements to engine emission standards, included in the EPA's national control programs, are projected to reduce MSAT emissions dramatically between 2020 and 2060.[6]

The 2007 EPA rule for MSAT requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines.[7] Using the EPA's Motor Vehicle Emission Simulator 3 (MOVES3) model, FHWA estimates that even if vehicle activity (VMT) were to increase by 31 percent from 2020 to 2060 as forecast, a combined reduction of 76 percent in the total annual emissions for the priority MSAT would be projected for the same time period as shown in Figure 1-1 below. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in virtually all locations.

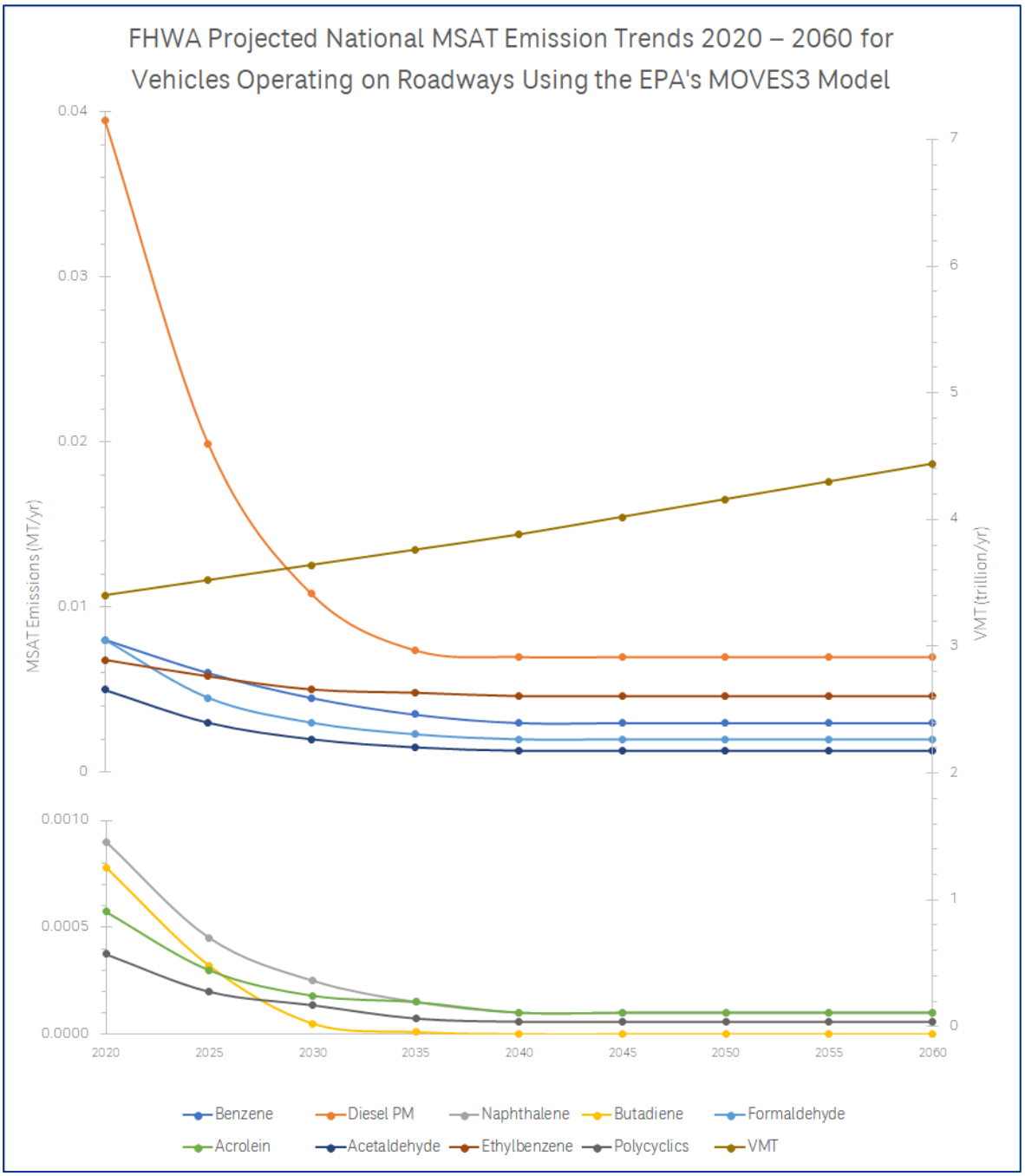
All Build Alternatives evaluated in this analysis would improve traffic flow on I-526 near the Long Point Road Interchange. However, the reconfiguration and construction of new highway ramps completed as part of the Build Alternatives may have the effect of increasing diesel emissions in the vicinity of nearby homes, schools, and businesses; therefore, under each alternative there may be localized areas where ambient concentrations of MSAT would be higher than under the No Build alternative. The localized

[6] FHWA. *Updated Interim Guidance on Mobile Source Air Toxics in NEPA Documents*, January 18, 2023.
[7] Federal Register, Vol. 72, No.37, page 8430, February 26, 2007.

differences in MSAT concentrations would likely be most pronounced under Alternatives 2 and 6 along the new port access ramps. However, with such minimal changes to overall VMT and average vehicle speeds across Build Alternatives relative to the No-Build Alternative, overall MSAT concentrations would not be expected to shift appreciably from those of the No-Build Alternative. As discussed in Section 1.1.2.2 the magnitude and duration of any potential differences cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific health impacts. Even though there may be differences among the Alternatives, on a region-wide basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial reductions over time that in almost all cases the MSAT levels in the future will be significantly lower than today.

In sum, the Build Alternatives in the design year could be associated with higher levels of MSAT emissions in the study area, relative to the No Build Alternative, along with some benefit from improvements in speeds and improvements to the flow of regional truck traffic. There also could be slightly greater differences in MSAT levels among Alternatives in a few localized areas where freight activity occurs closer to homes, schools, and businesses. Under all alternatives, MSAT levels are likely to decrease over time due to nationally mandated cleaner vehicles and fuels.

Figure 1-1: National Mobile Source Air Toxics Trends 2020 – 2060




Source: FHWA. *Updated Guidance on Mobile Source Air Toxic Analysis in NEPA Documents*, January 18, 2023. (recreated from graphic)