B&P Tunnel Project
Baltimore, Maryland

AIR QUALITY TECHNICAL REPORT

June 2016




U.S. Department of Transportation
Federal Railroad Administration

Maryland Department of Transportation

This page intentionally left blank.

TABLE OF CONTENTS

TABLES

FIGURES

I. AFFECTED ENVIRONMENT

This Technical Report presents the background, methodology, and results of the air quality analysis for the B&P Tunnel Project ("Project") Final Environmental Impact Statement (FEIS). The FEIS focuses on the assessment of the Preferred Alternative, identified as Alternative 3B. This report discusses emissions due to train operations, project construction, and ventilation systems.

This section provides background information on the management of air quality in Maryland, existing air quality conditions, and applicable federal regulations.

A. Air Quality Management Agencies

The management of air quality conditions in Maryland is the responsibility of federal, state, regional, and local governmental air quality regulatory agencies. Under the federal Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) establishes the guiding principles and policies for protecting air quality conditions throughout the nation. The USEPA's primary responsibilities in this area include promulgating the National Ambient Air Quality Standards (NAAQS) which define ambient (i.e., outdoor) levels of air pollutants that are considered safe for public health, welfare and the environment, as well as approving State Implementation Plans (SIPs), plans that demonstrate compliance with the NAAQS. The CAA requires states to develop, update, and maintain SIPs that define attainment timeframes or milestones, area-wide emissions inventories and budgets, and control and mitigation strategies that are to be employed.

The Federal Railroad Administration (FRA) is the primary agency involved in, and responsible for, ensuring that air quality impacts associated with proposed railroad projects adhere to the reporting and disclosure requirements of the National Environmental Policy Act (NEPA) as well as the General Conformity rule of the CAA.

On the state level, the Maryland Department of the Environment (MDE) is the primary authority for ensuring that federal (and state) air quality regulations are met. MDE is responsible for air quality monitoring throughout the state as well as the development and implementation of the SIP. The permitting of stationary emission sources, the regulation of mobile source emissions, and air programs related to criteria pollutants are also under the jurisdiction of MDE.

Baltimore City and Baltimore County are part of the Baltimore Regional Transportation Board (BRTB). The BRTB is the federally-designated Metropolitan Planning Organization (MPO) for the Baltimore region. The local MPO along with the Baltimore Metropolitan Council (BMC), assists the MDE with SIP development and compliance with Transportation Conformity regulations as they pertain to air quality. The Maryland Department of Transportation (MDOT) is involved in air quality management of Maryland's surface transportation facilities by means of coordination with the BMC and Federal Highway Administration (FHWA) in the development of Transportation Improvement Plans (TIP), the Long Range Transportation Plan (LRTP), and adherence to the Transportation Conformity rules.

B. National Ambient Air Quality Standards

Pursuant to the requirements of the CAA, the USEPA establishes, enforces, and periodically reviews the NAAQS. The NAAQS are set to safeguard public health and environmental welfare against the detrimental impacts of outdoor air pollution and are defined as primary and/or secondary standards. Primary NAAQS are health-based standards geared toward protecting sensitive or at-risk portions of the population such as asthmatics, children, and the elderly. Secondary NAAQS are welfare oriented and are designed to prevent decreased visibility and damage to animals, vegetation, and physical structures. NAAQS have been established for six common air pollutants, referred to as criteria pollutants, which include: carbon monoxide (CO); lead; nitrogen dioxide (NO_2); ozone; and particulate matter (PM), which includes particulate matter with a diameter of 10 microns or less (PM_{10}), $PM_{2.5}$, and sulfur dioxide (SO_2). Nitrogen oxides (NO_x) and volatile organic compound (VOC) emissions are precursors to ozone formation. The NAAQS are summarized in **Table 1**.

Table 1: National Ambient Air Quality Standards

Pollutant		Primary/Secondary	Averaging Time	Level
Carbon Monoxide (CO)[a]		Primary	8-hour	9 ppm
			1-hour	35 ppm
Lead (Pb)[b]		Primary and Secondary	Rolling 3-month average	0.15 µg/m^3[c]
Nitrogen Dioxide (NO_2)[d]		Primary	1-hour	100 ppb
		Primary and Secondary	1 year	53 ppb[e]
Ozone (O_3)[f]		Primary and Secondary	8-hour	0.070 ppm[g]
Particulate Matter	$PM_{2.5}$[h]	Primary	1 year	12 µg/m^3
		Secondary	1 year	15 µg/m^3
		Primary and Secondary	24-hour	35 µg/m^3
	PM_{10}[i]	Primary and Secondary	24-hour	150 µg/m^3
Sulfur Dioxide (SO_2)[j]		Primary	1-hour	75 ppb[k]
		Secondary	3-hour	0.5 ppm

Source: USEPA, National Ambient Air Quality Standards (NAAQS), 2016, http://www.epa.gov/air/criteria.html.
Notes: ppb = parts per billion, ppm = parts per million, and µg/m^3 = micrograms per cubic meter of air.
[a] CO 1-hour and 8-hour standard not to be exceeded more than once per year.
[b] Lead rolling three-month average standard not to be exceeded.
[c] 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/m3 as a calendar quarter average) also remain in effect.
[d] NO_2 1-hour standard represents the 98th percentile, averaged over three years.
[e] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is presented for the purpose of clearer comparison to the 1-hour standard.
[f] Ozone 8-hour standard represents the annual fourth-highest daily maximum 8-hr concentration, averaged over three years.
[g] Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
[h] $PM_{2.5}$ annual standards represent annual mean, averaged over three years. $PM_{2.5}$ 24-hour standard represents 98th percentile, averaged over three years.
[i] PM_{10} 24-hour standard not to be exceeded more than once per year on average over three years.
[j] SO_2 1-hour standard represents 99th percentile of 1-hour daily maximum concentrations, averaged over three years. SO_2 3-hour standard not to be exceeded more than once per year.
[k] 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 implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

C. Criteria Air Pollutants

The general characteristics of the six criteria pollutants and their effects on human health are described below.

1. Carbon Monoxide

CO is produced in urban environments primarily by the incomplete combustion of fossil fuels. CO concentrations can vary greatly over relatively short distances. In the environment, it may temporarily accumulate into localized “hot-spots”, especially in calm weather conditions and in the wintertime when CO forms easily and is chemically most stable. Elevated concentrations are typically along heavily travelled and congested roadways and can have effects on human health by reducing oxygen delivery to the body's vital organs such as the heart, brain, and tissues. People with heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia, often accompanied by chest pain when exercising or under increased stress.

