Susquehanna River Rail Bridge Project

Appendix F

Air Quality, Noise, and Vibration

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Maryland Department of Transportation

AMTRAK

A. INTRODUCTION

Chapter 12 "Air Quality," summarizes the assessment of potential for long-term impacts on ambient air quality from the operation of the Proposed Project. This appendix describes the regulatory context, methodology, and detailed discussion of the results of the air quality assessment. This appendix also includes a description of the construction period emissions estimate.

An increase in freight and passenger service is projected to occur with the Build Alternatives, as described in Chapter 3, "Transportation" and shown in **Table F-1** for the analysis year (2040).

Table F-1
Projected 2040 Train Volumes Across the Susquehanna River Rail Bridge (Average Weekday)

Types of Service		No Action		Build Alternatives	
		Daily	Peak (1)	Daily	Peak (1)
Amtrak Intercity (electric)	Northeast Regional and Long Distance	58	4	48	4
	High-Speed Rail	44	4	82	8
	Metropolitan Service	0	0	92	8
MARC Commuter (diesel)		14	3	44	3
NS Freight (diesel)		10 (2)	2 (2)	12 (2)	2 (2)

Notes:
(1) "Peak" is defined as 4:10-5:10 PM weekdays for Amtrak, and 5:40-6:40 AM and 6:20-7:20 PM weekdays for MARC. For freight, the timing of the peak hour varies but it generally occurs at night.
(2) 10 additional daily freight trains and 2 additional peak hourly trains were included within the model that would not cross the Susquehanna River Rail Bridge but would operate between Perryville and Wilmington.
Source: Service volumes provided by Amtrak, MDOT and FRA, November 2015.

The increase would be enabled by the increased number of tracks across the Susquehanna River introduced by the Proposed Project combined with components of NEC FUTURE.[1] This increase in service would result in additional emissions from the operation of diesel locomotives (diesel fuel combustion). Locomotives used in the freight industry are typically powered by onboard diesel engines and employ electric power transmission. Maryland Area Regional

[1] FRA, NEC FUTURE Tier I Final EIS, December 2016.

Commuter (MARC) passenger trains in the analysis year are assumed to be a mix of diesel and electric, based on latest MARC plans to replace older locomotives with newly manufactured diesel locomotives. Amtrak passenger trains (where the locomotives experience lower loads and higher speeds) use external electricity to directly power electric motors and do not directly generate emissions.

The physical changes in track curvature and grade with both Alternative 9A and Alternative 9B would result in increased fuel usage due to the additional power necessary, and would therefore also increase emissions. Additionally, the track realignment in Perryville would result in decreased distances between sensitive locations and the right-of-way leading to higher pollutant concentrations at those sensitive locations. The air quality assessment accounts for the effect of both these changes on both regional (i.e., mesoscale) emissions and local (i.e., microscale) concentrations of air pollutants. The Proposed Project would not introduce any new, permanent stationary emission sources, such as boilers or generators.

B. REGULATORY CONTEXT

AIR QUALITY STANDARDS

The Clean Air Act (CAA) mandated the establishment of primary and secondary National Ambient Air Quality Standards (NAAQS) for six "criteria" air pollutants: carbon dioxide (CO), nitrogen dioxide (NO_2), ozone, respirable particulate matter (PM—in two size categories, $PM_{2.5}$ and PM_{10}), sulfur dioxide (SO_2), and lead. The primary standards represent levels that are needed to protect the public health, allowing an adequate margin of safety. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. The NAAQS are presented in **Table F-2**. Maryland has not established standards or impact thresholds for criteria air pollutants that are more stringent than the NAAQS. Therefore, this analysis considers a Build Alternative to have an adverse impact on air quality if it causes or significantly exacerbates a violation of the NAAQS.

In addition to the criteria pollutants discussed above, toxic air pollutants—also known as hazardous air pollutants (HAPs) or mobile source air toxics (MSATs) in the on-road context—are pollutants known to cause or are suspected of causing cancer or other serious health ailments. The CAA Amendments of 1990 listed 188 HAPs and addressed the need to control toxic emissions from transportation. The U.S. Environmental Protection Agency's (USEPA) 2007 MSAT rule identified a subset of seven HAPs as having significant contributions from mobile sources: benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, polycyclic organic matter, and diesel particulate matter (DPM). In addition to adhering to all federal standards, the State of Maryland has a list of toxic air pollutants (TAPs); [2] the emission of those TAPs from stationary sources is regulated by the State.

[2] Maryland Code of Regulations 26.11.16.06 and 26.11.16.07.

Table F-2
National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary		Secondary	
	ppm	µg/m³	ppm	µg/m³
Carbon Monoxide (CO)				
8-Hour Average (1)	9	10,000	None	
1-Hour Average (1)	35	40,000		
Lead				
Rolling 3-Month Average (2)	NA	0.15	NA	0.15
Nitrogen Dioxide (NO_2)				
1-Hour Average (3)	0.100	189	None	
Annual Average	0.053	100	0.053	100
Ozone (O_3)				
8-Hour Average (4,5)	0.070	140	0.070	140
Respirable Particulate Matter (PM_{10})				
24-Hour Average (1)	NA	150	NA	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Annual Mean (6)	NA	12	NA	15
24-Hour Average (7)	NA	35	NA	35
Sulfur Dioxide (SO_2) (8)				
1-Hour Average(9)	0.075	196	NA	NA
Maximum 3-Hour Average (1)	NA	NA	0.50	1,300

Notes:

ppm – parts per million (unit of measure for gases only); µg/m³ – micrograms per cubic meter (unit of measure for gases and particles, including lead); NA – not applicable; All annual periods refer to calendar year. Standards are defined in ppm. Approximately equivalent concentrations in µg/m³ are presented.

1. Not to be exceeded more than once a year.
2. USEPA has lowered the NAAQS down from 1.5 µg/m³, effective January 12, 2009.
3. 3-year average of the annual 98th percentile daily maximum 1-hr average concentration. Effective April 12, 2010.
4. 3-year average of the annual fourth highest daily maximum 8-hr average concentration.
5. EPA has lowered the NAAQS down from 0.075 ppm, effective December 2015.
6. 3-year average of annual mean. USEPA has lowered the primary standard from 15 µg/m³, effective March 2013.
7. Not to be exceeded by the annual 98th percentile when averaged over 3 years.
8. USEPA revoked the 24-hour and annual primary standards, replacing them with a 1-hour average standard. Effective August 23, 2010.
9. 3-year average of the annual 99th percentile daily maximum 1-hr average concentration.

Source: 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards.

NAAQS ATTAINMENT STATUS

The CAA, as amended in 1990, defines non-attainment areas (NAA) as geographic regions that have been designated as not meeting one or more of the NAAQS. When an area is designated as non-attainment by USEPA, the state is required to develop and implement a State Implementation Plan (SIP), which delineates how a state plans to achieve air quality that meets the NAAQS under the deadlines established by the CAA, followed by a plan for maintaining the attainment of NAAQS following re-designation of the area.

Cecil County is within the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Air Quality Control Region (AQCR). USEPA has designated the area, including Cecil County, as a marginal nonattainment area for the 2008 ozone NAAQS. Harford County is within the Baltimore AQCR. USEPA has designated the area, including Harford County, as a moderate nonattainment area for the 2008 ozone NAAQS. Both Cecil County and Harford County are within the ozone transport region (OTR). USEPA has also re-designated the Baltimore AQCR as in attainment for the 1997 $PM_{2.5}$ standard, and the area is now in maintenance. USEPA has completed area designations for the 2006 $PM_{2.5}$ standard in October, 2012 as well as initial designations of the 2012 $PM_{2.5}$ standards and both counties have been designated as "unclassifiable/attainment". USEPA has designated both counties as in attainment with the 1-hour SO_2 standard.

USEPA has designated the entire state of Maryland as "unclassifiable/attainment" of the 1-hour NO_2 standard, until three years of monitoring data from required additional on-road monitors are collected.

CONFORMITY WITH STATE IMPLEMENTATION PLANS

The conformity requirements of the CAA and regulations promulgated thereunder (conformity requirements) limit the ability of federal agencies to assist, fund, permit, and approve projects in non-attainment or maintenance areas that do not conform to the applicable SIP. When subject to this regulation, the lead federal agency is responsible for demonstrating conformity of its proposed action. Conformity determinations for federal actions related to transportation plans, programs, and projects which are implemented, funded, or approved under title 23 U.S.C. or the Federal Transit Act (49 U.S.C. 1601 et seq.) must be made in accordance with 40 CFR § 93 Subpart A (federal transportation conformity regulations). Conformity determinations for all other federal actions must be made according to the requirements of 40 CFR § 93 Subpart B (federal general conformity regulations). Federal actions with the Federal Railroad Administration (FRA) as the lead agency are subject to the general conformity regulations.

As an FRA action, the Proposed Project must conform to the SIPs for the ozone and $PM_{2.5}$ nonattainment areas described above. Conformity needs to be addressed for each pollutant of concern in a non-attainment or maintenance area affected by a federal action. Conforming actions would not

- Cause or contribute to any new violation of any standard in any area;
- Interfere with provisions in the applicable SIP for maintenance of any standard;
- Increase the frequency or severity of any existing violation of any standard in any area; or
- Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

According to the regulations, federal actions whose criteria pollutant emissions have already been included in the local SIP's attainment or maintenance demonstrations are assumed to conform to the SIP.