2. Lead

Lead emissions are primarily associated with industrial sources and motor vehicles that use gasoline containing lead additives. Most U.S. vehicles produced since 1975, and all produced after 1980, are designed to use unleaded fuel. As newer vehicles have replaced the older ones, motor vehicle-related lead emissions have substantially decreased, thus, ambient concentrations of lead have declined significantly. In 1996, the CAA banned the sale of the small amount of leaded fuel that was still available in some parts of the U.S. for use in on-road vehicles, concluding the 25-year effort to phase out lead in gasoline. However, the USEPA still allows fuel containing lead to be sold for off-road uses, including aircraft, racing cars, farm equipment, and marine engines. In humans, lead exposures can cause nervous system damage.

3. Nitrogen Dioxide and Volatile Organic Compounds

NO_2, nitric oxide (NO), and the nitrate radical (NO_3) are collectively called oxides of nitrogen (NO_x). These three compounds are interrelated, often changing from one form to another in chemical reactions. The main source of NO_x is fuel combustion in motor vehicles and power plants. Reactions of NO_x with other chemicals, such as VOCs, can lead to ozone formation. Additionally, secondary PM can be formed within the atmosphere from precursor gases, such as NO_x. In humans, NO_2 can lead to respiratory illnesses.

4. Ozone

Ozone occurs both in the earth's upper atmosphere and at ground level. It occurs naturally in the upper atmosphere, where it forms a protective layer that shields the earth from the sun's harmful ultraviolet rays. Tropospheric, or ground-level ozone, is not emitted directly into the air, but is a result of VOCs and NO_x reacting in the presence of sunlight in the atmosphere. Typically, ozone levels are highest during warm-weather months. VOCs and NO_x are termed "ozone precursors" and their emissions are regulated in order to control the creation of ozone. VOCs, which are a subset of hydrocarbons (HC), are released in industrial processes, mobile sources, and from the evaporation of gasoline, solvents, and other hydrocarbon-based compounds.

Ozone concentrations can easily reach unhealthy levels when the weather is hot and sunny with relatively light winds. Even at relatively low levels, ozone may cause inflammation and irritation of the respiratory tract, particularly during physical activity. Groups that are most sensitive to ozone include children and adults who are active outdoors, and people with respiratory disease such as asthma.

5. Particulate Matter

PM is emitted into the atmosphere from a variety of sources: industrial facilities, power plants, construction activity, as well as some natural sources. Gasoline-powered vehicles emit relatively small quantities of particles. Conversely, exhaust emitted from diesel-powered vehicles, especially heavy trucks and buses, contains large quantities of particles, which are considered a health risk in humans because of their ability to penetrate into the human respiratory system.

The USEPA has two regulatory standards for PM: 1) less than or equal to 10 micrometers (denoted PM_{10} and also known as “inhalable coarse particles”) and 2) less than or equal to 2.5 micrometers (denoted $PM_{2.5}$ and also known as “fine particles”). PM_{10} forms as a result of incomplete fuel combustion, industrial processes, or wind erosion. $PM_{2.5}$ are more characteristically formed from the combustion of fuel and other various industrial processes (such as smelters, foundries, aluminum production, glass manufacturing, etc.).

6. Sulfur Dioxide

SO_2 is emitted into the atmosphere by both natural processes and by man-made sources such as the combustion of sulfur-containing fuels and sulfuric acid manufacturing. When combined with other substances in the air, SO_2 can precipitate out as rain, fog, snow, or dry particles (commonly referred to as “acid rain”). SO_2 sources include stationary sources as well as non-road diesel-powered sources such as construction equipment. No significant quantities are emitted from mobile sources. In humans, the inhalation of elevated concentrations of SO_2 can cause respiratory diseases.

D. Attainment/Nonattainment Status

The USEPA designates areas as either meeting (attainment) or not meeting (nonattainment) the NAAQS. An area with measured pollutant concentrations which are lower than the NAAQS is designated as an attainment area and an area with pollutant concentrations that exceed the NAAQS is designated as a nonattainment area. Once a nonattainment area meets the NAAQS and the additional redesignation requirements in the CAA, the USEPA will designate the area as a maintenance area. Ozone nonattainment areas are further classified as extreme, severe, moderate, or marginal. An area is designated as unclassifiable when there is a lack of sufficient data to form the basis of an attainment status determination.

The CAA requires states to develop a general plan to attain and/or maintain the primary and secondary NAAQS in all areas of the country and to develop a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as SIPs, are developed by state and local air quality management agencies and submitted to the USEPA for approval.

The Project is located in Baltimore City, Maryland, which is presently designated by the USEPA as a moderate nonattainment area for the 8-hour ozone and a maintenance area for $PM_{2.5}$. Although a portion of Baltimore City is designated as a maintenance area for CO, the Project is located outside of the maintenance area.

E. General Conformity Requirements

The General Conformity Rule of the federal CAA prohibits federal agencies (such as FRA) from permitting or funding projects that do not conform to an applicable SIP. The General Conformity Rule applies only to areas that are in nonattainment or within a maintenance status. Under the Rule, project-related emissions of the applicable nonattainment/maintenance pollutants are compared to *de-minimis* level thresholds. If the emissions exceed the thresholds, a formal Conformity Determination is required to demonstrate that the action conforms to the applicable SIP. Conversely, if project-related emissions are below the *de-minimis* levels, the project is assumed to conform to the SIP. The proposed project is funded by, and would require approval by the FRA and it is located in a nonattainment/maintenance area; therefore, the General Conformity requirements of the CAA are applicable. The General Conformity *de-minimis* levels for the B&P Tunnel Replacement Project are presented in **Table 2**.

Table 2: General Conformity *De-Minimis* Thresholds

Pollutant	Primary/Secondary (tons per year)
Ozone (VOC)	50
Ozone (NO_x)	100
$PM_{2.5}$	100

Note: Ozone thresholds are for locations inside an Ozone Transport Region (OTR).
Source: USEPA, *De-Minimis Levels*, *http://www.epa.gov/oar/genconform/deminimis.html*.

F. Transportation Conformity Requirements

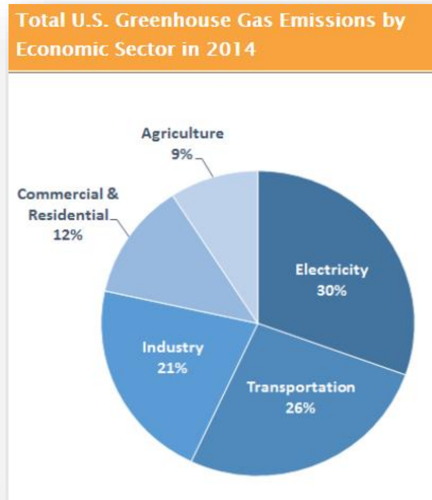
The CAA also contains a Transportation Conformity Rule that functions similarly to the General Conformity Rule. The Transportation Conformity Rule restricts federal funding to highway or transportation projects that do not conform to an applicable SIP. The responsibility of transportation conformity determination is vested in the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA). It is assumed that the proposed project is not subject to the Transportation Conformity Rule because it is not an FHWA/FTA project (i.e., will not receive funding assistance and approval from Federal-Aid Highway program and will not require FHWA or FTA approval for any aspect of the project).

G. Greenhouse Gases

Another emerging issue of global and national air quality concern is greenhouse gas (GHG) emissions. GHG emissions from transportation sources include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and various hydrofluorocarbons (HFCs). The majority of GHG emissions from transportation are CO_2 emissions resulting from the combustion of petroleum-based products, like gasoline, in internal combustion engines. Small amounts of CH_4 and N_2O are emitted during fuel combustion, and HFCs are predominately the result of refrigerants used in vehicles, refrigeration, heating and air-conditioning systems.

In 2014, in the U.S. GHG emissions from transportation accounted for about 26 percent, making it the second largest contributor of U.S. GHG emissions after the Electricity sector.[1]

Figure 1. Greenhouse Gases



Historically, GHG emissions have not been regulated under the CAA as air pollutants. However, after the U.S. Supreme Court in 2007 clarified that CO_2 is an "air pollutant" subject to regulation under the CAA, the USEPA embarked on developing requirements and standards for GHG emissions from mobile and stationary sources under the CAA. However, currently there are no national ambient air quality standards or *de-minimis* thresholds in place for GHG.

The following summarizes the main GHG regulatory initiatives recently undertaken by the USEPA in the transportation sector.

USEPA and the National Highway Traffic Safety Administration (NHTSA) are taking steps to enable the production of a new generation of clean vehicles, through the reduction of GHG emissions and improved fuel use. Together, the enacted and proposed standards are expected to save more than six billion barrels of oil through 2025 and reduce more than 3,100 million metric tons (MT) of CO_2 emissions (USEPA 2016).

USEPA is also responsible for developing and implementing regulations to ensure that transportation fuel sold in the U.S. contains a minimum volume of renewable fuel. By 2022, the Renewable Fuel Standard (RFS) Program, which was created under the Energy Policy Act (EPAct) of 2005, anticipates reducing GHG emissions by 138 million MT, equivalent to the annual emissions of 27 million passenger vehicles (USEPA 2016).

Additionally, Maryland has been at the forefront in addressing global climate change and GHGs. The following summarizes relevant regulations and initiatives in place and planned in Maryland that address these concerns.

Regional Greenhouse Gas Initiative (RGGI) **–** Maryland is part of the RGGI which is a cooperative effort by nine Northeast and Mid-Atlantic States to reduce CO_2 emissions from fossil fuel-fired power plants, while maintaining electricity affordability and reliability.

Commission on Climate Change - In April 2007 Governor Martin O'Malley issued Executive Order 01.01.2007.07, *Commission on Climate Change*, which established the Maryland Commission on Climate

[1] USEPA, *Sources of Greenhouse Gas Emissions*, https://www3.epa.gov/climatechange/ghgemissions/sources.html.

Change (MCCC). The MCCC is charged with developing a Climate Action Plan (CAP) to address the drivers and consequences of climate change, to prepare for its ensuing impacts in the State, and to establish firm benchmarks and timetables for Plan implementation. In August 2008 the MCCC released its final *Climate Action Plan (2008 Plan)* which lays out a strategy, including specific recommendations to address climate change and reduce its GHG emissions.

Maryland Greenhouse Gas Emissions Reduction Act (GGRA) - On May 7, 2009, Governor Martin O'Malley passed into law the GGRA, requiring Maryland to develop and implement a Plan that will achieve a 25 percent reduction in 2006 GHG emissions by 2020. While the majority of GHG emissions are related to power generation, the transportation sector produces approximately three percent of Maryland's GHG emissions. Achieving a significant reduction in GHG emissions from the transportation sector is critical to supporting the requirements of the Act. On June 20, 2012 the *2011 GGRA Draft Plan* was published, which puts Maryland on track to achieve the 25 percent GHG reduction required by the law.

Maryland Climate Action Plan – As stated previously, Maryland's Climate Action Plan was released in August 2008 and the first Draft Implementation Status Report was released on November 2009. On April 11, 2011, the MDOT released the most recent *Draft 2012 Implementation Plan* which supports Maryland's ongoing efforts to develop a state-wide GHG Reduction Plan. Transportation GHG reduction measures and strategies are a key element to this plan; in fact, MDOT has identified plans, programs, and strategies that could reduce transportation related emissions by 8.44 million MT of CO_2 by 2020.

Furthermore, the Council on Environmental Quality (CEQ) in February 2010 released a draft guidance memorandum addressing the ways Federal agencies can improve their consideration of the effects of GHG emissions and climate change in their evaluation of proposals for Federal actions under NEPA.[2] On December 2014, CEQ released a revised draft guidance (which supersedes the guidance released in February 2010), with a comment period that ended in March 2015. The revised guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated GHG emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should employ quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. CEQ recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent (CO_{2e}) emissions on an annual basis as a reference point below which a quantitative analysis of GHG is not recommended unless it is easily accomplished based on available tools and data.[3] CEQ is currently wading through nearly 500 NEPA comment letters before finalizing the guidance. When released as final, the guidance will be effective immediately.

[2] CEQ, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, February 18, 2010, https://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf.

[3] CEQ, *Revised Draft Guidance on the Considerations of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews*, December 18, 2014, https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf.

II. OPERATIONAL EMISSIONS ANALYSIS

The tunnel operations data for existing year 2014, No-Build year 2040, and Build year 2040 (i.e., Build Alternative 3B) are summarized in **Tables 3, 4, and 5**, respectively. Although the number of Amtrak operations increases with the Build Year, the Acela, Northeast Regional, and Metropolitan trains are powered by electric locomotives which do not directly generate significant air emissions. The regional MARC commuter train service plans to replace all existing electric locomotives with diesel-powered locomotives by 2019, as well as doubling their operations in 2040 with the operation of the proposed tunnel.

Table 3: Tunnel Operating Characteristics in the Existing Year (2014)

Train Service	Locomotive Type	Total Bi-directional Frequencies		Consist Data		Speed N/S* (mph)
		Daily	Peak Hour	# of Locos	# of Cars	
MARC (Regional)	Diesel (~60%) & Electric (~40%)	55	4	1	8	30/30
Acela (Intercity Express)	Electric	39	2	1	8	30/30
NE Regional (Intercity Corridor)	Electric	49	3	1	8	30/30
Freight	Diesel	2	0	1	30	30/30
Total	**All**	**145**	**9**			

*Note: Average train speed entering and exiting the North Portal (N) and South Portal (S).