While the Proposed Project is not subject to transportation conformity, as a project that effects transportation, coordination is ongoing with the relevant metropolitan planning organizations (MPO)—the Wilmington Area Planning Council (WILMAPCO), which is the federally mandated organization responsible for transportation planning in the Cecil County portion of the study area and the Baltimore Regional Transportation Board (BRTB), the MPO for the Harford County portion of the study area. WILMAPCO included preliminary engineering and environmental review for the Proposed Project in the Transportation Improvement Plan (TIP) for 2015-2018. BRTB also included the preliminary engineering and environmental review phases of the Proposed Project in its 2014-2017 TIP. These planning and engineering phases of the Proposed Project do not generate emissions. The conformity status for these phases of the Proposed Project is therefore listed in the TIP as exempt.

Regional (mesoscale) emissions are analyzed for the Proposed Project, as described below in "Methodology," to determine their potential effect on regional air quality and evaluate the need for a general conformity determination.

Actions resulting in emissions of pollutants of concern less than the established *de minimis* screening threshold emissions rates are assumed to conform to SIPs. The applicable *de minimis* threshold for these non-attainment and maintenance areas is 100 tons per year (tpy) of nitrogen oxides (nitric oxide—NO and NO_2, collectively referred to as NO_x), 50 tpy of volatile organic compounds (VOCs), and 100 tpy of $PM_{2.5}$.

C. METHODOLOGY

POLLUTANTS FOR ANALYSIS

Criteria pollutants including CO and PM, and ozone precursors VOCs and NO_x, are all emitted from the combustion of both gasoline and diesel fuel. CO is emitted predominantly from gasoline combustion, while NO_x and PM are emitted predominantly from diesel combustion. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs. Ozone formation occurs relatively slowly and as such would take place downwind from the sources of precursor emissions.

Since VOC, PM, and NO_x are emitted from diesel engines that power freight locomotives, they are included in the mesoscale (regional) analysis. Diesel combustion currently contributes very little to SO_2 emissions since the sulfur content of diesel fuel, which is federally regulated, is extremely low.[3] Therefore, SO_2 from transportation sources in general, including diesel powered freight locomotives, is not an issue of concern for local concentrations or as a precursor for $PM_{2.5}$ formation. Similarly, lead in gasoline has been banned under the CAA, and therefore, lead is not a pollutant of concern for the Proposed Project.

Pollutant concentrations can vary greatly with the distance from the source of emissions and may consequently be locally elevated near ground level emission sources. While NO_2 and PM

[3] All diesel fuel used domestically for on-road or non-road vehicles is ultra-low sulfur diesel with a maximum sulfur content of 15 parts per billion.

would be of concern to local public health, VOCs would only be of concern as a precursor to ozone formation, addressed in the mesoscale analysis. Therefore, NO_2 and PM have been evaluated on the local scale (microscale).

REGIONAL (MESOSCALE) ASSESSMENT

Mesoscale analyses address emissions within each nonattainment area. Increases in emissions that will result from the Build Alternatives during operation were quantified; this includes the increase in emissions associated with the projected growth in freight movement and MARC train service associated with the increased capacity across the Susquehanna River introduced by the Proposed Project and components of NEC FUTURE program. Emissions during the construction period were also estimated (see Section G, “Construction Period Emissions Estimates.”)

STUDY AREA

The Proposed Project is located within two non-attainment areas: Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE and Baltimore, MD. The growth in freight rail traffic would increase emissions in these non-attainment areas and in other non-attainment areas further away. Additionally, a significant increase in MARC service as well as a planned change to the MARC locomotive fleet in the Build Alternatives would also result in increased emissions. Emissions associated with these changes within the non-attainment areas encompassing the Proposed Project were quantified; emissions in other, more distant non-attainment areas were addressed qualitatively.

Conservatively, the analysis does not account for emission reductions that would result from reduced on-road VMT due to increase passenger rail services or reduced VMT for freight trucks due to increased freight rail service. These reductions were not quantified as part of this analysis since the detailed projections associated with all NEC FUTURE program components are not available. Therefore, only the quantified increased emissions were compared to the established *de minimis* screening thresholds.

EMISSIONS FACTORS

The emissions from diesel freight locomotives were calculated using fuel consumption, based on typical locomotive models used by the rail operators, a fleet-average energy consumption factor of 296 British thermal units (BTU) per ton-mile[4] and a heat content of 138,700 BTU per gallon of diesel, and the USEPA’s estimates of typical fleet average emission rates of criteria pollutants for locomotives. The fleet average includes the gradual decrease in emissions as more stringent engine emission standards are phased in for newly manufactured locomotive engines by USEPA. The expected fleet average criteria pollutant emission factors in grams per gallon in the 2040 analysis year were obtained from the USEPA’s projected future emission factors, which include the expected fleet penetration of the various tiers of locomotives engines.[5]

MARC diesel locomotive emissions were calculated based on the MARC fleet mix of electric and diesel locomotives by USEPA Tier that would operate in the No Action and Build Alternatives. In the No Action Alternative, MARC service would utilize a fleet of six electric

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[4] Oak Ridge National Laboratory and the U.S. Department of Energy, Transportation Energy Data Book, Table 9.8, Edition 34, 2015.

[5] Emission Factors for Locomotives, USEPA-420-F-09-025, April, 2009.

locomotives, six Tier 0+ locomotives, 26 Tier 2 locomotives, and eight Tier 4 locomotives. The additional two tracks that are a part of the Build Alternative would allow for expanded MARC commuter rail service. The expanded service would be accommodated by the purchase of additional Tier 4 diesel locomotives, and retiring older locomotives within the fleet. In the Build Alternative, MARC service would utilize a fleet of 26 Tier 3 locomotives and 20 Tier 4 locomotives. **Table F-3** presents the USEPA emission rates used for this analysis.

Table F-3
2040 Locomotive Emission Factors (grams/gallon)

Criteria Pollutant	Freight Emission Factor	MARC Emission Factor	
	Fleet Average	No Action Alternative	Build Alternative
NO_x	28	7.2 / 3.91 [(1)]	4.95 / 3.23 [(2)]
PM_{10}	0.4	0.13	0.05
$PM_{2.5}$ [(2)]	0.38	0.13	0.05
HC	1	0.19	0.09
VOC [(3)]	1.053	0.20	0.10

Notes:
(1) NO_x emission rates for Tier 0+ and the No Action Alternative MARC locomotive engine mix for the 1-hour and annual averaging periods, respectively.
(2) NO_x emission rates for Tier 3 and the Build Alternative MARC locomotive engine mix for the 1-hour and annual averaging periods, respectively.
(3) $PM_{2.5}$ emission factors are assumed to be 0.97 times PM_{10} factors.
(4) VOC emission factors are assumed to be 1.053 times HC factors.
Sources: Emission Factors for Locomotives, USEPA-420-F-09-025, April, 2009.

The amount of freight transported annually through the non-attainment areas was estimated using 20 trains per day with the No Action Alternative and 22 trains per day with the Build Alternatives (see **Table F-1**). The daily level of service was assumed for the full year. Based on the number of cars per train, a freight car maximum weight capacity of 143 tons per car, a locomotive weight of 204 ton per locomotive, and two locomotives per train[6], Baltimore-bound trains (an increase of two freight trains from the No Action to the Build Alternative) account for an estimated 18,590 tons per train. Baltimore-bound trains transport freight for 15.2 miles of railway within the Philadelphia-Wilmington-Atlantic City AQCR and 32.6 miles of railway within the Baltimore AQCR. The return trips would be either empty or transporting a lighter commodity. However, it was conservatively assumed that all trains transport the maximum amount.

Similarly, emissions associated with MARC commuter rail service were calculated based on a passenger train total weight of 330 tons as well as a measured travel distance of 42.6 miles within the Baltimore AQCR. Using 14 trains per day with the No Action Alternative and 44 trains per day with the Build Alternatives (see **Table F-1**) the expanded MARC service would result in increased passenger ton-mile within the region.

[6] Susquehanna River Rail Bridge—2040 Train Projections and Assumptions Memo, Amtrak, November, 2015.

LOCAL (MICROSCALE) ASSESSMENT

The Build Alternatives would have an effect on pollutant emissions and nearby concentrations by changing the distance between the track and nearby uses (such as residential and publically accessible open space), and by introducing changes in track grade. This EA analyzes the potential for adverse air quality impacts associated with the above changes at sensitive receptors (residential buildings, publicly accessible open space, etc.) located within 1,000 feet of the railway at the analyzed south wye track curve site (microscale analysis). The Build Alternatives would realign track curvature on the south wye track such that freight rail traffic would be relocated closer to nearby residences.

Improvements made as part of NEC FUTURE program and the Proposed Project, would also result in increases in freight and MARC train movement along the NEC. This would result in two additional diesel freight trains per day on the NEC corridor track–south of the Proposed Project and on the Norfolk Southern (NS) Port Road Branch[7] (increasing from 20 freight trains projected for the No Action Alternative to 22 freight trains per day with the Build Alternatives), but would not change the maximum number of diesel freight trains in the peak hour.