Table 4: Tunnel Operating Characteristics in the No-Build Year (2040)

Train Service	Locomotive Type	Total Bi-directional Frequencies		Consist Data		Speed N/S* (mph)
		Daily	Peak Hour	# of Locos	# of Cars	
MARC (Regional)	Diesel	82	7	1	8	30/30
Acela (Intercity Express)	Electric	58	4	N/A	14	30/30
NE Regional (Intercity Corridor)	Electric	52	3	1	8	30/30
Metropolitan	Electric	0	0	N/A	N/A	30/30
Freight	Diesel	2	0	1	30	30/30
Total	**All**	**194**	**14**			

*Note: Average train speed entering and exiting the North Portal (N) and South Portal (S).
Source: Federal Railroad Administration NEC FUTURE Project, Tier I EIS Alternatives (Alternative 1).

Table 5: Tunnel Operating Characteristics in the Build Year (2040)

Train Service	Locomotive Type	Total Bi-directional Frequencies		Consist Data		Speed N/S* (mph)
		Daily	Peak Hour	# of Locos	# of Cars	
MARC (Regional)	Diesel	164	15	1	8	30/70
Acela (Intercity Express)	Electric	82	8	N/A	14	30/70
NE Regional (Intercity Corridor)	Electric	48	4	1	8	30/70
Metropolitan	Electric	92	8	N/A	14	30/70
Freight	Diesel	2	0	1	30	30/70
Total	**All**	**388**	**35**			

*Note: Average train speed entering and exiting the North Portal (N) and South Portal (S).
Source: Federal Railroad Administration, NEC FUTURE Project, February 2015 (NEC Future Data Responses).

Table 6 summarizes the analysis of MARC diesel locomotive emissions. The No-Build and Build diesel emissions were estimated based upon the length of the tunnel and emissions factors provided by USEPA for CO, VOC, NO_x, and PM. Emissions of SO_2 are dependent on fuel properties, and therefore the USEPA does not provide any locomotive-specific emission factors. As shown in **Table 6**, the MARC equipment and operational changes would not have any significant effects on air quality because the net changes in emissions of VOC, NO_x, and $PM_{2.5}$ would be below the *de-minimis* levels. Of note, freight rail operations, which are also powered by diesel locomotives, would not increase as a result of the Build alternative, and therefore were not included in the diesel emissions calculations.

Table 6: MARC Diesel Locomotive Emissions Estimates (tons per year)

Scenario	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$
2040 No-Build	8.6	0.3	6.7	0.1	0.1
2040 Build	19.4	0.6	15.2	0.2	0.2
Net Increase	**10.9**	**0.3**	**8.5**	**0.1**	**0.1**
De-Minimis Threshold	--	50	100	--	100
Below *De-Minimis*?	**--**	**Yes**	**Yes**	**--**	**Yes**

Notes:
Values of "Net Increase" subject to rounding. All values in table rounded to the nearest 0.1 tons.
USEPA does not provide any SO2 or SOx emissions factors (see *Emission Factors for Locomotives,* EPA-420-F-09-025, April 2009); furthermore, the project is in an attainment area for SOx.

III. CONSTRUCTION EMISSIONS ANALYSIS

To evaluate air emissions during the construction of the Project, equipment activity levels and vehicle parameters were estimated based on the expected construction project elements and construction schedule. The construction project elements involve the realignment and replacement of existing tracks and the construction of new tunnels. Specifically, the Project will require the construction of four single-track tunnels each with a cross-section capable of accommodating both passenger and freight service, tunnel portals, and walkways and vent shafts along the tunnel.

The construction activities associated with these project elements include, but are not limited to: site clearing, boring, cut and cover, grading, earthwork, material handling, concrete operations, and staging areas. These construction activities would also require the use of heavy haul and delivery trucks, excavating and grading equipment, material loaders, cranes, and other construction equipment. For the purpose of the evaluation, it was assumed that construction of the project elements would occur within a six-year period starting in January 2020 and ending December 2025.

Construction-related emissions were estimated using the EPA's Motor Vehicle Emissions Simulator (MOVES Version 2014a) motor vehicle emission factor model, the NONROAD (Version 2008a) emission factor model, and other appropriate guidelines. During construction, air emissions are attributed to the exhaust of heavy equipment (i.e., cranes, excavators, loaders, etc.) and trucks (i.e., water trucks, delivery/haul trucks, etc.). Emissions also result from construction crew worker vehicles travelling to and from the construction site; and fugitive dust from site preparation, land clearing, material handling and equipment movement on unpaved areas along construction staging areas. Notably, these emissions are temporary in nature and generally confined to the construction site and access/egress roadways.

Emissions from construction activities were estimated based on the projected construction activity schedule, the number of vehicles/pieces of equipment, the types of equipment/type of fuel used, vehicle/equipment utilization rates (including usage factor), the equipment size (horsepower), and the year in which construction would occur. A total of eight different types of standard construction equipment were used as a basis of the construction activities required. It was assumed that this equipment would be on-site for the duration of the construction period of six years. **Table 7** presents the types of construction equipment and their level of activity, which were estimated based on five days per week and three eight-hour shifts per day. The horsepower and the usage factors assigned to the construction equipment type were derived from the NONROAD model.

Table 7: Construction Equipment Parameters and Level of Activity

Equipment Type	Fuel	HP Average	Usage Factor	Hours of Operation/Year
Cranes	Diesel	238	0.48	25,040
Tractors/Loaders/Backhoes	Diesel	87	0.55	25,040
Air Compressors	Diesel	84	0.39	25,040
Rollers	Diesel	85	0.37	12,520
Excavators	Diesel	138	0.53	25,040
Signal Boards/Light Plants	Diesel	22	0.26	125,200
Other Construction Equipment	Diesel	443	0.29	25,040
Off-highway Trucks	Diesel	420	0.79	25,040

Note: HP = horsepower.
Source: EPA's MOVES2014a/ NONROAD, May 2016.

Table 8 presents the emission factors used in this emissions inventory for the construction years 2020 through 2025, which were also derived from the NONROAD model. Emission factors (grams per horsepower-hour) for each equipment type were then applied to the anticipated equipment work output (horsepower-hours of expected equipment use) and converted to tons per year. These results are presented later in **Table 11**.

Table 8: Construction Equipment Emission Factors (grams per horsepower-hour)

Continued on following page

Equipment Type	Pollutant	2020	2021	2022	2023	2024	2025
Cranes	CO	0.4	0.4	0.3	0.3	0.2	0.2
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	1.1	1.1	1.1	1.0	1.0	0.9
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	0.1	0.1	0.1	<0.1	<0.1
	$PM_{2.5}$	0.1	0.1	0.1	<0.1	<0.1	<0.1
Tractors/Loaders/ Backhoes	CO	1.7	1.8	2.0	2.1	2.3	2.4
	VOC	0.5	0.5	0.5	0.4	0.4	0.4
	NO_x	2.8	2.6	2.5	2.3	2.2	2.1
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.3	0.3	0.3	0.3	0.3	0.3
	$PM_{2.5}$	0.3	0.3	0.3	0.3	0.3	0.3
Air Compressors	CO	0.9	0.8	0.7	0.6	0.5	0.4
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	2.2	2.0	1.9	1.7	1.6	1.5
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	0.1	0.1	0.1	0.1	<0.1
	$PM_{2.5}$	0.1	0.1	0.1	0.1	0.1	<0.1
Rollers	CO	1.1	0.9	0.8	0.6	0.4	0.3
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	2.7	2.4	2.0	1.7	1.3	1.0
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	0.1	0.1	0.1	<0.1	<0.1
	$PM_{2.5}$	0.1	0.1	0.1	0.1	<0.1	<0.1
Excavators	CO	0.4	0.4	0.4	0.4	0.4	0.4
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	1.0	0.9	0.8	0.7	0.6	0.5
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	$PM_{2.5}$	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Signal Boards/ Light Plants	CO	1.7	1.5	1.3	1.2	1.0	0.8
	VOC	0.4	0.4	0.3	0.3	0.3	0.2
	NO_x	3.6	3.5	3.4	3.2	3.1	3.0
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.3	0.2	0.2	0.2	0.1	0.1
	$PM_{2.5}$	0.3	0.2	0.2	0.2	0.1	0.1

Equipment Type	Pollutant	2020	2021	2022	2023	2024	2025
Other Construction Equipment	CO	0.6	0.6	0.6	0.7	0.7	0.8
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	1.6	1.8	2.1	2.3	2.6	2.8
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	0.1	0.1	0.1	0.1	0.1
	$PM_{2.5}$	0.1	0.1	0.1	0.1	0.1	0.1
Off-highway Trucks	CO	0.4	0.4	0.3	0.3	0.2	0.2
	VOC	0.2	0.2	0.2	0.2	0.2	0.2
	NO_x	1.9	1.9	1.9	1.8	1.8	1.8
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	$PM_{2.5}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

*Note: Emission factors account for load factor.
Source: USEPA's MOVES2014a/ NONROAD, May 2016.

Table 9 presents the vehicle miles travelled (VMT) by the construction crew vehicles associated with water, delivery, and haul trucks, as well as miles travelled by construction crew vehicles commuting to and from the site. The construction crew VMT shown in **Table 9** were based on the following assumptions:

- Water trucks were based on assuming six trucks per day and an on-site trip travel distance of 20 miles.
- Haul truck trips were based on the cubic yards of materials being excavated and a haul truck capacity of 16 cubic yard, which resulted in 107 trucks per day. An on- and off-site trip travel distance of 40 miles was also assumed.
- The delivery truck trips were based on the cubic yards of concrete being delivered and a concrete truck capacity of 10 cubic yard, which resulted in 25 trucks per day. An on- and off-site trip travel distance of 40 miles was also assumed.
- Commuter construction crew vehicles were based on manpower needs and an average roundtrip travel distance of 30 miles.

Table 9: Construction Crew Vehicles Level of Activity

Vehicle Type	Fuel	VMT/year
Water trucks	Composite	15,650
Haul trucks	Composite	1,196,748
Delivery trucks	Composite	257,978
Commuter vehicles	Composite	6,291,300

*Note: VMT - vehicle miles travelled.
Composite is a combination of fuels (gasoline and diesel) from the default percentage breakdown within MOVES2014a for Baltimore City.
Source: USEPA's MOVES2014a/ NONROAD, May 2016.

Table 10 presents the on-road vehicle emission factors (grams per mile) for construction water trucks, delivery/haul trucks, and commuter vehicles during the six-year construction period. MOVES was developed based on specific information (vehicle/fuel mix, fuel specifications, inspection/maintenance program, etc.) related to the Baltimore City area. Emission estimates for these on-road construction vehicles were computed by multiplying the emission factors by their respective VMT and converting to tons. These results are presented later in **Table 11**.

Table 10: Construction Vehicle Emission Factors (grams per mile)

Equipment Type	Pollutant	2020	2021	2022	2023	2024	2025
Water and haul/delivery trucks	CO	10.7	10.4	10.1	9.8	9.6	9.3
	VOC	0.6	0.5	0.5	0.4	0.4	0.4
	NO_x	2.2	2.0	1.8	1.7	1.5	1.3
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.3	0.3	0.3	0.3	0.2	0.2
	$PM_{2.5}$	0.1	0.1	0.1	0.1	0.1	0.1
Commuter vehicles	CO	6.6	6.2	5.8	5.4	5.0	4.6
	VOC	0.6	0.5	0.5	0.5	0.4	0.4
	NO_x	0.4	0.4	0.3	0.3	0.3	0.2
	SO_x	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	PM_{10}	0.1	0.1	0.1	0.1	0.1	0.1
	$PM_{2.5}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Source: EPA's MOVES2014a/ NONROAD, May 2016.

Additionally, the construction emissions inventory for fugitive dust sources was calculated using emission factors within USEPA's *Compilation of Air Pollutant Emission Factors (AP-42)*. Fugitive dust emissions result from site preparation, land clearing, material handling, and equipment movement on unpaved areas. A fugitive dust (PM_{10}) emission factor of 1.2 tons per acre disturbed per month during construction activity was used, assuming that fugitive dust is generated throughout the construction period such that 25 percent of the Project area would be disturbed in any given construction month. Based on USEPA's AP-42, $PM_{2.5}$ emissions were assumed to be 10 percent of PM_{10} emissions. Erosion control measures and water programs are typically taken into account to minimize fugitive dust and particulate emissions at construction sites. For this analysis, a dust control efficiency of 75 percent due to daily watering and other measures (limiting vehicle speed, stockpile control) was assumed. The total disturbed area associated with the Project is estimated to be 18.7 acres; based on the size of the staging areas surrounding the south and north portals.