As described, the MARC commuter rail fleet would replace older electric and diesel locomotives with newly purchased Tier 4 diesel locomotives in the Build Alternatives. Moreover, while MARC service increase substantially (increasing from 18 to 44 trains with the Build Alternatives). Therefore, the increase in MARC passenger rail service would also potentially impact local air quality.

Additionally, a substantial increase in MARC service would be present with the Build Alternatives and may result in an increase in local on-road vehicle traffic. While this increase in MARC service would be enabled in part by the Proposed Project, this added service is not being proposed as part of the Susquehanna River Bridge Project and would be studied under a separate environmental review for MDOT’s service extension to Elkton and beyond. The potential for additional MARC service is further discussed in Chapter 18, “Indirect and Cumulative Effects.”

STUDY AREA

The area surrounding the wye track in Perryville was selected for analysis as the worst-case location for assessment of local air quality effects. Alternative 9A and Alternative 9B both propose to use the same track realignment at the south wye track in Perryville (see **Figure F-1**). The Build Alternatives would result in a change in track grade and curvature, as well as the shift track currently used by freight and MARC diesel locomotives to a location that is closer to nearby residential and other uses considered sensitive. The effect of the projected increase in diesel train volumes (both freight and MARC) would therefore be greatest at this location.

These physical changes and the changes in frequency of freight rail service would be most pronounced in the area surrounding the wye track changes, and that area was, therefore, selected as the worst-case study area for the study of local concentrations (microscale) under both Build Alternatives.

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[7] The NS Port Road Branch connects with the Amtrak NEC via a “wye” connection at Perry interlocking, just north of the Susquehanna River Bridge. This connection allows freight to move between the Harrisburg, PA area and locations north and south of Perryville, MD.

South Wye Track Realignment
Figure F-1

While the changes in the alignment of the south wye track would be the same in both Build Alternatives, the alternatives differ in Havre de Grace. Alternative 9A would allow Amtrak service to operate at a higher travel speed in Havre de Grace than Alternative 9B due to changes in track curvature (see **Figure 4-3**), but would require more land acquisition. However, the track used by freight locomotives would not differ between the two Build Alternatives in Havre de Grace. Alternative 9A would shift Amtrak service closer to the adjacent Havre de Grade Middle School/High School than Alternative 9B. Since Amtrak service would be fully electric, the changes in Havre de Grace would not affect air quality; therefore, the results below are representative of both Build Alternatives.

ANALYSIS YEAR

While the Proposed Project is expected to be operational beginning in 2024, total emissions would be greater in the 2040 analysis year due to the projected additional freight and MARC diesel trains. Therefore, the 2040 Build Year was selected for analysis.

DISPERSION MODEL

Pollutant concentrations were projected using the USEPA recommended AERMOD model.[8] AERMOD is a state-of-the-art dispersion model, applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). AERMOD is a steady-state plume model that incorporates current concepts about flow and dispersion in complex terrain, including updated treatments of the boundary layer theory, understanding of turbulence and dispersion, and includes handling of terrain interactions. The AERMOD model calculates pollutant concentrations based on hourly meteorological data. The analysis of potential impacts was performed assuming rural dispersion and surface roughness length, and elimination of calms.

EPA's AERMOD model is capable of producing detailed output data that can be analyzed at the hourly level as required for consistency with the form of the 1-hour standards. 1-hour average NO_2 concentration increments associated with locomotive operation were estimated using AERMOD's Plume Volume Molar Ratio Method (PVMRM) module to analyze chemical transformation within the model. The PVMRM module incorporates hourly background ozone concentrations to estimate NO_x chemical transformation within the source plume. Five years of hourly ozone concentrations, obtained from the Fair Hill Natural Resource Management Area monitoring station (located in Cecil County, Maryland—the nearest ozone monitoring station) were applied in the PVMRM analysis. An initial NO_2 to NO_x ratio of 10 percent at the source exhaust was assumed[9]. Hourly seasonal NO_2 background concentrations monitored at the Essex monitor station (in Essex County, Maryland) were added to hourly modeled concentrations within the model (see description below). $PM_{2.5}$ and PM_{10} background concentrations were instead applied to modeled concentrations afterwards.

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[8] USEPA. *AERMOD: Description Of Model Formulation*. 454/R-03-004. September 2004; and USEPA. *User's Guide for the AMS/USEPA Regulatory Model AERMOD*. 454/B-03-001. September 2004 and Addendum June 2015.

[9] This is a conservatively high assumption. Diesel NO_2 emissions generally range from 3 to 10 percent of total NO_x. See—EPA. *NO_2*/NOx In-Stack Ratio (ISR) Database. http://www3.epa.gov/scram001/no2_isr_database.htm, accessed September 30, 2015.

The 1-hour NO_2 design concentrations for comparison with the NAAQS were calculated following USEPA guidance[10] by adding the monitored background to modeled concentrations, as follows:

1. Hourly modeled concentrations from simulated sources were first added to the seasonal hourly background monitored concentrations within the AERMOD model calculation producing hourly total concentrations;
2. The highest 1-hour total NO_2 concentration was then determined within the AERMOD model at each receptor location for each day of the year;
3. The 98th percentile daily 1-hour maximum concentration for each modeled year was calculated within the AERMOD model; and
4. The 98th percentile concentrations were averaged over the latest five years.

EMISSIONS

Diesel locomotive emissions were calculated based on estimated horsepower and USEPA's estimates of typical in-use criteria pollutant emission factors for the 2040 target year, as described in the "Regional Emissions." Emission factors used for freight and passenger rail services are presented in **Table F-4**.

Table F-4
2040 Locomotive Emission Factors (g/hp-hr)

Pollutant	**Freight Fleet Average Locomotives**	**Passenger Locomotives (1)**	
		No Action Alternative	**Build Alternative**
NO_x	1.35	0.35 / 0.19 (2)	0.24 / 0.16 (3)
PM_{10}	$1.92 x10^{-2}$	$6.27 x10^{-3}$	$2.49 x10^{-3}$
$PM_{2.5}$ (4)	$1.86 x10^{-2}$	$6.08 x10^{-3}$	$2.41 x10^{-3}$

Notes:
Emission factors are based on the 20.8 bhp-hr/gal conversion factor.
(1) MARC passenger service would use a mix of electric and diesel locomotives in the No Action Alternative. In the Build Alternatives, older electric and diesel locomotives would be replaced with newly purchased Tier 4 locomotives and MARC passenger service would exclusively use diesel locomotives.
(2) NO_x emission rates for Tier 0+ and the No Action Alternative MARC locomotive engine mix for the 1-hour and annual averaging periods, respectively.
(3) NO_x emission rates for Tier 3 and the Build Alternatives MARC locomotive engine mix for the 1-hour and annual averaging periods, respectively.
(4) $PM_{2.5}$ emissions are assumed to be 0.97 times PM_{10} emissions.
Sources: Emission Factors for Locomotives, USEPA-420-F-09-025, April, 2009.

[10] USEPA. Memorandum: *Clarification on the use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard*. September 30, 2014.

The required horsepower was estimated for the local freight rail service operating at a maximum travel speed of 15 mph along the sections of railway track surrounding the Perryville station. If the estimated power exceeded the capacity of the locomotive, a slower traveling speed for the locomotive was analyzed. The calculation method for the power output required[11] included the power necessary to overcome the drag forces associated with rolling resistance,[12] curvature of the railway track,[13] and grade[14] of the track. These calculations took into account the conditions of the railway track, the weight of the trains, the average speed of the train, as well as whether the train would be accelerating or not.[15]

Additionally, a track signal to stop freight train traffic when necessary would be located approximately 600 feet north of the wye track curve. Emissions associated with extended idling due to track conflicts were included. It was assumed, based on Amtrak dispatchers experience, that there would be one freight train stopped per day, and would idle for a period of 2 hours. Load levels and emission factors for both dynamic braking and engine idling were based on the USEPA inventory of line-haul locomotives' emissions for discrete throttle settings.[16]

The primary commodity transported on the freight railways are coal and oil trains (some other, lighter, trains would operate as well, but the heaviest trains are assumed as a reasonable worst case). Freight trains would consist of two 4,400 horsepower diesel-electric locomotives, and 130 or 100 cars per train for Baltimore-bound coal trains or Wilmington-bound oil trains, respectively. The weight of either a coal hopper or oil tanker being transported by freight train was assumed to be the maximum weight limit of 286,000 pounds. Regional commuter MARC trains were assumed to consist of a single locomotive and eight passenger rail cars, each weighing 104,000 pounds.[17]

For the 1-hour analysis, hourly train data on the NEC (for the time period between September 2015 and April 2016) was used to develop the worst case hourly conditions. These conditions included the emissions associated with the transport of empty freight cars. An empty train car was conservatively assumed to be the maximum empty train car weight observed on the South wye track—34 tons.[18] Additionally, all MARC trains in the peak hour were assumed to be the

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[11] Method developed by Al A. Krug. While this method has not been validated formally, the results have been compared with formally modeled results from other projects and other methods, and produce similar results. http://www.alkrug.vcn.com/rrfacts/RRForcesCalc.html

[12] Where rolling drag (lbs) for the train cars is calculated as:
(1.3 + 29 / [Tonnage per Wheel] + 0.045 * [Travel MPH] * [Total Car Tonnage]
and for locomotives as:
(2.18 + 0.045 * [Travel MPH] + 0.1 * ([Travel MPH]) ^ 2) * [Total Locomotive Tonnage]

[13] Where curvature drag (lbs) is calculated as:
0.8 * [Track Curvature] * [Total Train Tonnage]

[14] Where grade drag (lbs) is calculated as:
20 * [Track Grade] * [Total Train Tonnage]

[15] It is assumed that 10 lbs of resistance per ton are needed to be overcome for train acceleration.

[16] Locomotive Emission Standards Regulatory Support Document, Appendix B, EPA-420-R-98-101, April 1998.

[17] Based on the dry weight limitations of the PRIIA Single-Level Passenger Coach Rail Car.

[18] Based on the maximum average empty train car weight from freight rail activity NEC records at the Prince and Grace interlocking stations located to the north and south of the wye track.

worst case locomotives based on the MARC locomotive fleet mix for the No Action and Build Alternatives—Tier 0+ and Tier 3 locomotives respectively.

RECEPTOR PLACEMENT

As seen in **Figure F-2**, discrete receptors (i.e., locations at which concentrations are calculated) were modeled at nearby residential and other sensitive locations (e.g., schools, parks). Publically assessable locations (e.g., sidewalks, parks, outdoor recreational facilities) were also included in the air quality analysis.

MODELING PARAMETERS

Emissions from rail operations were modeled as a series of area sources over the existing and proposed railway tracks, consistent with USEPA guidance for simulating line sources (such as railways) with nearby receptors in AERMOD. Based on the methodology used for the Southern California International Gateway (SCIG) Project[19] and Roseville Rail Yard Study,[20] a screening level approach was used to estimate the plume rise of locomotive sources. The USEPA preferred screening model, AERSCREEN, replaced the previous screening model, SCREEN3, in April 2011. Therefore, the AERSCREEN model was used for estimating plume rise. Estimated plume heights obtained using AERSCREEN were then applied to the AERMOD dispersion analysis for the study area.

The area sources modeled are displayed in **Figure F-2**. Per USEPA guidance, source width was taken as the width of the railways (3.05 meters) with an additional 6 meters to account for turbulent mixing as a result of the locomotives' movements. Additionally, representative exhaust stack parameters for idling locomotives at the Otsego crossing signal location were developed from the rail sources of the Roseville Rail Yard Study. Modeling parameters used are presented in **Table F-5**.

Emission rates for the railway area sources (g/m^2-s) were developed using these source parameters and the emissions developed above. **Table F-6** and **Table F-7** present the maximum hourly area source emission rates of rail operations along tracks sections within the study area for the No Action and Build Alternatives, respectively. A site layout showing the location of track sections referenced can be found in **Figure F-3.**

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[19] Southern California International Gateway (SCIG) Project Final Environmental Impact Report, Appendix C2: Dispersion Modeling, Los Angeles Harbor Department, February 2013.

[20] Roseville Rail Yard Study, Appendix G: Adjustments for Modeling Parameters, California Air Resources Board (CARB), October 2014.

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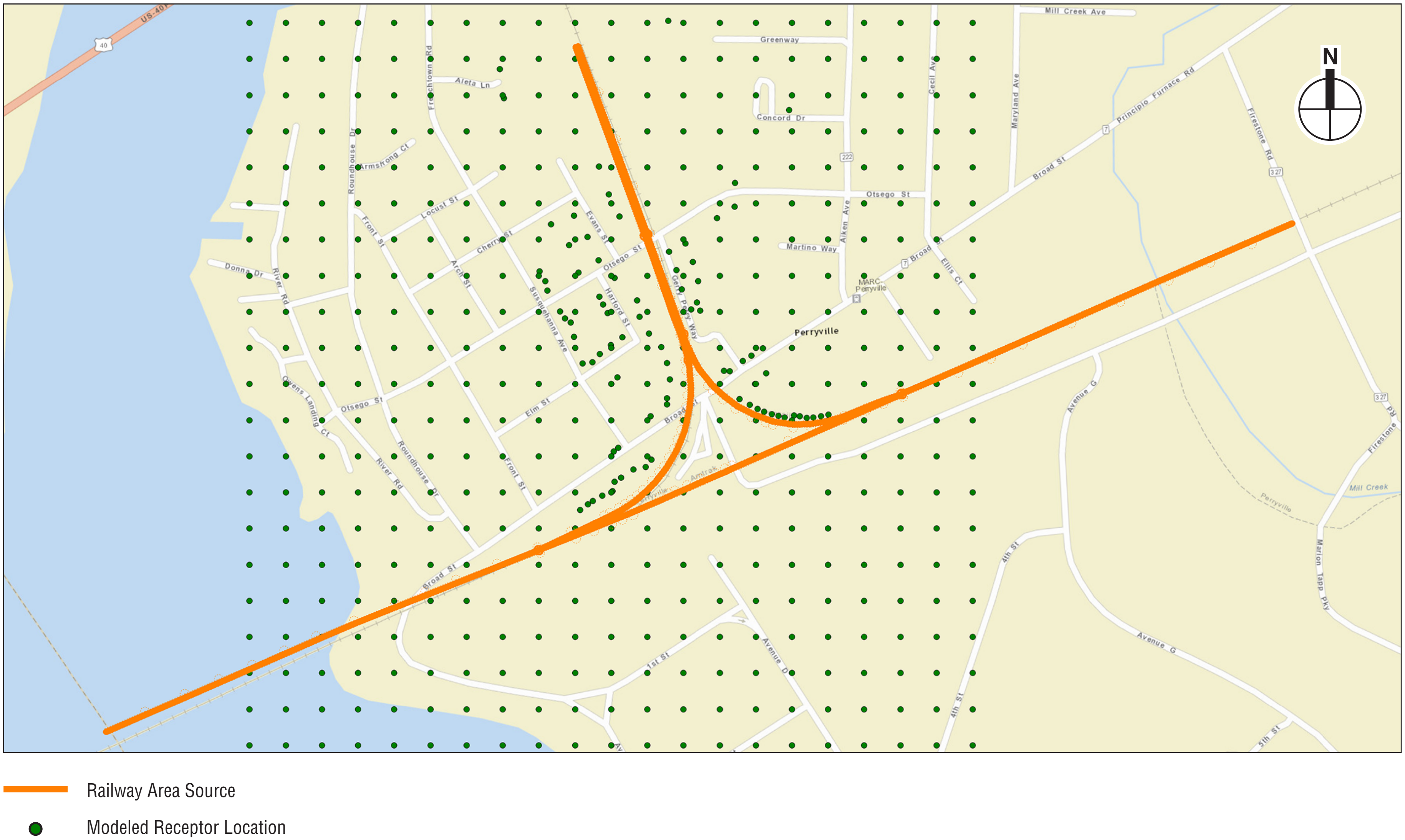


Susquehanna River Rail Bridge Project

AERMOD Model Source & Receptor Locations

Figure F-2

1.13.17

Modeled Track Sections
Figure F-3

Table F-5
Locomotive Modeling Parameters

Parameter	Value
Rail Movement Area Sources[1]	
Release Height (m)	4.21
Initial Vertical Dispersion (m)	3.91
Source Width (m)	9.05
Rail Idle Source[2]	
Release Height (m)	4.57
Exhaust Temperature (K)	369
Exhaust Diameter (m)	0.625
Exhaust Velocity (m/s)	3.07

Notes:
(1) Based on AERSCREEN model of locomotive traveling at 15 mph.
(2) Based on idle exhaust parameters of the EMDSD-70 locomotive as a representative engine based on engine size.

Table F-6
No Action Alternative
Lcomotive Emission Rates (g/m^2-s)

Track Section	NO_x		$PM_{2.5}$	PM_{10}
	1-Hour (1)	Annual	24-Hour and Annual	24-Hour
To/From Baltimore				
Bridge Crossing (2)	4.43×10^{-5}	1.39×10^{-5}	1.96×10^{-7}	2.02×10^{-7}
Wye Curve (3)	5.13×10^{-5}	1.46×10^{-5}	2.02×10^{-7}	2.09×10^{-7}
Otsego Crossing 3)	2.38×10^{-5}	3.42×10^{-6}	4.74×10^{-8}	4.98×10^{-8}
Perryville Station (4)	1.75×10^{-6}	1.84×10^{-7}	5.96×10^{-9}	6.15×10^{-9}
To/From Wilmington				
Track North	1.88×10^{-5}	8.63×10^{-6}	1.20×10^{-7}	1.23×10^{-7}
Wye Curve (3)	1.70×10^{-5}	7.79×10^{-6}	1.08×10^{-7}	1.11×10^{-7}
Otsego Crossing (3)	5.15×10^{-6}	2.36×10^{-6}	3.27×10^{-8}	3.37×10^{-8}

Notes:
(1) Representative of the maximum emissions rates in a single 1-hour period.
(2) Emission rates include the combined emissions of freight rail and diesel locomotives utilized for regional MARC passenger rail service with the No Action Alternative.
(3) Emission rates include emission associated with dynamic braking, idle emissions, acceleration from full stop (full load), and travel at 15 mph.
(4) MARC passenger rail emissions for diesel trains serving the Perryville Station in the No Action Alternative with the worst-case 1-hour emissions based on Tier 0+ emission factors.