Construction emissions associated with the Project are presented in **Table 11** for construction years 2020 through 2025. As shown, the total emissions associated with construction activities are below the *de-minimis* threshold of 100 tons per year for NO_x and $PM_{2.5}$, and 50 tons per year for VOC. Therefore, a Conformity Determination is not required and the Project is presumed to comply with the SIP.

Table 11: Construction Emissions (tons)

Year	CO	VOC	NO_x	SO_x	PM_{10}	$PM_{2.5}$
2020	75	9	45	0.1	20	4
2021	72	9	44	0.1	20	4
2022	68	9	43	0.1	19	4
2023	64	8	42	0.1	19	3
2024	60	8	41	0.1	19	3
2025	57	7	41	0.1	19	3
De-Minimis Threshold (tons per year)	--	50	100	--	--	100
Below *De-minimis* for Every Year?	**--**	**Yes**	**Yes**	**--**	**--**	**Yes**

A. Construction Emission Reduction Measures

Exhaust emissions due to construction activities can be reduced by reducing equipment idling times, storing recyclable construction materials on-site to reduce the amount of haul truck trips, and using low- or zero-emissions equipment. Employees could also be encouraged to carpool in order to reduce the vehicle miles travelled associated with their trips to and from the site.

Fugitive dust (PM) emissions can be mitigated by regularly watering or applying dust suppressants to unpaved areas, installing pads to deter track-out as vehicles enter and leave the site, reducing vehicle speeds on unpaved roads, covering materials stockpiles, covering haul trucks during materials transportation, and limiting construction activity during high wind events. Ensuring the contractor has knowledge of appropriate fugitive dust and equipment exhaust controls is also a measure to reduce emissions.

In order to reduce emissions, construction activities will be performed in accordance with Maryland's *Standard Specifications for Construction and Materials*[4] which outlines the procedures to be followed by contractors involved in site work. In addition, the Maryland Air and Radiation Management Administration has determined that the specifications are consistent with the requirements of the *Regulations Governing the Control of Air Pollution in the State of Maryland.* Therefore, during the construction period, all appropriate measures cited in the Code of Maryland Regulations (COMAR) 26.11.06.03D – *Fugitive Particulate Matter from Materials Handling and Construction*[5] would be employed to reduce emissions.

[4] Maryland Department of Transportation State Highway Administration, *Standard Specifications for Construction and Materials*, July 2008, http://www.roads.maryland.gov/ohd/frontpage.pdf.

[5] COMAR 26.11.06.03, http://www.dsd.state.md.us/comar/getfile.aspx?file=26.11.06.03.htm.

IV. VENTILATION SYSTEM ANALYSIS

The principal purposes of the tunnel ventilation system are: (i) to furnish outside air into the underground space; (ii) to remove air emissions and heat from inside the tunnel; and (iii) to provide a means for evacuating smoke and other by-products in the event of a fire or other emergency. The current Project design is a “passive” tunnel ventilation system during normal operations. With passive ventilation, air circulation and exchange results from a combination of train movement through the tunnel (i.e., the “piston effect”) and natural air flow (i.e., as winds blow through the tunnel, warmer air rises out of the tunnel, and cooler air sinks into the tunnel). Under this passive system, tunnel air may exit at the intermediate vent plant and/or at either end of the tunnel via the portals or portal vent plants.

The pollutant of greatest potential concern is NO_2, which is associated with diesel engine exhaust from train locomotives. Sensors throughout the tunnel will automatically activate mechanical fans at the south, intermediate, and north ventilation facilities if NO_2 levels exceed 3 parts per million (ppm).[6] This criterion is based on the recommended Threshold Limit Value—Time Weighted Average (TLVTWA) established by the American Conference of Governmental Industrial Hygienists (ACGIH).

An air dispersion modeling analysis was performed to determine the potential above-ground NO_2 concentrations from the three ventilation facilities and two tunnel portals associated with the Project. The analysis focused on the Preferred Alternative (i.e., Alternative 3B). Results were compared to the more-stringent 1-hour NO_2 NAAQS of 100 parts per billion (ppb) as opposed to the annual standard of 53 ppb (see **Section I.B** for more information about the NAAQS). Emission studies have demonstrated that if NO_2 concentrations are maintained within acceptable levels, then other pollutant concentrations associated with diesel exhaust emissions will also be within acceptable limits.[7]

The air dispersion modeling approach followed the latest USEPA modeling guidelines[8] for predicting air quality effects for regulated pollutants. The following sections present a summary of the modeling assumptions and methodology.

A. Air Dispersion Modeling

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD)[9] was used to evaluate the potential 1-hour NO_2 emissions from the proposed Project. AERMOD is USEPA’s preferred and recommended steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.[10]

---

[6] TLV-TWA corresponds to an 8-hour typical workday exposure.

[7] Parsons Brinckeroff/Parsons, *Tunnel Ventilation Report*, September 25, 2015.

[8] USEPA, Appendix W, 40 CFR Part 51 Appendix W (November 2005), https://www3.epa.gov/ttn/scram/guidance/guide/appw_05.pdf.

[9] USEPA, AERMOD (Version 15181), https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

[10] USEPA, *Preferred/Recommended Models*, https://www3.epa.gov/scram001/dispersion_prefrec.htm.

The following USEPA "regulatory default" options were used within AERMOD:

- Stack-tip downwash effects,
- Incorporate the effects of elevated terrain,
- Use of the calms processing routines,
- Use of missing data processing routine, and
- Building downwash effects.

In urban areas such as Baltimore, surface areas cool at a slower rate as opposed to rural areas. This can create an urban heat island effect at night; the urban modelling option in AERMOD was used to account for these effects. A population of 620,961 was obtained from the U.S. Census Bureau[11] and was used as an input parameter for the urban modeling option.

The assumptions and parameters used as inputs to AERMOD are listed below and individually described in the following subsections:

1. Emission sources and rates,
2. Building downwash effects,
3. Receptor locations, and
4. Meteorological and terrain data.

1. Emission Sources and Rates

For the AERMOD analysis, a "worst case" scenario was analyzed assuming an average of ten diesel trains per hour operating between the hours of 6:00 am to 7:00 pm as these are assumed to be peak hours of operation. No diesel operations were assumed from 10:00 pm to 3:00 am and partial operations (i.e., five diesel trains per hour) were assumed for the remaining time.

For this analysis, air emissions from the diesel train operations were assumed to exit through the north and south Portals, and from all of the three ventilation facilities (i.e., South, Intermediate, and North). Each ventilation facility is defined in AERMOD as a single "point source", and the portals are considered as "area sources".[12] Each ventilation facility represents the location where air from the tunnel is exhausted vertically into the atmosphere. Seasonal variability (i.e., summer and winter) was used when calculating the potential emission rates at each ventilation facility and tunnel portal. The temperature of the air being exhausted from each ventilation facility is based on assumed train operations and tunnel thermal properties. **Tables 12 and 13** present the parameters and NO_2 emission rates used to model each ventilation facility and portal in AERMOD.