Table F-7
Build Alternatives
Emission Rates (g/m^2-s)

Track Section	NO_x 1-Hour (1)	NO_x Annual	$PM_{2.5}$ 24-Hour and Annual	PM_{10} 24-Hour
To/From Baltimore				
Bridge Crossing (2)	5.03×10^{-5}	1.94×10^{-5}	3.92×10^{-7}	4.05×10^{-7}
Wye Curve (3)	5.13×10^{-5}	1.81×10^{-5}	2.51×10^{-7}	2.59×10^{-7}
Otsego Crossing (3)	2.38×10^{-5}	3.95×10^{-6}	5.47×10^{-8}	5.64×10^{-8}
Perryville Station (4)	1.20×10^{-6}	4.79×10^{-7}	1.05×10^{-7}	1.08×10^{-7}
To/From Wilmington				
Track North	1.88×10^{-5}	8.63×10^{-6}	1.20×10^{-7}	1.23×10^{-7}
Wye Curve (3)	1.70×10^{-5}	7.79×10^{-6}	1.08×10^{-7}	1.11×10^{-7}
Otsego Crossing (3)	5.15×10^{-6}	2.36×10^{-6}	3.27×10^{-8}	3.37×10^{-8}

Notes:
(1) Representative of the maximum emissions rates in a single 1-hour period.
(2) Emission rates include the combined emissions of freight rail and diesel locomotives utilized for regional MARC passenger rail service with the Build Alternatives.
(3) Emission rates include emission associated with dynamic braking, idle emissions, acceleration from full stop (full load), and travel at 15 mph.
(3) MARC passenger rail emissions for diesel trains serving the Perryville Station in the Build Alternatives with the worst-case 1-hour emissions based on Tier 3 emission factors.

Both freight and passenger rail service is projected to increase under the Build Alternatives. A daily profile of train traffic was used to model a daily emissions profile associated with all diesel rail service within the study area. For time periods shorter than 24 hours, the average peak hourly number of trains was used. For periods 24 hours or longer, the average number of trains during nighttime and daytime hours were used, and a full load for all trains was conservatively assumed.

For short-term models, hourly train data on the NEC (for the time period between September 2015 and April 2016) were used to develop the worst-case hourly freight conditions. While the freight railways on the north and south wye tracks are able to handle two trains within a single hour (for a total of four freight trains in a single hour), the maximum number of freight trains operating over both the north and south wye tracks was observed to not exceed three trains within a single hour. Therefore, it was determined that the peak modeled conditions would include one fully loaded freight train traveling on the south wye track, one fully loaded freight train traveling on the north wye track, and one empty freight train traveling on the south wye track.

BACKGROUND CONCENTRATIONS

To estimate the maximum expected total pollutant concentrations at a given receptor, the predicted levels were added to corresponding background concentrations (see **Table F-8**). The background levels were based on concentrations monitored at the nearest monitoring station. The measured background concentration was added to the predicted contribution from the modeled source to determine the maximum predicted total pollutant concentration. It was conservatively assumed that the maximum background concentrations would occur on all days. As discussed above, hourly seasonal background monitored NO_2 concentrations from the Essex monitoring station (in Essex County, Maryland) were used within the AERMOD model for the 1-hour average NO_2 analysis.

Table F-8
Maximum Background Pollutant Concentrations

Pollutant	Average Period	Location	Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	1-hour	Essex, Baltimore County	16 to 82*	188
	Annual		24.74	100
$PM_{2.5}$	24-hour	Fair Hill, Cecil County	23.5	35
	Annual		10.9	12
PM_{10}	24-hour	Baltimore, Baltimore County	44.0	150

Note:
***** Hourly seasonal background monitored concentrations from the Essex monitoring station (in Essex County, Maryland) were used within the AERMOD model for the 1-hour average analysis. The values applied represent the 98th percentile of seasonal 1-hour average concentrations, per USEPA guidance.
Source: USEPA. AirData for 2010–2014. http://www3.epa.gov/airdata/, accessed January, 2016.

METEOROLOGICAL DATA

The meteorological data set consisted of five consecutive years of meteorological data: surface data collected at Wilmington, Delaware Airport (2009–2013) and concurrent upper air data collected at Sterling, VA. The meteorological data include wind speed and direction, parameters describing the profiles of vertical and horizontal turbulence, and the altitude of the temperature inversion for each hour over the five-year period. These data were processed using the USEPA AERMET program to develop data in a format which can be readily processed by the AERMOD model. The land uses around the site where meteorological surface data were available were classified using categories defined in digital United States Geological Survey (USGS) maps to determine surface parameters used by the AERMET program.

D. EXISTING CONDITIONS

Pollutant levels measured at area monitoring stations are used to characterize existing conditions. Concentrations of carbon monoxide (CO), sulfur dioxide (SO_2), PM (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), and ozone measured in 2014 at monitoring stations closest to the project area, are shown in **Table F-9**. These values are the most recent data available at the time the analysis was undertaken, and are consistent with the background conditions used in the future conditions analyses (see below). Monitored levels of ozone exceed the National Ambient Air Quality Standards (NAAQS).

Table F-9
Representative Monitored Ambient Air Quality Data

Pollutant	Location	Units	Averaging Period	Concentration(1)	NAAQS
CO	Essex, Baltimore County	ppm	8-hour	1.3	9
			1-hour	1.8	35
SO_2	Essex, Baltimore County	µg/m³	3-hour	N/A	1,300
			1-hour	68	196
PM_{10}	Baltimore, Baltimore County	µg/m³	24-hour	41	150
$PM_{2.5}$	Fair Hill, Cecil County	µg/m³	Annual	8.6	12
	Edgewood, Harford County			10.3	
	Fair Hill, Cecil County	µg/m³	24-hour	24	35
	Edgewood, Harford County			21	
NO_2	Essex, Baltimore County	µg/m³	Annual	21	100
			1-hour	87	188
Ozone	Fair Hill, Cecil County	ppm	8-hour	**0.074**	0.070
	Churchville, Harford County			0.070	

Notes: Concentrations in **bold** exceed the NAAQS.

1. All concentrations presented are based on 2014 data. CO and PM_{10} concentrations are the second-highest values. SO_2 1-hour is the 99th percentile of daily maximum 1-hour average concentrations. NO_2 1-hour is the 98th percentile of daily maximum 1-hour average concentrations averaged over the 3-year period of 2012-2014. 24-hour average $PM_{2.5}$ is the 98th percentile. Annual value is the mean for the year. 8-hour average ozone concentrations are the 4th highest-daily values for 2014.

Sources: USEPA, Air Data, Monitor Values Report for 2014 http://www.epa.gov/airdata/ad_rep_mon.html, accessed January 6, 2016.

While the measured concentrations of pollutants excluding ozone are below the NAAQS, the monitors are not located adjacent to specific sources such as highways or rail lines and do not represent concentrations specifically affected by such operations, but rather the general background in the broader study area. In 2015, 14 diesel-powered freight trains and 108 passenger trains (10 of which are diesel powered) crossed the bridge in a typical day (see Chapter 3, “Transportation”). Diesel train operations result in localized differences in pollutant concentrations, which are higher in the areas adjacent to the railway tracks. Specifically, concentrations of PM and NO_2 in the vicinity of the existing railways are likely above those observed at monitoring stations due to the proximity to diesel locomotive operations.

E. NO ACTION ALTERNATIVE

Between existing conditions and the 2040 No Action Alternative, freight rail volumes are anticipated to increase, resulting in six additional daily trains (from 14 freight trains to 20), but the peak hourly number of trains would not increase due to capacity constraints. Regional (mesoscale) emissions are assessed on an incremental basis. Therefore, an analysis of the No Action Alternative is not presented (see Section F: Potential Impacts of the Proposed Project).

Based on recent MARC plans, the passenger MARC fleet will be trains would continue to operate a locomotive fleet comprising a mix of diesel and electric powered engines under the No

Action Alternative. In 2040 the MARC fleet would utilize six electric locomotives, six Tier 0+ locomotives, 26 Tier 3 locomotives, and eight Tier 4 locomotives.

Projected pollutant concentrations for the 2040 No Action Alternative are presented in **Table F-10**. Maximum projected $PM_{2.5}$ (24-hour and annual average), PM_{10} (24-hour average), and annual average NO_2 concentrations would be below the respective NAAQS. However, due primarily to the freight rail operations within the study area (existing operations with growth), 1-hour average NO_2 concentrations were projected to potentially exceed the NAAQS.

Table F-10
Maximum Projected Concentrations—No Action Alternative (μg/m³)

Pollutant	Time Period	Background Concentration	No Action Modeled Concentration	No Action Total Concentration	NAAQS
NO_2	1-Hour	(1)	(1)	**288**	188
	Annual	24.7	8.45	33.2	100
$PM_{2.5}$	24-Hour	23.5	0.5	24.0	35
	Annual	10.9	0.1	11.0	12
PM_{10}	24-Hour	44	0.5	44.5	150

Notes:
Results in **bold** exceed the NAAQS.
1. Consistent with USEPA guidance, total NO_2 1-hour concentrations include seasonal hourly background concentrations developed from hourly monitored NO_2 concentrations at the Fair Hill monitoring station over the years 2010 to 2014.

The above 1-hour average NO_2 concentrations were predicted using a conservative modeling approach in which peak activity within the overnight and daytime periods was modeled throughout these periods at all hours. This approach ensures that worst-case meteorological conditions, resulting in peak potential concentrations at each of the nearby receptors, are captured. Given the uncertainty regarding specific hours during which trains pass by, this approach is necessary. However, due to the infrequent number of times that peak activity would occur, it is unlikely that peak activity would consistently occur during worst-case meteorological conditions at any one receptor, and therefore, this approach results in conservatively high estimates of potential 1-hour NO_2 concentrations. To demonstrate this effect, additional modeling was performed using actual hourly freight train activity recorded on the NEC from September 2015 to April 2016. When actual recorded activity was modeled, projected 1-hour NO_2 concentrations fell below the NAAQS threshold of 188 μg/m³.

In March 2008, USEPA adopted an emissions reduction program for diesel locomotive engines. Emission standards for locomotive engines remanufactured or newly manufactured are being phased in and will reduce fleetwide emissions between the existing conditions and the No Action Alternative. However, freight rail in the region is anticipated to grow at a comparable annual growth rate over the same period. Due to the decreased diesel locomotive emission rates combined with the projected growth in diesel locomotive operations enabled by the Proposed Project and components of NEC FUTURE program, local concentrations projected above for the No Action Alternative are likely comparable to the concentrations near the freight and MARC track in the existing conditions.

F. POTENTIAL IMPACTS OF THE PROPOSED PROJECT

MESOSCALE ANALYSIS

Predicted annual emission increases associated with the additional ton-miles in the Build Alternatives within the two non-attainment areas are presented in **Table F-11**. The reduction in emissions due to VMT reductions (both passenger car and truck) was conservatively not included in the mesoscale analysis. If taken into account, this would result in lower emissions than those presented and may partially or fully offset the projected emissions increases. Note that the emissions increases due to the increase in freight and MARC volumes are reported for 2040. Increases in emissions in earlier years would be lower due to less amount of freight transported and the fewer number of passenger rail service operating through the region in these years, even when considering the higher engine emissions associated with less efficient engine fleets in earlier years.

Table F-11
Predicted Increases in Regional Annual Emissions

Criteria Pollutant	Baltimore		Philadelphia-Wilmington-Atlantic City		*De minimis*
	Freight Increase (thousand ton-miles)	Emissions Increase (ton/year)	Freight Increase (thousand ton-miles)	Emissions Increase (ton/year)	
NO_x	442,405	29	206,275	14	100
$PM_{2.5}$	442,405	0.4	206,275	0.2	100
VOC	442,405	1.1	206,275	0.5	50

The emissions increase associated with the Build Alternatives represent a small fraction of the *de minimis* emission levels in the Philadelphia-Wilmington-Atlantic City and Baltimore non-attainment areas, demonstrating that the operation of the Proposed Project would not substantially impact region-wide concentrations. Since any emission increases, should they occur, would not exceed *de minimis* levels defined in the general conformity regulations, the operation of the Proposed Project would not interfere with the SIP for region–wide attainment of the ozone NAAQS or maintenance of the $PM_{2.5}$ NAAQS, and would not require a conformity determination. Note that emissions in other non-attainment areas traversed by affected rail lines beyond the project study area may be affected as well—emissions in those more distant areas would likely be similar to those shown in **Table F-11**, and, therefore, no conformity determinations would be required for any other non-attainment or maintenance areas.

MICROSCALE ANALYSIS

Table F-12 presents total concentrations projected to potentially occur due to track realignment at the wye track west of the Perryville station with Alternative 9A or Alternative 9B and increased locomotive activity along the track on the NEC track-south of the Proposed Project and along the NS Port Road Branch to the north. Projected concentrations are compared with the NAAQS.

Table F-12
Maximum Projected Concentrations—Build Alternatives (µg/m³)

Pollutant	Time Period	Background Concentration	No Action Concentration	Build Concentration	NAAQS
NO_2	1-Hour	(1)	**288**	**291**	188
	Annual	24.7	33.2	34.0	100
$PM_{2.5}$	24-Hour	23.5	24.0	24.3	35
	Annual	10.9	11.0	11.0	12
PM_{10}	24-Hour	44	44.5	44.8	150

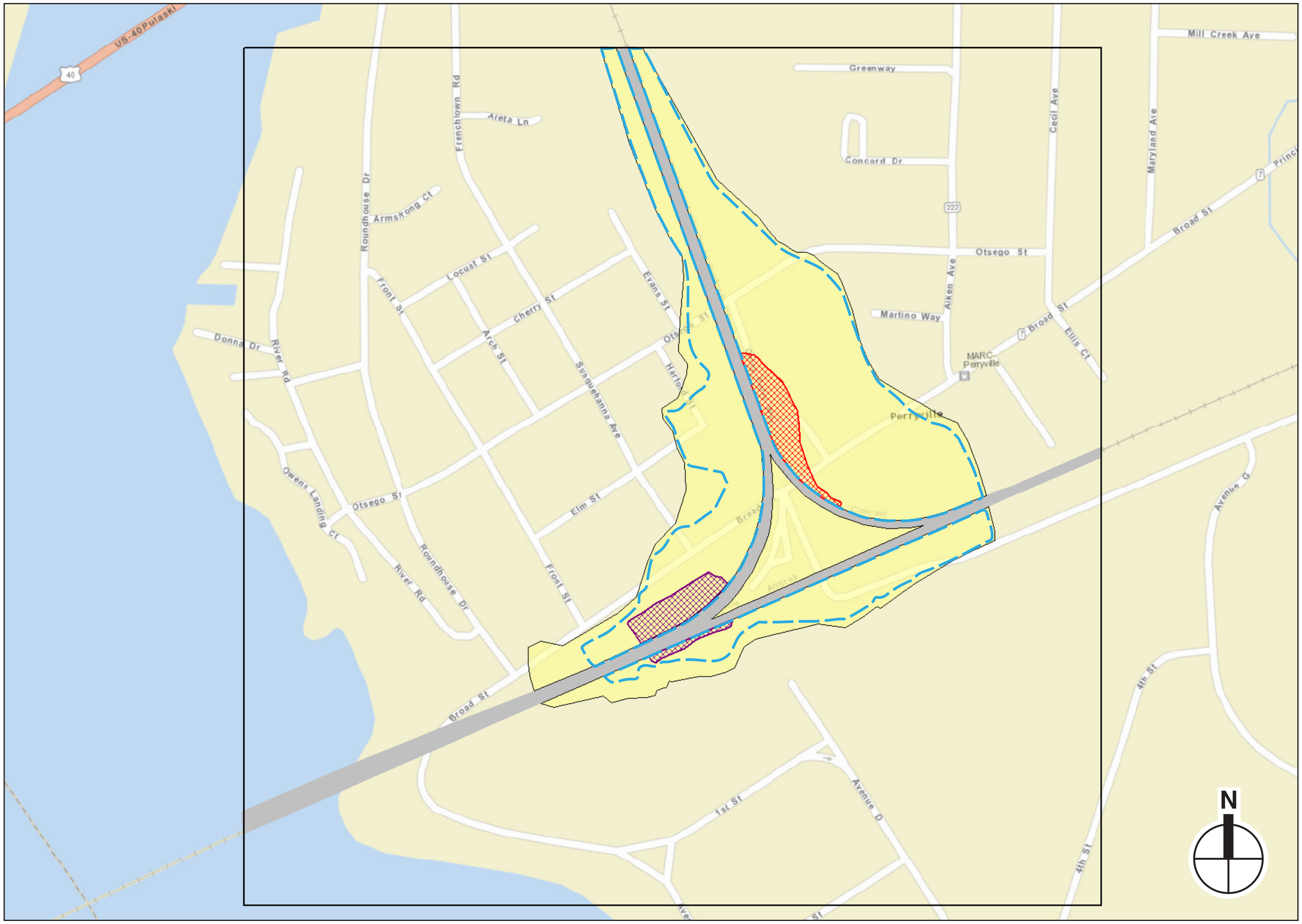
Notes:
Results in **bold** exceed the NAAQS.
Project concentrations represent results at the wye track under Alternative 9A and Alternative 9B.
1. Consistent with USEPA guidance, NO_2 1-hour concentrations utilized seasonal hourly background concentrations developed from hourly monitored NO_2 concentrations at Fair Hill monitoring station over the years 2010 to 2014.

As described above (Section C, "Methodology"), due to the proposed changes in track alignment, the proximity to receptors, and the overall number of diesel locomotives operating at the wye track in Perryville, the concentrations presented in **Table F-12** represent the maximum total potential concentrations.

Similar to the No Action Alternative, maximum projected $PM_{2.5}$ (24-hour and annual average), PM_{10} (24-hour average), and annual average NO_2 concentrations with the Build Alternatives would be lower than the respective NAAQS. Concentrations at other locations near the freight tracks between the wye track in Perryville and areas to the north along the NS Port Road Branch towards Pennsylvania are also anticipated to increase somewhat with the Build Alternatives when compared to the No Action Alternative due to the growth in daily freight movement (associated with the Proposed Project and components of NEC FUTURE program). The changes at these other locations would be less than presented above since there would be no change in track location or grade at those locations, and total concentrations at those locations would not exceed the NAAQS.