[11] United States Census Bureau, 2010, http://www.census.gov/en.html.

[12] In AERMOD point sources are defined as a single, identifiable source of emissions and area sources are defined as a two-dimensional source of diffuse emissions.

Table 12: Ventilation Facility Emission Parameters and Rates

Ventilation Facility	Total Vent Area (ft^2)	Vent Height (ft)	Vent Diameter (ft)	Vent Exhaust Temperature (°F)	Vent Exhaust Flow Rate (kcfm)	Vent Exhaust Velocity (ft/s)	NO_2 Emission Rate (lb/hr)
Summer Season (April – September)							
SVF	530	55	26.0	105	1,598	50	17.0
IVF	400	62	22.6	88	1,180	50	3.6
NVF	530	50	26.0	92	1,598	50	7.3
Winter Season (October – March)							
SVF	530	55	26.0	92	1,598	50	15.0
IVF	400	62	22.6	74	1,180	49	3.2
NVF	530	50	26.0	73	1,597	50	6.3

Note: IVF = Intermediate Ventilation Facility, NVF = North Ventilation Facility, SVF = South Ventilation Facility, °F = degrees Fahrenheit, ft/s = feet per second, kcfm = thousand cubic feet per minute, and lb/hr = pounds per hour.
Source: Parsons Brinckerhoff, 2016.

As the train exits the tunnel, it has a continuous source of momentum which creates a mechanically mixed “jet” of air with a length, width, and height. Based on the geometry of the exit portals, as well as the speed and size of the trains, the jet of air from each portal was computed to be 80 feet wide, 28 feet high, and 300 feet long.[13] The NO_2 emission rates from the jet of air exiting the tunnel portals used in the analysis are shown in **Table 13**.

Table 13: Portal Emission Rates

Tunnel Portal	NO_2 Emission Rate (lb/hr)
Summer Season (April – September)	
South	0.009
North	<0.001
Winter Season (October – March)	
South	0.001
North	<0.001

Note: lb/hr = pounds per hour.
Source: Parsons Brinckerhoff, 2016.

2. Building Downwash Effects

Building downwash occurs when the aerodynamic turbulence, induced by nearby buildings, causes emissions from an elevated source to be mixed rapidly toward the ground. This results in higher ground-level concentrations. To avoid building downwash, the USEPA recommends that Good Engineering Practice (GEP) be applied. These practices consist of determining the GEP stack height, which is calculated using the following formula:

[13] Parsons Brinckerhoff, 2016.

GEP Stack Height = H + 1.5L

Where:
H = height of nearby structure(s)
L = lesser dimension, height or projected width, of nearby structure(s)

The effects of building downwash from the ventilation facilities were included in the air dispersion modeling analysis and were calculated using USEPA's Building Profile Input Program (BPIP).[14] **Table 14** presents the ventilation facilities' building dimensions.

Table 14: Ventilation Facilities Dimensions

Ventilation Building	Building Dimensions (feet)			
	Roof Height	Stack Height	Bldg. Width	Bldg. Length
SVF	38	55	190	220
IVF	59	62	125	180
NVF	40	50	30	60

Note: IVF = Intermediate Ventilation Facility, NVF = North Ventilation Facility, and SVF = South Ventilation Facility.
Source: Parsons Brinckerhoff, 2016.

3. Receptor Locations

The locations at which concentrations are estimated within the model are known as "receptors". A Cartesian receptor grid (with over 2,000 receptors) was used to predict concentrations around the locations of the ventilation facilities and portals. The receptor grid extended out to approximately 2.5 miles in each direction from each vent facility and portal, with grid points spaced closer together near the emissions sources. Within one mile of each vent facility and portal, the grid points were spaced at 100 meters (330 feet) apart; this grid spacing resulted in a receptor point being located at approximately every city block including locations immediately surrounding each portal and ventilation facility.

4. Meteorological and Terrain Data

There are two input data pre-processors that are regulatory components of AERMOD: (i.) AERMET[15], a meteorological data pre-processor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and (ii.) AERMAP[16], a terrain data pre-processor that incorporates complex terrain using the United States Geological Survey (USGS) Digital Elevation Data.

USEPA modeling guidance recommends using five years of meteorological data when predicting pollutant concentrations with AERMOD. The most recent meteorological data (i.e., from 2011 through 2015) from Baltimore-Washington International Airport (KBWI) and Phillips Army Airfield/Aberdeen Proving Ground (KAPG) were used in the air dispersion analysis. Notably, the Project is located

[14] USEPA, BPIP (Version 04274), https://www3.epa.gov/ttn/scram/dispersion_related.htm#bpipprm.
[15] USEPA, AERMET (Version 15181), https://www3.epa.gov/ttn/scram/metobsdata_procaccprogs.htm#aermet.
[16] USEPA, AERMAP (Version 11103), https://www3.epa.gov/ttn/scram/dispersion_related.htm.

approximately 9 miles north of KBWI and approximately 29 miles southwest of KAPG; therefore, it is assumed that meteorological conditions at KBWI and KAPG are representative of the project location.

Meteorological data was pre-processed using AERMET. AERMET processes commercially available or custom on-site met data and creates two files: a surface data file and a profile data file. One-minute wind speed and direction information collected by the Automatic surface observing system (ASOS) at KBWI was also utilized to refine the hourly wind data.

The AERSURFACE[17] tool is used in conjunction with AERMET to calculate the surface characteristics (i.e., the albedo, Bowen ratio, and surface roughness) based on the land use. Land use data for KBWI was obtained from the USGS's 1992 land use database. These surface characteristics are part of the planetary boundary layer parameter calculations that are used in AERMOD.

AERMAP was used to process terrain data from USGS' Digital Elevation Model (DEM) data for Baltimore City. AERMAP generates location and height data for each receptor and source location.

B. Background Concentrations

Background concentrations account for existing nearby emissions sources. The background concentration was obtained from the nearby EPA monitoring station located in the Oldtown Fire Station at 100 Hillen Street in Baltimore, which is approximately 1.5 miles from the Project. Following USEPA guidance, the 1-hour NO_2 background concentration was based on the most recent (i.e., 2013 through 2015) three-year average of the 98th percentile of the daily 1-hour maximum value, which equals 51 ppb.