Additionally, the increase in MARC service in the Build Alternatives would result in increased concentrations along the NEC Corridor where MARC service operates. Similarly, the increased concentrations would be less than those predicted for the Perryville Station site, and total concentrations would not exceed the NAAQS.

As with the No Action Alternative, the projected 1-hour average NO_2 concentrations were projected to potentially exceed the NAAQS within the area surrounding the wye track west of the Perryville station (NEC track-south). **Figure F-4** shows the extent of the potential exceedances, the area where the highest total concentrations would occur, and the area where the maximum concentration increase is projected to occur. Exceedances are projected to potentially occur up to 500 feet to the east and west of the NS Port Road Branch in Perryville (this does not change from the No Action Alternative as the peak hourly freight traffic does not increase in the Build Alternatives), and up to 250 feet north and south of the Susquehanna River Bridge approach in Perryville (50 feet further than in the No Action Alternative) where diesel locomotives operate.



Extent of Potential Exceedance – Build Alternatives

Extent of Potential Exceedance – No Action Alternative

Area of Highest Potential Concentrations

Area of Highest Potential Increment

Extent of Model Projections

Modeled Railroad Source

AERMOD Projected Areas of Potential NO_2 1-Hour Exceedance
Build Alternatives 9A / 9B

Figure F-4

Maximum 1-hour average NO_2 concentrations are predicted to occur at sensitive receptor locations immediately east and west of the wye track between Broad Street and Otsego Street, and would potentially increase from 288 $\mu g/m^3$ under the No Action Alternative, to 291 $\mu g/m^3$ with the Build Alternatives (both Alternative 9A and Alternative 9B)—representing an increase of less than 2 percent. While total potential concentrations at residences adjacent to the track curve re-alignment (south of Broad Street and west of the wye track) are projected to be lower (at most 215 $\mu g/m^3$ and 224 $\mu g/m^3$ in the No Action and Build Alternatives, respectively), the concentrations at those locations would nonetheless also potentially exceed the NAAQS, and would represent an increase up to 6 percent from the No Action Alternative. The area where the concentration increase could be within this range would be north of the bridge approach, extending up to 250 feet from the track along Broad Street to the north of the south wye track. The potentially affected area would be located closest to the largest change in grade as well as the relocated track and includes residential buildings along the south side of Broad Street.

The above concentrations were predicted using a conservative modeling approach for which the peak conditions within the overnight and daytime periods were modeled through the respective periods. This approach ensures that potential peak conditions would occur during worst-case meteorological conditions for all nearby receptors. Due to the infrequent number of times that peak conditions would occur, it is unlikely that peak conditions would consistently occur during worst-case meteorological conditions at any one receptor. Furthermore, additional modeling was performed using hourly freight train activity recorded on the NEC from September, 2015 to April, 2016. When actual recorded activity was modeled, 1-hour NO_2 concentrations fell below the NNAQS threshold of 188 $\mu g/m^3$.

Build Alternative 9A and Alternative 9B would also include track realignment in Havre de Grace, straightening the curve to allow for maximum speeds of 160 mph and 150 mph, for Build Alternative 9A and Alternative 9B, respectively. This realignment would shift Amtrak service closer to the adjacent Havre de Grade Middle School property with Alternative 9A than with Alternative 9B. The location of both freight and MARC tracks in Havre de Grace would not differ between the two Build Alternatives. Since Amtrak service would be fully electric, the air quality impacts would not differ between the two Build Alternatives.

While NO_2 1-hour average exceedances are possible at locations along the NEC freight track and along the NS Port Road Branch due to total peak hour freight movement during the overnight period, they would not increase due to the Proposed Project since peak hour freight movement is not projected to increase.[21]

[21] Note that in order to conservatively analyze the combination of high emissions with worst case meteorology conditions, every hour is modeled with its maximum potential emission rate, representing two trains per hour. Due to the increased number of freight trains the frequency of this occurring could increase somewhat from the No Action Alternative to the Build Alternatives. This increase in probability would be small given the small increase in the number of trains. Therefore, there could be an increase in the probability that these concentrations would occur as there would be an increased likelihood that the peak conditions would coincide with worst case meteorology. However, since the worst-case meteorological conditions usually do not occur for only a single hour, this is likely to be a negligible difference.

CONCLUSIONS

Overall, the Proposed Project would not substantially affect regional air quality. Some increases in local concentrations of 1-hour average NO_2 may occur near the proposed bridge, resulting in increases in the range of up to 8.6 percent in areas where exceedance of the NAAQS are possible both in the No Action and Build Alternatives. Given the necessarily conservative modeling approach required to address the complex form of the 1-hour NO_2 standard, actual increases of 1-hour NO_2 concentrations would likely be much lower than the modeled 8.6 percent and actual total concentrations would likely not exceed the NAAQS. Furthermore, concentration increases would likely be limited to smaller areas than those shown in **Figure F-4**. Overall, air quality in the No Action and Build Alternatives is likely to be very similar. Considering all of the above, the low probability of NAAQS exceedance, the small potential increase as compared with the No Action Alternative, and the limited area potentially affected, these conditions would not represent a significant adverse impact on air quality.

G. CONSTRUCTION PERIOD EMISSIONS ESTIMATES

Most construction work would not require a general conformity evaluation, since construction activity in general is included in the SIP estimates, based on past activity levels and assumptions regarding growth in future years. Generally, construction emissions are considered to be included in the SIP if they would have reasonably been anticipated as part of normal construction and growth in the construction industry in the area. However, since the Proposed Project may have been beyond the scope of what was anticipated during SIP preparation, emissions are conservatively analyzed as additional for the purposes of conformity.

As a conservative estimate, the analysis below assumes that the emissions intensity per expenditure (tons per dollar) for the Proposed Project would be similar to the average intensity of the construction sector in the region. While it is possible that the intensity of the Proposed Project may be different given its unique nature including infrastructure and on-water work, this is accounted for qualitatively in the discussion below.

Construction expenditure data is available from the U.S. Census Bureau's 2007 Survey of Business Owners.[22] Since the expenditure data represent firms by their location and not necessarily the location where construction takes place, applying this data at the county level may affect the results in some cases. As a broader estimate, we have used emissions and expenditure for the entire Baltimore NAA. Total construction expenditure in 2007 in the Baltimore NAA was approximately 17.9 billion dollars.

Total nonroad construction engine emissions in the Baltimore NAA for the year 2008 were obtained from the Baltimore NAA emission inventories.[23,24,25] The area wide emissions were estimated at 5,197 tpy of NO_x, 727 tpy VOC, and 447 tpy of direct $PM_{2.5}$.

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[22] U.S. Census Bureau. *2007 Survey of Business Owners*, Statistics for All U.S. Firms by Industry, Gender, Ethnicity, and Race for the U.S., States, Metro Areas, Counties, and Places: 2007; SB0700CSA01.

[23] Maryland Department of the Environment. *Baltimore Serious Nonattainment Area 0.08 ppm 8-Hour Ozone State Implementation Plan*, Apx. F6. June 17, 2013.

[24] Maryland Department of the Environment. *Baltimore Nonattainment Area $PM_{2.5}$ State Implementation Plan and Base Year Inventory*, Apx. A-6. March 24, 2008

The total maximum annual emissions from the Proposed Project construction were estimated to be equivalent to the fraction of region wide emissions based on the relative construction expenditure, calculated as follows:

$$\textit{Proposed Project Annual Emissions} = \textit{NAA Annual Emissions} \times \frac{\textit{Proposed Project Annual Expenditure}}{\textit{NAA Annual Expenditure}}$$

The maximum annual Proposed Project construction expenditure is estimated at $105.15 million in the Baltimore NAA, and $103.15 million in the MD portion of the Philadelphia-Wilmington-Atlantic City NAA. The Proposed Project's construction emissions would be approximately 31 tpy of NO_x, 4 tpy of VOC, and 3 tpy of $PM_{2.5}$ in each of the adjacent non-attainment and maintenance areas (the expenditure is nearly equal in the two areas). Note that this estimate does not include engine advances introduced since 2007 which would substantially reduce PM and NO_x emissions, or specific requirements of the Proposed Project for emissions controls.

The emissions would be substantially lower than the *de minimis* levels defined in the general conformity regulations. Therefore, the construction of the Proposed Project would not substantially impact region-wide pollutant concentrations, would not interfere with the SIP for region–wide attainment of the ozone NAAQS or maintenance of the $PM_{2.5}$ NAAQS, and would not require a conformity determination.

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[25] NO_x and $PM_{2.5}$ annual emissions in 2008 were available in the $PM_{2.5}$ SIP inventory. VOC estimates were estimated from the 2008 daily emission rate available in the ozone SIP, multiplied by the ratio of annual to daily VOC emissions from the 2002 baseline inventory.

Susquehanna River Rail Bridge Project
General Noise Assessment Results

				Existing		Alternative											
Alternative	Resceptor Site	Distance to Receptor	Noise Metric	Measured	Total Railroad Noise Component	Freight & MARC	Intercity Corridor (Northeast Regional and Long Distance)	Acela	Intercity Express (High-Speed Rail)	Metropolitan	Cumulative Rail Noise	Project Noise Exposure	Total Noise Level	Incremental Noise Level Change	Moderate Impact Threshold	Severe Impact Threshold	Impact?
Existing	1	388	2	67.4	60.2	59.4	51.3	46.2	n/a	n/a	60.2	n/a	n/a	n/a	62.5	67.7	n/a
	2	820	2	60.5	51.3	50.6	42.0	36.9	n/a	n/a	51.3	n/a	n/a	n/a	58.1	63.7	n/a
	3	746	2	67.8	60.1	56.9	56.1	51.0	n/a	n/a	60.1	n/a	n/a	n/a	62.7	68.0	n/a
	4	529	2	57.8	57.5	53.3	54.3	49.2	n/a	n/a	57.5	n/a	n/a	n/a	56.6	62.3	n/a
	5	728	2	65.0	53.8	52.3	47.2	42.2	n/a	n/a	53.8	n/a	n/a	n/a	60.8	66.2	n/a
	6	328	2	66.8	60.6	56.4	57.3	52.3	n/a	n/a	60.6	n/a	n/a	n/a	62.0	67.3	n/a
	7	718	2	52.6	48.9	47.2	42.8	37.8	n/a	n/a	48.9	n/a	n/a	n/a	54.3	60.3	n/a
	8	281	3	63.5	64.5	56.7	62.8	56.4	n/a	n/a	64.5	n/a	n/a	n/a	64.9	70.3	n/a
	9	264	2	68.8	60.9	59.7	53.7	48.7	n/a	n/a	60.9	n/a	n/a	n/a	63.5	68.7	n/a
	10	406	2	53.8	56.4	52.4	53.0	47.9	n/a	n/a	56.4	n/a	n/a	n/a	54.8	60.7	n/a
	11	782	2	62.4	55.8	52.6	51.8	46.7	n/a	n/a	55.8	n/a	n/a	n/a	59.2	64.7	n/a
	12	350	2	59.0	57.3	53.4	53.9	48.9	n/a	n/a	57.3	n/a	n/a	n/a	57.2	62.9	n/a
No Action	1	388	2	67.4	60.2	59.8	51.8	n/a	49.9	n/a	60.8	51.6	67.5	0.1	62.5	67.7	No Impact
	2	820	2	60.5	51.3	51.2	42.5	n/a	40.6	n/a	52.1	44.0	60.6	0.1	58.1	63.7	No Impact
	3	746	2	67.8	60.1	57.4	56.6	n/a	54.7	n/a	61.1	54.4	68.0	0.2	62.7	68.0	No Impact
	4	529	2	57.8	57.5	55.2	54.9	n/a	52.9	n/a	59.2	54.3	59.4	1.6	56.6	62.3	No Impact
	5	728	2	65.0	53.8	52.8	47.8	n/a	45.9	n/a	54.6	47.1	65.1	0.1	60.8	66.2	No Impact
	6	328	2	66.8	60.6	58.3	57.9	n/a	56.0	n/a	62.3	57.4	67.3	0.5	62.0	67.3	No Impact
	7	718	2	52.6	48.9	47.6	43.4	n/a	41.5	n/a	49.7	42.2	53.0	0.4	54.3	60.3	No Impact
	8	281	3	63.5	64.5	57.4	61.0	n/a	62.3	n/a	65.4	58.4	64.7	1.2	64.9	70.3	No Impact
	9	264	2	68.8	60.9	60.1	54.3	n/a	52.4	n/a	61.7	53.7	68.9	0.1	63.5	68.7	No Impact
	10	406	2	53.8	56.4	52.8	53.6	n/a	51.6	n/a	57.5	51.2	55.7	1.9	54.8	60.7	No Impact
	11	782	2	62.4	55.8	53.1	52.3	n/a	50.4	n/a	56.8	50.1	62.6	0.2	59.2	64.7	No Impact
	12	350	2	59.0	57.3	53.8	54.5	n/a	52.6	n/a	58.5	52.2	59.8	0.8	57.2	62.9	No Impact

Susquehanna River Rail Bridge Project
General Noise Assessment Results

Alternative	Resceptor Site	Distance to Receptor	Noise Metric	Existing: Measured	Existing: Total Railroad Noise Component	Alternative: Freight & MARC	Alternative: Intercity Corridor (Northeast Regional and Long Distance)	Alternative: Acela	Alternative: Intercity Express (High-Speed Rail)	Alternative: Metropolitan	Alternative: Cumulative Rail Noise	Alternative: Project Noise Exposure	Alternative: Total Noise Level	Alternative: Incremental Noise Level Change	Moderate Impact Threshold	Severe Impact Threshold	Impact?
Alternative 9A	1	388	2	67.4	60.2	61.4	48.9	n/a	54.9	55.2	63.2	60.2	68.2	0.8	62.5	67.7	No Impact
	2	820	2	60.5	51.3	52.1	39.7	n/a	45.7	46	54.0	50.6	60.9	0.4	58.1	63.7	No Impact
	3	746	2	67.8	60.1	59.2	53.8	n/a	59.8	60.1	64.8	63.1	69.1	1.3	62.7	68.0	Moderate Impact
	4	529	2	57.8	57.5	56.0	52.1	n/a	58.1	58.4	62.8	61.2	62.9	5.1	56.6	62.3	Moderate Impact
	5	728	2	65.0	53.8	54.4	45.1	n/a	51.2	51.4	57.6	55.3	65.4	0.4	60.8	66.2	No Impact
	6	328	2	66.8	60.6	59.1	55.2	n/a	61.2	58.7	65.1	63.1	68.4	1.6	62.0	67.3	Moderate Impact
	7	718	2	52.6	48.9	49.0	40.8	n/a	46.8	44.3	52.2	49.5	54.3	1.7	54.3	60.3	No Impact
	8	281	3	63.5	64.5	57.6	60.9	n/a	67.6	64.8	70.2	68.9	70.0	6.5	64.9	70.3	Moderate Impact
	9	264	2	68.8	60.9	62.4	51.2	n/a	57.2	54.7	64.3	61.6	69.5	0.7	63.5	68.7	No Impact
	10	406	2	53.8	56.4	54.4	50.8	n/a	56.8	54.3	60.6	58.5	59.8	6.0	54.8	60.7	Moderate Impact
	11	782	2	62.4	55.8	54.8	49.2	n/a	55.2	52.7	59.6	57.2	63.5	1.1	59.2	64.7	No Impact
	12	350	2	59.0	57.3	55.4	51.8	n/a	57.8	55.3	61.6	59.5	62.3	3.3	57.2	62.9	Moderate Impact
Alternative 9B	1	388	2	67.4	60.2	61.4	48.9	n/a	54.9	55.2	63.2	60.2	68.2	0.8	62.5	67.7	No Impact
	2	820	2	60.5	51.3	52.1	39.7	n/a	45.7	46	54.0	50.6	60.9	0.4	58.1	63.7	No Impact
	3	746	2	67.8	60.1	59.2	53.8	n/a	59.8	60.1	64.8	63.1	69.1	1.3	62.7	68.0	Moderate Impact
	4	529	2	57.8	57.5	56.0	52.1	n/a	58.1	58.4	62.8	61.2	62.9	5.1	56.6	62.3	Moderate Impact
	5	728	2	65.0	53.8	54.4	45.1	n/a	51.2	51.4	57.6	55.3	65.4	0.4	60.8	66.2	No Impact
	6	328	2	66.8	60.6	59.1	55.2	n/a	61.2	58.7	65.1	63.1	68.4	1.6	62.0	67.3	Moderate Impact
	7	718	2	52.6	48.9	49.0	40.7	n/a	46.7	44.2	52.1	49.4	54.3	1.7	54.3	60.3	No Impact
	8	281	3	63.5	64.5	57.6	60.8	n/a	67.5	64.7	70.2	68.8	69.9	6.4	64.9	70.3	Moderate Impact
	9	264	2	68.8	60.9	61.1	51.4	n/a	57.4	54.5	63.5	60.1	69.3	0.5	63.5	68.7	No Impact
	10	406	2	53.8	56.4	54.4	50.8	n/a	56.8	54.3	60.6	58.5	59.8	6.0	54.8	60.7	Moderate Impact
	11	782	2	62.4	55.8	54.8	49.4	n/a	55.4	53	59.7	57.4	63.6	1.2	59.2	64.7	No Impact
	12	350	2	59.0	57.3	55.4	51.8	n/a	57.8	55.3	61.6	59.5	62.3	3.3	57.2	62.9	Moderate Impact

Susquehanna River Rail Bridge Project
General Vibration Assessment Results

	FTA/FRA Land Use Category	Ground-Borne Vibration Impact Assessment					Ground-Borne Noise Impact		
		FTA/FRA Criteria (VdB)	Predicted Vibration Level (VdB)	Impact?	Exceed Impact Threshold in dBA	Drop-off Distance (Feet)	FTA/FRA Impact Criteria (dBA)	Predicted Noise Level (dBA)	Impact?
Exisitng	2	72	68	No Impact	0.0	0	35	33	No Impact
No Build	2	72	69	No Impact	0.0	0	35	34	No Impact
Build	2	72	72	No Impact	0.5	56	35	37	Impact