C. Modeling Results

The results of the ventilation facility and portal dispersion modeling are shown in **Table 15.** The maximum predicted 1-hour NO_2 concentration from all sources combined (i.e., the three ventilation facilities as well as the north and south portals) was 12.8 ppb. When added to the NO_2 background concentration of 51 ppb, the total predicted 1-hour concentration amounted to 63.8 ppb, which is below the NAAQS of 100 ppb. The table also presents the individual concentrations due to each emissions source individually. Of note, the individual concentrations occur at different locations based on the location and height of each emissions source.

As discussed at the beginning of **Section IV,** where concentrations of NO_2 are within acceptable levels, all other criteria pollutant concentrations would be within acceptable levels of the NAAQS.

---

[17] USEPA, AERSURFACE (Version 13016), https://www3.epa.gov/ttn/scram/dispersion_related.htm.

Table 15. Ventilation Facility and Portal Emissions Results (parts per billion [ppb])

Emissions Source	Maximum Predicted 1-hour NO_2 Concentration	Measured Background NO_2 Concentration	Total 1-hour NO_2 Concentration	1-hour NO_2 NAAQS Threshold	Below NAAQS Threshold?
SVF	12.6	51.0	63.6	100	Yes
IVF	2.9	51.0	53.9	100	Yes
NVF	7.5	51.0	58.5	100	Yes
South Portal	1.8	51.0	52.8	100	Yes
North Portal	0.2	51.0	51.2	100	Yes
All Sources	**12.8**	**51.0**	**63.8**	**100**	**Yes**

V. CONCLUSION

The proposed Project would not result in adverse impacts to air quality due to operational emissions. The net change in diesel locomotive emissions of NO_x, VOC, and $PM_{2.5}$ with the proposed Project would be below the *de-minimis* levels. The analysis accounted for the projected increase of MARC operations in 2040 and the planned replacement of existing MARC electric locomotives with diesel-powered locomotives. Furthermore, there are no projected increases in diesel freight train operations, and no significant direct air emissions generated by the electric locomotive trains operated by Amtrak.

The construction of the Project would not result in adverse impacts to air quality. The emissions of NO_x, VOC, and $PM_{2.5}$ would be below the *de-minimis* levels for every construction year. In addition, emissions associated with the construction of the Project would be short-term and would not result in a long-term change to local air quality. Application of the measures in Maryland's *Standard Specifications for Construction and Materials,* as well as COMAR 26.11.06.03D, would reduce construction-related emissions.

The emissions associated with the proposed ventilation facilities and the air exiting the portals would not result in adverse impacts to air quality. The maximum 1-hour NO_2 concentrations were predicted to be below the NAAQS threshold. Because the concentrations of NO_2 were within acceptable levels, all other criteria pollutant concentrations would be within acceptable levels of the NAAQS.

VI. REFERENCES

Baltimore County Department of Public Works, *Standard Specifications for Construction and Materials,* http://resources.baltimorecountymd.gov/Documents/Public_Works/standardsandspecs/feb2007/stdspec20002007.pdf.

CEQ, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, February 18, 2010, https://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf.

CEQ, *Revised Draft Guidance on the Considerations of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews*, December 18, 2015, https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf.

Code of Maryland Regulations (COMAR) 26.11.06.03, *Particulate Matter*, http://www.dsd.state.md.us/comar/getfile.aspx?file=26.11.06.03.htm.

Maryland DOT, State Highway Administration (SHA), *2008 Standard Specifications of Construction and Materials*, http://www.roads.maryland.gov/index.aspx?pageid=44.

Maryland Transit Authority, *MARC Train*, https://mta.maryland.gov/sites/default/files/mgip_update_2013-09-13.pdf.

United States Census Bureau, 2010, http://www.census.gov/en.html.

USEPA, AERMAP (Version 11103), https://www3.epa.gov/ttn/scram/dispersion_related.htm.

USEPA, AERMET (Version 15181), https://www3.epa.gov/ttn/scram/metobsdata_procaccprogs.htm#aermet.

USEPA, AERMOD (Version 15181), https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

USEPA, AERSURFACE (Version 13016), https://www3.epa.gov/ttn/scram/dispersion_related.htm.

USEPA, Appendix W, 40 CFR Part 51 Appendix W (November 2005), https://www3.epa.gov/ttn/scram/guidance/guide/appw_05.pdf.

USEPA, BPIP (Version 04274), https://www3.epa.gov/ttn/scram/dispersion_related.htm#bpipprm.

USEPA, *De-Minimis Levels,* http://www.epa.gov/oar/genconform/deminimis.html.

USEPA, *Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors*, https://www3.epa.gov/ttnchie1/ap42/.

USEPA, *GHG Regulatory Initiatives*, http://www.epa.gov/climatechange/EPAactivities/regulatory-initiatives.html#transportation.

USEPA, *Motor Vehicle Emission Simulator (MOVES)*, https://www3.epa.gov/otaq/models/moves/.

USEPA, *National Ambient Air Quality Standards (NAAQS),* http://www.epa.gov/air/criteria.html.

USEPA, Office of Transportation and Air Quality, *Emission Factors for Locomotives* [EPA-420-F-09-025], April 2009.

USEPA, *Preferred/Recommended Models*, https://www3.epa.gov/scram001/dispersion_prefrec.htm.

USEPA, *Sources of Greenhouse Gas Emissions*, http://www.epa.gov/climatechange/ghgemissions/sources/transportation.html.

VII. ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AERMOD	The American Meteorological Society/Environmental Protection Agency Regulatory Model
ASOS	Automatic surface observing system
BMC	Baltimore Metropolitan Council
BPIP	Building Profile Input Program
BRTB	Baltimore Regional Transportation Board
CAA	Clean Air Act
CAP	Climate Action Plan
CEQ	Council on Environmental Quality
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COMAR	Code of Maryland Regulations
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
EPAct	Energy Policy Act of 2005
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GEP	Good Engineering Practice
GGRA	Maryland Greenhouse Gas Emissions Reduction Act
GHG	Greenhouse Gas
HFCs	Hydrofluorocarbons
LRTP	Long Range Transportation Plan
MCCC	Maryland Commission on Climate Change
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MPO	Metropolitan Planning Organization
MT	Metric Tons
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHTSA	National Highway Traffic Safety Administration
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_3	Nitrate Radical
NO_x	Nitrogen Oxides
PM	Particulate Matter
PM_{10}	Particulate Matter with a Diameter of 10 Microns or Less
$PM_{2.5}$	Particulate Matter with a Diameter of 2.5 Microns or Less
PPB	Parts per Billion
PPM	Parts per Million

RGGI	Regional Greenhouse Gas Initiative
SIP	State Implementation Plans
SO_2	Sulfur Dioxide
TIP	Transportation Improvement Plan
TLVTWA	Threshold Limit Value—Time Weighted Average
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound