# Appendix D

## Emissions Inventory Documentation

## Contents

## 1.0 Introduction & Overview

This document contains a detailed explanation of the attainment year and maintenance year emissions inventories for stationary, nonpoint, quasi-point, nonroad, and onroad anthropogenic sources in Maryland. Anthropogenic emissions are estimated for Nitrogen Oxide (NOx) and Volatile Organic Compounds (VOC) for a typical ozone season day.

The attainment inventory consists of the actual emissions for the year during the three-year period associated with the monitoring data showing attainment of the ozone National Ambient Air Quality Standard (NAAQS). In this case, the year is 2023. The 2023 inventory is appropriate to use because it represents the typical inventory for the three-year period demonstrating attainment of the standard and because 2023 was a triennial national emissions inventory (NEI) year.[1]

The maintenance inventory consists of attainment inventory emissions projected for the 10-year period following approval of a redesignation request and maintenance plan. In this case, the 2023 attainment inventory is projected to 2038, and an interim year of 2032.[2]

The attainment and maintenance inventories are consistent with Environmental Protection Agency (EPA) guidance, is based on daily emissions of NOx and VOCs[3], and contains a list of sources and emissions in ozone season tons per day (tpd). For this effort, average daily metrics for the weekdays in July were included as inputs to calculate onroad and nonroad daily emissions. For all other sectors daily emissions were estimated based on available data for each sector and standard inventory practices.

## 2.0 Point Sources

### 2.1 Source Description and Emissions

Point sources are emissions sources located at a fixed, stationary location. Point sources include power plants, industrial facilities and smaller industrial, non-industrial and commercial facilities. The emissions potential for each facility determines whether that facility should be reported as a point source, according to emissions thresholds set in the Air Emissions Reporting Rule (AERR).[4] In Maryland, a point source located within a designated ozone nonattainment area is defined as a stationary commercial or industrial facility that operates and emits more than 25 tons per year of VOCs or 25 tons per year or more of NOx.[5] Detailed 2023, 2032 and 2038 emission estimates are provided in Appendices A through C.

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[1] For a limited number of emissions source sectors, a 2022 emissions inventory developed by EPA for ozone photochemical modeling (2022v1) was used as 2023 NEI data was not available at the time of submission.

[2] Per 40 CFR part 93, a MVEB must be established for the last year of the maintenance plan. However, a State may adopt MVEBs for other years as well. If the maintenance plan does not establish MVEBs for any years other than the last year of the maintenance plan, the demonstration of consistency with the motor vehicle emissions budget(s) must be accompanied by a qualitative finding that there are no factors which would cause or contribute to a new violation or exacerbate an existing violation in the years before the last year of the maintenance plan. This maintenance plan establishes MVEBs for NOx and VOC for 2023 the attainment year, 2032 the interim year, and 2038 the last year of the maintenance plan.

[3] 40 CFR 51.900(v)

[4] 40 CFR Part 51 Subpart A

[5] Maryland maintains the lowest reporting threshold associated with its highest ozone classification. For the 1979 1-hour ozone standard, the Baltimore area was classified as a “severe” nonattainment area. Therefore, the reporting threshold for all nonattainment areas is the severe threshold of 25 tons per year of NOx or VOC.

## 2.2 2023 Facility Emissions Reporting and Verification

The Maryland Department of the Environment (MDE or Department) maintains a substantial database of point sources. These facilities contain a wide variety of air emission sources and processes such as fuel combustion, on-site heat and power generation, materials handling, and equipment maintenance. For each particular facility, the emissions from the individual sources and processes are totaled under the single facility.

Several methods of source identification are used to ensure that the identification of point sources is complete. The primary data source is MDE's Air Quality Permits Program, which oversees the registration requirements in Code of Maryland Regulations (COMAR) Title 26, Subtitle 11, Chapter 02. As a secondary means, the Air Quality Compliance Program identifies other point sources through annual facility inspections and investigations conducted in response to citizen complaints. The primary means of new source identification are permit applications and equipment registrations. Most sources are not considered to be point sources for inventory purposes; even though they require permits, their emissions are lower than the threshold. However, all sources that are registered with MDE are tracked until the Department receives notification that the emission source has ceased operations.

Facilities are required by COMAR 26.11.01.05-1 and 26.11.02.19D to certify their emissions from the past calendar year. The certified emissions are used for inventory and planning purposes as well as to form a basis for billing Permit-to-Operate fees. The emissions certification must be submitted to MDE annually by April 1st.

Major source facilities certify that the emission estimates that are submitted to the Department are accurate to the best of their knowledge. Facilities typically use one of the following methodologies to calculate emissions:

- Continuous emissions monitoring data
- EPA-supplied emission factors
- Material balances
- Emissions based on source test data
- Agency or company-generated emission factors

After receiving the emission certification reports for major sources MDE reviews the reports for completeness and correctness. Of particular importance are the estimate of emissions and the documentation of calculations. Any errors in calculation will be corrected before data is entered into the state data system.

After verifying the accuracy of the emission estimates and methodology, the results are then entered into MDE's Environmental Tracking System (ETS), a database to manage air quality data, emissions inventories and regulatory compliance.

## 2.3 2023 Emissions Projected to 2032 and 2038

Point source emissions are projected to future years using data from the Maryland Department of Labor, Licensing and Regulation (DLLR), Maryland Industry Projections.[6] The industry projection data from the DLLR was correlated to standard North American Industry Classification System (NAICS) industry employment codes. The calculated growth per NAICS industry employment code is used as the growth surrogate for each major source. MDE does not allow for negative NAICS growth surrogates (less than one) for a State Implementation Plan (SIP) inventory. Therefore, all growth surrogates calculated to be

[6] Maryland Department of Labor. *Maryland Industry Projections 2023-2033 – Workforce Information and Performance.* http://www.dllr.state.md.us/lmi/iandoproj/industry.s).

less than one are defaulted to a growth surrogate of one indicating no growth for the facility. Growth surrogates and future year emissions are provided in Appendices B and C.

### 2.4 Emissions Reduction Credits

Emission Reduction Credits (ERCs) are created when certain operating facilities shut down or voluntarily curtail their emissions. In general, and as part of the permitting process, certain new or expanding facilities must obtain ERCs to offset the new or increased emissions prior to constructing or modifying the air pollution sources at the facility. Thus, ERCs created by the shut down or voluntary curtailment of one facility can be sold to another new or expanding facility. Regulations governing ERCs in Maryland are at COMAR 26.11.17.[7] ERC's are provided in Appendices B and C.

### 2.5 Emissions Post-Processing for SIPs

Major source facilities certify, and MDE verifies, annual emissions. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[8] Annual emissions are converted to ozone season day emissions by dividing the annual emissions by the reported operating days.

## 3.0 Nonpoint Sources

### 3.1 Source Description and Emissions

Nonpoint Sources include emissions estimates for sources which individually are too small in magnitude to report as point sources. These emissions sources are included in the inventory as a county total. Examples include residential heating, commercial combustion, asphalt paving, and commercial and consumer solvent usage. Detailed emission estimates are provided in Appendices A through C.

### 3.2 2023 Emissions Estimation Methods

MDE estimates most nonpoint emissions using activity (ex. gallons of fuel sold for gasoline refueling activities) and emissions factors. Where appropriate, emissions are adjusted for state and federal regulations. For a limited number of nonpoint categories, mostly associated with fuel combustion, further adjustments are made to the activity to account for activity associated with point sources; this is to limit the potential for double counting of emissions. For a select subset of nonpoint sources, MDE accepts emissions estimates from EPA. All nonpoint emissions are estimated at the county-level.

Nonpoint emissions are estimated, generally, using the following formula:

$$E = Act \; x \; EF \; x \; [1 - RE \; x \; RP \; x \; CE]$$

Where:

| | | |
|---|---|---|
| $E$ | = | Total emissions, in tons per year |
| $Act$ | = | Activity for source category |
| $EF$ | = | Emission factor for source category |
| $RE$ | = | Rule effectiveness for source category |
| $RP$ | = | Rule penetration for source category |
| $CE$ | = | Control efficiency for source category |

Specific details for each calculation method are provided in Appendix F.

[7] Maryland Department of the Environment Air Quality Permits Program. Emission Reduction Credits. https://mde.maryland.gov/programs/permits/airmanagementpermits/pages/erc.aspx

[8] 40 CFR 51.900(v)

### 3.3 2023 Emissions Projected to 2032 and 2038

Nonpoint emissions are projected to future years using data from the Baltimore Metropolitan Council's *Round 10 Cooperative Forecast.*[9] The Round 10 forecast includes population (POP), housing (HSE), and employment (EMP) forecasts by jurisdiction for the 2020-2050 period. For a select number of sources, emissions are projected to future years using gasoline sales projections from MDE's Mobile Sources Division's Periodic Emissions Inventory.

Nonpoint source surrogate growth factors for 2024 to 2038 were calculated using 2020, 2025, 2030, 2035, and 2040 population, household, and employment data. Linear interpolation was used to establish activity data for 2032 and 2038. Dividing the *Round 10* population, household, and employment forecasts by the base year 2023 values for the region produced the growth factors for the periods of 2024 to 2038. Growth surrogates are provided in Appendices B and C.

### 3.4 Emissions Post-Processing for SIPs

Both MDE and EPA calculate annual emissions for the nonpoint source categories. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[10]

Annual emissions first adjusted for seasonality. Temporal adjustments are made because of seasonal differences in the rate of emissions or activity. A seasonal adjustment factor (SAF) is based on the quarterly percentage of operations estimated by the company adjusted for June, July, and August:

$$SAF = ActualCoreOS_{act} \div DefaultCoreOS_{act}$$

Where:

| | |
|---|---|
| $SAF$ | = Seasonal Adjustment Factor |
| $ActualCoreOS_{act}$ | = quarterly percentage of operations estimated by the company adjusted for June, July, and August |
| $DefaultCoreOS_{act}$ | = June, July, and August quarter of year (0.25) |

By way of example, if a VOC source category has one third more emissions during the 3-month ozone ratio: seasonal adjustment factor, the ratio of seasonal activity or emissions to average period emissions would equal SAF = 0.33/0.25 = 1.33.

The seasonally adjusted emissions are then converted to ozone season day emissions using the following process:

$$EmisOS_{day} = (Emis_{Ann} \div Operting\ Days) \times SAF$$

Where:

| | |
|---|---|
| $EmisOS_{day}$ | = Ozone season day emissions (tons) |
| $Emis_{Ann}$ | = Annual emissions (tons) |
| $Operating\ Days$ | = June, July, and August quarter of year (0.25) |
| $SAF$ | = Seasonal adjustment factor |

### 4.0 Quasi Point

Quasi Point sources are facilities that due to their size and/or function are considered point sources. However, these facilities or establishments contain a wide variety of air emissions sources including traditional point sources, on-road mobile sources, off-road mobile sources and nonpoint sources. For this

[9] https://baltometro.org/community/planning-areas/demographic-socioeconomic-forecasting/
[10] 40 CFR 51.900(v)

reason, MDE classifies these sources as “quasi point”. Detailed emission estimates are provided in Appendices A through C.

## 4.1 Aberdeen Proving Grounds

### 4.1.1 Source Description and Emissions

The Aberdeen Proving Ground (APG) is a 72,500 acre military installation for the testing of military equipment, laboratory research, and military training in Harford County. The installation comprises two principal areas, separated by the Bush River: the northern Aberdeen Area and the southern Edgewood Area.

Aberdeen Proving Ground is home to over 60 garrison supported activities, 8 satellite activities, and 12 private organizations.[11] APG is recognized as one of the world’s most important research, development, testing and evaluation facilities for military weapons, equipment and material. APG is the Defense Department’s Center for Excellence for (1) Command, Control, Communications, Computers, Intelligence, and Reconnaissance, (2) Chemical and Biological Defense, (3) Research and Development; Test and Evaluation, (4) Public Health, and (5) Personnel Security Investigation.[12]

More than 21,000 military, civilian and contractors work at APG. Approximately 1,700 people reside within the APG census-designated place, which acts as a residential community for military personnel and families. The base population includes over 1,000 military residents and over 1,300 family members.[13]

Environmental stewardship is an essential component of all activity at APG. The installation and its tenants are actively involved in a wide variety of environmental compliance, pollution prevention, conservation, and restoration programs.

### 4.1.2 2023 Emissions Estimation Methods

The point source emissions associated with Aberdeen Proving Ground are submitted annually to the Department and are reviewed as described in Section 2.2.

Emissions estimates for Aberdeen Proving Grounds, that are not addressed in the annual point source submission were provided to MDE by APGs private contractor. This includes:

- Mobile On-Road Source Emissions
    - Mobile - LDGV Emissions
    - Mobile - LDGT 1&2 Emissions
    - Mobile - LDGT 3&4 Emissions
    - Mobile – HDGV
    - Mobile - LDDT 1-4
    - Mobile – HDDV
    - Mobile - HDDV Exhaust
    - Mobile – HDDB
    - Mobile - HD CNG Trucks
    - Mobile - LD CNG Trucks
- Mobile Nonroad Source Emissions
    - 2-Stroke Gas Eng; Lawn & Garden Equip; Other Equipment
    - 4-Stroke Gas Eng; Recreational Equip; Golf Carts
    - 4-Stroke Gas Eng; Recreational Equip; Specialty Vehicles/Carts

[11] U.S. Army. *About Aberdeen Proving Ground – Garrison*. https://home.army.mil/apg/about/Garrison
[12] U.S. Army. *About Aberdeen Proving Ground – History*. https://home.army.mil/apg/about/history
[13] Military OneSource. *Aberdeen Proving Ground*. https://installations.militaryonesource.mil/in-depth-overview/aberdeen-proving-ground

    - 4-Stroke Gas Eng; Construction & Mining Equip; Off-Highway Trucks
    - 4-Stroke Gas Eng; Industrial Equip; Forklifts
    - 4-Stroke Gas Eng; Lawn & Garden Equip; Chain Saws
    - 4-Stroke Gas Eng; Lawn & Garden Equip; Leaf blowers/Vacuums
    - 4-Stroke Gas Eng; Lawn & Garden Equip; Rear Eng Riding Mowers
    - 4-Stroke Gas Eng; Lawn & Garden Equip; Front Mowers
    - 4-Stroke Gas Eng; Lawn & Garden Equip; Other Lawn & Garden Equip
    - 4-Stroke Gas Eng; Commercial Equip; Generator Sets
    - LPG Eng; Construction & Mining Equip; Off-Highway Trucks
    - Diesel Eng; Construction & Mining Equip; Rollers
    - Diesel Eng; Construction & Mining Equip; Cranes
    - Diesel Eng; Construction & Mining Equip; Graders
    - Diesel Eng; Construction & Mining Equip; Off-highway Trucks
    - Diesel Eng; Construction & Mining Equip; Tractors/Loaders/Backhoes
    - Diesel Eng; Construction & Mining Equip; Other Construction Equip
    - Diesel Eng; Industrial Equip; Forklifts o Diesel Eng; Industrial Equip; Sweepers/Scrubbers
    - Diesel Eng; Lawn & Garden Equip; Front Mowers
    - Diesel Eng; Agricultural Equip; Agricultural Tractors
    - Diesel Eng; Commercial Equip; Generator Sets
    - Recreational marine 4-stroke gasoline equipment
    - Recreational marine diesel compression ignition equipment
    - Aircraft
- Area Source Emissions
    - Emissions from aircraft refueling
    - Construction Welding
    - Solvent-based architectural surface coatings
    - Water-based architectural surface coatings
    - Cold cleaning solvents
    - Solvent Utilization – Miscellaneous
    - Commercial/consumer solvents
    - Open Burning Detonation
    - Landfills - All Categories
    - Munitions Detonation
    - Firefighting Training
    - Industrial Process – Miscellaneous
    - Commercial/institutional distillate oil combustion
    - Commercial/institutional natural gas combustion.

MDE reviewed the emissions estimates and finds them to be reasonable. APG's contractor report is included in Appendix F.

### 4.1.3 2023 Emissions Projected to 2032 and 2038

The Aberdeen Proving Grounds emissions were projected to 2032 and 2038 using population. Per APG's 2023 emissions inventory submission, emissions will be generally proportional to APG population, and the population is expected to remain consistent. APG obtained population data for 2020-2026 from the installation's Directorate of Public Works Master Planning. MDE estimated the 2027-2038 population using APG's 2020-2026 data and the TREND function in Microsoft Excel. Growth factors were estimated by dividing the future population by the 2023 population. Growth surrogates are provided in Appendices B and C.

### 4.1.4 Emissions Post-Processing for SIPs

Aberdeen Proving Grounds contractor calculates annual emissions for the on-site sources. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[14] Annual emissions are converted to ozone season day emissions using the following process:

- For point source emissions data reported to MDE, the annual emissions were divided by the operations day.
- For all other emissions reported by APG's contractor, MDE assumed activity is year-round, and therefore divided annual emissions by 365 days/year.

## 4.2 Baltimore/Washington International Thurgood Marshall Airport

### 4.2.1 Source Description and Emissions

Baltimore-Washington International Airport (BWI) is located in Anne Arundel County. BWI Airport is generally bounded on the north, east, and west by Aviation Boulevard (MD Route 170 and MD Route 162) and on the south by Dorsey Road (MD Route 176). Interstate 195 (I-195) is a four-lane divided highway that serves as the primary access point to the airport terminal area. Elm Road and Aviation Boulevard provide secondary access to the terminal and cargo facilities.

Occupying 3,596 acres, the facility is owned by the Maryland Department of Transportation (MDOT) and operated by the Maryland Aviation Administration (MAA). Air carriers using the facility include 36 commercial, commuter, charter, and cargo airlines engaged in an average of 608 flight operations daily. An average of over 60,000 passengers per day are served by a single terminal building with 1 international and 4 domestic concourses, comprising 2.4 million square feet. There are three primary air cargo facility areas at BWI: North Cargo Complex, Elm Road Cargo Complex, and the Midfield Cargo Facility. These cargo areas combined contain approximately 395,000 square feet of building space on 100 acres of cargo related land uses at the Airport.[15]

Inter-modal transportation services at the site include multiple parking facilities with associated shuttle buses, an AMTRAK station, and Light-Rail stops. Significant stationary sources of air pollution at BWI include fossil fuel-fired boilers at the Central Utility Plant, smaller boilers located in the Terminal Building, standby electric generators, fuel storage, and training fires.[16]

BWI reduces its environmental impact through a variety of carbon-free programs. Nearly 50% of BWI's energy portfolio comes from carbon-free sources including a 500kW solar panel array. The availability of

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[14] 40 CFR 51.900(v)

[15] Maryland Department of Transportation. *BWI Marshall Airport Facts & Figures*. https://bwiairport.com/flying-with-us/about-bwi/facts-figures/

[16] Part 70 Operating Permit. https://mde.maryland.gov/programs/permits/AirManagementPermits/Test/BWI2024IssuedT5PermitandFactSheet.pdf

multiple public transportation options reduces emissions from cars and trucks. Also, 27 electric vehicle (EV) charters are installed at airport facilities.[17]

### 4.2.2 2023 Emissions Estimation Methods

The point source emissions associated with BWI are submitted annually to the Department and are reviewed as described in Section 2.2.

Emissions estimates for BWI, that are not addressed in the annual point source submission were provided to MDE by APGs private contractor. This includes:

- Mobile Nonroad Source Emissions
    - Emissions from aircraft ground support equipment
    - Emissions from military aircraft Landing and Take-Offs (LTOs)
    - Emissions from commercial aircraft LTOs
    - Emissions from general aviation aircraft LTOs
    - Emissions from aircraft auxiliary power units
- Mobile Onroad Source Emissions
    - Mobile - LDGV Emissions
    - Firefighting Training

MDE reviewed the emissions estimates and finds them to be reasonable. BWI's contractor report is included in Appendix F.

### 4.2.3 2023 Emissions Projected to 2032 and 2038

Emissions for BWI were projected to 2032 and 2038 using The Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) report.[18] The report provided the BWI operations data for fiscal year 2023 to 2038. Growth factors were estimated by dividing the future operations by the 2023 operations. Growth surrogates are provided in Appendices B and C.

### 4.2.4 Emissions Post-Processing for SIPs

Emissions for BWI are calculated on an annual basis. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[19] MDE assumes activity is year-round, and therefore divided annual emissions by 365 days/year.

## 4.3 Port of Baltimore

### 4.3.1 Source Description and Emissions

The Port of Baltimore is a dynamic network of terminals, companies, and infrastructure stretching across the Chesapeake region. The Maryland Port Authority (MPA) plays a central role, working alongside private partners and sister agencies to keep operations running smoothly. MPA operates six marine terminals, which includes Cruise Maryland, facilitating the movement of goods and passengers.[20]

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[17] Maryland Department of Transportation. *BWI Environmental Sustainability*. https://bwiairport.com/at-bwi/destination-thriving-communities/our-environment/

[18] Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) report. https://taf.faa.gov/

[19] 40 CFR 51.900(v)

[20] Maryland Port Administration. *2024 Sustainability Report*. https://mpa.maryland.gov/greenport/Documents/MPASustainabilityReportFINAL07232025.pdf

The Port of Baltimore is a 50-foot deep-water port located on the Chesapeake Bay and consists of State-owned marine terminals that are owned and leased by the Maryland Port Administration (MPA) as well as private marine terminals.[21]

The State-owned marine terminals include Seagirt Marine Terminal, Dundalk Marine Terminal, South Locust Point Marine Terminal, North Locust Point Marine Terminal, Hawkins Point and the Masonville/Fairfield Terminal area. These terminals handle general cargo commodities including containerized cargo, automobiles and other roll-on/roll-off cargo, forest products and other breakbulk cargoes, such as iron and steel and palletized cargo. A variety of bulk commodities are handled at MPA's Hawkins Point and North Locust Point Marine Terminals.[22]

The private marine terminals include Curtis Bay Coal and Ore Pier, Consolidation Coal Pier, Chesapeake Terminal, Atlantic Terminal, Rukert Terminals Corporation, Trade Point Atlantic and Canton Marine Terminal in addition to several others. Most of the private terminals handle bulk cargoes, steel and metals, and a small amount of containerized cargo and breakbulk cargo including steel, pulp and miscellaneous cargo, while Chesapeake and Atlantic Terminals handle automobiles. In addition, new automobile import operations have been developed at Trade Point Atlantic.[23]

In addition to the activity handled at the State-owned and private marine terminals at the Port of Baltimore, the Maryland Port Administration has developed a successful cruise business since the opening of the Cruise Maryland Terminal in 2006. The Port is currently served by three of the world's top cruise lines: Carnival, Royal Caribbean and Norwegian Cruise Lines. These lines provide service to such destinations as Bermuda, the Bahamas and the Caribbean Islands.[24]

The Port of Baltimore engages in a wide variety of actions to reduce its environmental impact. The Port is transitioning to zero-emission equipment, including electric cranes, forklifts, and dray trucks through the EPA's Clean Ports Program. The Dollars for Drays program assists truck owners with replacing older, high-emission vehicles with cleaner models. The port is also installing solar panels and upgrading to more efficient HVAC and lighting systems.[25]

### 4.3.2 2023 Emissions Estimation Methods

The point source emissions associated with the Port of Baltimore are submitted annually to the Department and are reviewed as described in Section 2.2.

The point marine vessel emissions associated with the Port of Baltimore are adopted from EPA as described in Section 7.

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[21] Maryland Department to Transportation. *THE 2023 ECONOMIC IMPACT OF THE PORT OF BALTIMORE IN MARYLAND*.
https://mpa.maryland.gov/Documents/2023EconomicImpactofthePoBinMarylandfullreport06212024ADA31526.pdf
[22] Maryland Department to Transportation. *THE 2023 ECONOMIC IMPACT OF THE PORT OF BALTIMORE IN MARYLAND*.
https://mpa.maryland.gov/Documents/2023EconomicImpactofthePoBinMarylandfullreport06212024ADA31526.pdf
[23] Maryland Department to Transportation. *THE 2023 ECONOMIC IMPACT OF THE PORT OF BALTIMORE IN MARYLAND*.
https://mpa.maryland.gov/Documents/2023EconomicImpactofthePoBinMarylandfullreport06212024ADA31526.pdf
[24] Maryland Department to Transportation. *THE 2023 ECONOMIC IMPACT OF THE PORT OF BALTIMORE IN MARYLAND*.
https://mpa.maryland.gov/Documents/2023EconomicImpactofthePoBinMarylandfullreport06212024ADA31526.pdf
[25] Maryland Port Administration. *2024 Sustainability Report*.
https://mpa.maryland.gov/greenport/Documents/MPASustainabilityReportFINAL07232025.pdf

### 4.3.3 2023 Emissions Projected to 2032 and 2038

Port of Baltimore 2032 and 2038 emissions were projected to 2032 and 2038 using the Maryland Port Administration's *Port of Baltimore Strategic Plan 2019.*[26] MDE utilized the strategic plan's goal of greater 3% container volume growth per year to estimate future emissions.

### 4.3.4 Emissions Post-Processing for SIPs

Emissions for the Port of Baltimore are calculated on an annual basis. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[27] MDE assumes activity is year-round, and therefore divided annual emissions by 365 days/year.

## 5.0 On-Road Mobile

### 5.1 Source Description and Emissions

On-Road sources include emissions from onroad vehicles that use gasoline, diesel, and other fuels. These sources include light duty and heavy duty vehicle emissions from operation on roads, highway ramps, and during idling. Detailed emission estimates are provided in Appendices A through C.

### 5.2 2023 Emissions Estimation Methods

The US EPA's MOtor Vehicle Emission Simulator (MOVES) model estimates onroad source emissions based on model inputs provided by State, Local, and Tribal air agencies. The MOVES model also computes refueling emissions, which are included in the Nonpoint Data Category.

In the modeling process, the user specifies vehicle types, time periods, geographical areas, pollutants, vehicle operating characteristics, and road types to be modeled. The model then performs a series of calculations, which have been carefully developed to accurately reflect vehicle operating processes (such as cold start or extended idle) and provide estimates of bulk emissions or emission rates. Emissions can be calculated in "inventory mode" which gives total emissions, or "rate mode" which gives emissions in grams per mile or grams per vehicle hour, which are often used as inputs for more complex air quality simulations.

MOVES accounts for control programs by adjusting its internal emission rates and fleet data based on the specific regulatory standards and localized programs active during the modeled year. MOVES automatically incorporates finalized federal emissions standards as they phase in overtime. Users can input localized Inspection and Maintenance (I/M) program data to model the benefits of mandatory vehicle testing. The model accounts for changes in fuel properties resulting from regulatory requirements, such as seasonal fuel requirements. MOVES can simulate the impact of Stage II vehicle refueling controls, which are designed to capture vapors during the pumping process. The model inherently simulates "fleet turnover", where older, higher-emitting vehicles are gradually replaced by newer vehicles that comply with the more stringent control programs.

MOVES calculates onroad emissions using complex multi-variable algorithms based on vehicle type, fuel, age, activity, driving behavior, fuel types, temperatures, local conditions, and regulatory requirements. The core calculation follows a standard formula:

$$E = Act \; x \; EF \; x \; Adj$$

Where:

$E$ = Total emissions
$Act$ = Activity, including vehicle miles traveled, population, vehicle age, operating hours

[26] Maryland Port Administration. *Port of Baltimore Strategic Plan 2019.* https://mpa.maryland.gov/Documents/Strategic__Plan2019.pdf
[27] 40 CFR 51.900(v)

*EF* = Emission factor, in grams per hour or grams per mile traveled
*Adj* = Adjustment factor, including temperature, humidity, air conditioning, I/M programs, electric vehicle (EV) charging and battery efficiency, and fleet averaging

For the purpose of this inventory, MDE utilized emissions estimated by the MOVES5 model. MOVES5 was released in December 2024 and is the current version of EPA's modeling tool with the most recent and up-to-date data on vehicle populations, travel activity, emissions rates, fuel data, and regulations.[28] A mix of local data and national default (internal to MOVES) is utilized to estimate emissions. Local inputs reflect the latest available data from MDE, the Motor Vehicle Administration (MVA), the Maryland State Highway Administration (SHA) and the Baltimore Metropolitan Council (BMC).

For detailed documentation on the function of MOVES5 for onroad mobile sources, see documentation on EPA's MOVES5 site.[29]

MDE utilized the MOVES5 model to estimate 2023 emissions. The computation of highway vehicle emissions requires two primary datasets: (1) vehicle emission factors and (2) vehicle activity. Vehicle emission factors are generated by MOVES5, and vehicle miles traveled (VMT) is derived from SHA vehicle counts and BMC data. Custom post-processing software (PPSUITE) is used to calculate hourly speeds and prepare key traffic inputs.

A large number of inputs to MOVES are needed to fully account for the numerous vehicle and environmental parameters that affect emissions. These include traffic flow characteristics, vehicle descriptions, fuel parameters, inspection/maintenance program parameters, and environmental variables. Input files required for MOVES include:

- Roadway Data and VMT
- Month VMT Fractions
- Day VMT Fractions
- Hour VMT Fractions
- Average Speed Distribution
- Road Type Distribution
- Ramp Fraction
- Source Type Population
- Source Type Age Distribution
- Fuel Formulation
- Fuel Supply
- Fuel Usage Fraction
- I/M Programs
- Meteorological Data
- Alterative Vehicle Fuel Technology

MOVES includes a default national database of meteorology, vehicle fleet, vehicle activity, fuel, and emission control program data for every county; but EPA cannot certify that the default data is the most

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[28] U.S. Environmental Protection Agency (EPA). *Official Release of the MOVES5 Motor Vehicle Emissions Model for SIPs and Transportation Conformity.* (89 FR 99862). https://www.federalregister.gov/documents/2024/12/11/2024-29073/official-release-of-the-moves5-motor-vehicle-emissions-model-for-sips-and-transportation-conformity

[29] U.S. EPA. Latest Version of MOtor Vehicle Emission Simulator (MOVES). https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

current or best available information for any specific area. As a result, local data is recommended for use for analyses SIPs. MDE utilized a mix of local and default data for this inventory; local data, as discussed below, is used for all inputs that have a significant impact on emission rates:

- Roadway Data: SHA maintains a database of lanes, distances, volume representing average annual daily traffic, truck percentages, urban/rural classifications and functional class codes. The volumes and distances are used to calculate VMT. The lane values, area type, and functional class are key inputs for determining congestion and speeds for individual highway segments. Truck percentages are used in the speed determination processes and are used to split volumes into individual vehicle types used by MOVES.
- Traffic Volume Growth Rates: Traffic volume projections are needed to support forecasted emission inventories. Historic VMT growth from the Highway Performance Monitoring System (HPMS), travel model forecasts, and other factors are used to develop growth rates, which estimate future year congested speeds.
- Other Traffic Data: Other data is used to adjust and disaggregate traffic volume. This includes using HPMS VMT to adjust baseline VMT, seasonal adjustment factors to correct average daily traffic volume to summer weekday traffic volume, and hourly patterns to adjust traffic volume by hour, given that speeds and emissions may vary considerably depending on the time of day.
- Vehicle Class Data: Emission rates within MOVES vary significantly by vehicle type. MOVES produces emissions and rates by thirteen vehicle source types.[30] However, VMT is input to MOVES by five SHA HPMS vehicle groups.[31] SHA count data was used to develop percentage splits for the following four vehicle groups: auto, heavy truck, motorcycle, bus. From these groups, MOVES default county VMT distributions by source type are used to divide the four groups into the MOVES thirteen source types.
- Vehicle Age: Vehicle age distributions are input to MOVES for each county by the thirteen source types. The distributions reflect the percentage of vehicles in the fleet up to 31 years old. The vehicle age distributions were prepared by MDE based on information obtained from 2020 MVA registration data. The data was subjected to vehicle identification number (VIN) decoding to obtain vehicle information at a finer resolution and then transformed into vehicle age mixes following EPA's guidance.
- Vehicle Population: Vehicle fleet, including the number and age of vehicles, impacts start and evaporative emissions. MOVES requires the population of vehicles by the thirteen source type categories. Maryland county vehicle registration data was used to estimate vehicle population for light-duty vehicles, buses, refuse trucks and motor homes for all counties in the region. The vehicle population for heavy-duty trucks were estimated using county VMT and MOVES default VMT/population ratios for those source types.
- Fuel Data: MDE obtains monthly fuel data reports regularly from the Maryland Fuel Laboratory, which is under the jurisdiction of Maryland Fuel Tax Division of the Office of the Comptroller of Maryland. The 2020 bulk terminal fuel data was compiled, and fuel data parameters were developed separately for all 14 counties required by EPA which use only reformulated gasoline and the remaining counties dispensing conventional gasoline. Three out of four sets of fuel data inputs (Fuel Formulation, Fuel Supply, and Alternate Vehicle and Fuel Technology (AVFT) tables) required by MOVES model were developed by MDE for every county in MD. Sulfur level, ethanol volume, aromatic content, olefin content, benzine content, and percentages of fuel evaporated at 200F and 300F were changed from the MOVES defaults to local fuel data. The

[30] Motorcycle (11); Passenger Car (21); Passenger Truck (31); Light Commercial Truck (32); Intercity Bus (41); Transit Bus (42); School Bus (43); Refuse Truck (51); Single Unit Short Haul Truck (52); Single Unit Long Haul Truck (53); Motor Home (54); Combination Short Haul Truck (61); Combination Long Haul Truck (62).
[31] Motorcycle (10); Light Duty Vehicles (25); Busses (40); Single Unit Trucks (50); Combination Trucks (60).

AVFT tables were developed individually for all MD jurisdictions from the 2020 MVA data; this includes vehicle type, model year, fuel type, engine technology and fuel engine fractions.

- Meteorological Data: Evaporative emissions are influenced significantly by the temperatures of the surrounding air. Meteorological data for MOVES inputs, including hourly average temperature and relative humidity, are compiled on a triennial basis for every county in MD. The data used for this analysis was prepared using the 2020 month by month raw hourly-data sets from the National Climate Data Center of NOAA based on weather data collected at the airport situated closest to the county modeled. Hourly average temps and humidity computations were developed from the 24-hourly values for every day in each month. Since the data source for the six jurisdictions in the Baltimore Area is the BWI Airport, the same set of meteorological data was used for all these constituent city/counties of the Baltimore Area.
- Vehicle Technology and Control Strategy Data: The MOVES default I/M data was reviewed and updated by MDE for all the I/M counties in the state to align with Maryland's current I/M program known as Vehicle Emission Inspection Program (VEIP).

For detailed documentation for Maryland's MOVES5 onroad mobile sources, please refer to Appendix E.

### 5.3 2023 Emissions Projected to 2032 and 2038

MOVES projects onroad emissions by applying growth rates to VMT and implementing control measures to vehicle emission factors. It uses local or regional travel demand model projections for growth, while incorporating new emission standards and inspection/maintenance programs for controls.

Increasingly stringent EPA regulations, higher EV penetration rates, and updated data on vehicle activity, age, and fuel properties generally projects lower emissions in the long term despite VMT growth. For detailed documentation on growth and control functions in MOVES5 for onroad mobile sources, see documentation on EPA's MOVES5 site.[32]

MDE estimated 2032 and 2038 onroad emissions using MOVES5.[33] The model formula/method did not change between the 2023 baseline and the projection years. Maryland did not make any changes to the inputs compared to the 2023 base year. For detailed documentation for Maryland's MOVES5 onroad mobile sources, please refer to Appendix E.

### 5.4 Emissions Post-Processing for SIPs

40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[34] MOVES July weekday emissions were used to represent the typical ozone season day. MOVES outputs average July weekday emissions by county and by SCC. The average July weekday emissions are simply summed to determine the daily emissions for the nonattainment area.

## 6.0 Non-Road Mobile

### 6.1 Source Description and Emissions

Non-road sources include off-road mobile sources such as recreational marine vessels, recreational land-based vehicles, farm and construction machinery, lawn and garden equipment, aircraft ground support equipment (GSE), and rail maintenance equipment. This equipment is powered by diesel, gasoline,

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[32] U.S. EPA. Latest Version of MOtor Vehicle Emission Simulator (MOVES). https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

[33] U.S. Environmental Protection Agency (EPA). *Official Release of the MOVES5 Motor Vehicle Emissions Model for SIPs and Transportation Conformity.* (89 FR 99862). https://www.federalregister.gov/documents/2024/12/11/2024-29073/official-release-of-the-moves5-motor-vehicle-emissions-model-for-sips-and-transportation-conformity

[34] 40 CFR 51.900(v)

compressed natural gas, or liquefied petroleum gas engines. Detailed emission estimates are provided in Appendices A through C.

### 6.2 2023 Emissions Estimation Methods

Emissions for non-road sources are estimated using a module within MOVES, known as MOVES NONROAD. The MOVES nonroad module estimates emissions as the product of an adjusted emission factor multiplied by rated power, load factor, engine population and activity. Estimates of median life at full load, load factors, activity and age distributions are then combined to generate estimates of nonroad emissions by equipment type, fuel type and age. Equipment populations are also allocated to county and season; national equipment populations are allocated to the county level using surrogate data.

MOVES NONROAD also accounts for growth and scrappage rates, predicting how many old machines are retired and replaced by newer, cleaner technology. MOVES tracks the "tier" level of equipment (Tier 1 through Tier 4). It automatically adjusts its estimates based on when stricter federal emission standards were phased in for specific types of machinery.

MOVES calculates nonroad emissions using a formula based on equipment population, activity, power, load, and emission factors, generally expressed as:

$$E = Pop\ x\ Act\ x\ HP\ x\ LF\ x\ EF\ x\ DF$$

Where:

| | | |
|---|---|---|
| $E$ | = | Total exhaust emissions, in tons per year |
| $Pop$ | = | Population, number of equipment units |
| $Act$ | = | Operating hours per year |
| $HP$ | = | Average rated horsepower |
| $LF$ | = | Load factor, average of rated power utilized |
| $EF$ | = | Emission factor, grams per horsepower-hour |
| $DF$ | = | Deterioration factor, accounting for emissions increase as equipment ages |

MDE estimated emissions using NONROAD in MOVES5.[35] The model utilizes EPA nonroad defaults for equipment populations and growth factors and interfaces with MOVES highway defaults for fuel specific parameters and climatological data. Maryland did not make any changes to the default values. The model was run to estimate emissions on average July weekdays in 2023.

### 6.3 2023 Emissions Projected to 2032 and 2038

MOVES NONROAD projects nonroad emissions by calculating future-year inventories based on equipment population growth, age distribution (scrappage rates), and control program impacts. Starting with base-year equipment populations by technology type and model year, the model uses growth factors to estimate the population in the analysis year.

Changes in nonroad engine activity levels over years are the result of complex interactions between human population growth, changes in national and local economic factors, and changes in the markets for nonroad engines and products they produce. Because trends in nonroad engine activity levels are rarely directly measured, MOVES instead starts with base year engine populations and estimates growth in the populations of nonroad engines while applying constant annual activity values for every engine type. The

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[35] U.S. Environmental Protection Agency (EPA). *Official Release of the MOVES5 Motor Vehicle Emissions Model for SIPs and Transportation Conformity.* (89 FR 99862). https://www.federalregister.gov/documents/2024/12/11/2024-29073/official-release-of-the-moves5-motor-vehicle-emissions-model-for-sips-and-transportation-conformity

last significant update to the nonroad engine population growth occurred in MOVES2014b; see that documentation for additional details.[36]

MDE estimated 2032 and 2038 emissions using NONROAD in MOVES5.[37] The model formula/method did not change between the 2023 baseline and the projection years. Maryland did not make any changes to the default values. The model was run to estimate emissions on average July weekdays in 2032, and 2038.

### 6.4 Emissions Post-Processing for SIPs

40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[38] MOVES NONROAD July weekday emissions were used to represent the typical ozone season day. MOVES NONROAD outputs average July weekday emissions by county and by SCC. The average July weekday emissions are simply summed to determine the daily emissions for the nonattainment area.

## 7.0 Marine-Air-Rail

### 7.1 Source Description and Emissions

Marine-Air-Rail (M-A-R) sources include off-road commercial marine vessels, aircraft engines and ground support equipment, and locomotives. Emissions from these off road sources are calculated outside of the NONORAD Model.

Commercial Marine Vessels (CMV) includes all boats and ships used either directly or indirectly for commerce or military activity. These include vessels ranging in size from 20-foot charter boats to the largest tankers and military vessels, which can exceed 1,000 feet in length. The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard. Recreational marine vessel emissions are included in those calculated by the NONROAD model.

Aircraft emissions sources are identified as: commercial aircraft, general aviation, and military aircraft. Commercial aircraft are used in regularly scheduled flights transporting passengers, freight, or both. General aviation, which includes air taxis and commuter aviation, is used for recreational flying, business travel, personal transportation, and various other activities. Military aviation is the operation and activities of military aircraft.

Diesel-electric locomotives can perform two different types of operations: Line Haul and Yard. Line haul locomotives, which perform the line haul operations, generally travel between distant locations, such as from one city to another. Yard locomotives, which perform yard operations, are primarily responsible for moving railcars within a particular railway yard. The Rail category does not include emissions from railroad operations including the small gasoline and diesel engines used on refrigerated and heated rail cars. These engines are thermostatically controlled, working independently of train motive power, and fall into the category of nonroad equipment

Detailed emission estimates are provided in Appendices A through C.

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[36] U.S. EPA. *Nonroad Engine Population Growth Estimates in MOVES2014b.* https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100UXJK.pdf

[37] U.S. Environmental Protection Agency (EPA). *Official Release of the MOVES5 Motor Vehicle Emissions Model for SIPs and Transportation Conformity.* (89 FR 99862). https://www.federalregister.gov/documents/2024/12/11/2024-29073/official-release-of-the-moves5-motor-vehicle-emissions-model-for-sips-and-transportation-conformity

[38] 40 CFR 51.900(v)

### 7.2 2023 Emissions Estimation Methods

Emissions for M-A-R sources are adopted from EPA's 2022v2 Emissions Modeling Platform (EMP) [39] for the following sector groups:

- Commercial Marine Vessels 1 and 2[40]
- Commercial Marine Vessels 3[41]
- Aircraft[42]
- Rail - Class 1 Line Haul[43]
- Rail Yard[44]
- Rail – Class 2 and 3 Line Haul[45]
- Passenger Rail[46]
- Commuter Rail[47]

The EMP includes 2022 and 2026 emissions data. MDE estimated the 2023 emissions using EPA's 2022-2026 data and the FORECAST function in Microsoft Excel.

### 7.3 2023 Emissions Projected to 2032 and 2038

The EMP includes 2022 and 2026 emissions data. MDE estimated the 2032 and 2038 emissions using EPA's 2022-2026 data and the FORECAST function in Microsoft Excel. FORECAST growth surrogates are provided in Appendices B and C.

### 7.4 Emissions Post-Processing for SIPs

Emissions for M-A-R are calculated on an annual basis. 40 CFR 51 Subpart X requires that emissions in SIPs are reported as a typical ozone season day value.[48] Annual emissions are converted to ozone season day emissions using the following process:

- For CMV emissions, MDE utilized EPA's day-total value. The day total value for a specific SCC and county was added, and the average was calculated.

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[39] Environmental Protection Agency. *Technical Support Document (TSD): Preparation of Emissions Inventories for the 2022v2 North American Emissions Modeling Platform*. https://www.epa.gov/air-emissions-modeling/2022v2-emissions-modeling-platform

[40] Eastern Research Group. *CATEGORY 1 AND 2 COMMERCIAL MARINE VESSEL 2022 EMISSIONS INVENTORY*.
https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/CMV/C1C2_Documentation_2022Platform_08012024.pdf

[41] U.S. Environmental Protection Agency National Vehicle and Fuel Emissions Laboratory. *CATEGORY 3 COMMERCIAL MARINE VESSEL 2022 EMISSIONS INVENTORY.*
https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/CMV/2022%20C3%20Marine%20Emissions%20Tool%20%20Documentation.pdf

[42] Eastern Research Group. *2022 National Emissions Inventory: Aviation Component*.
https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/airports/Aviation2022%20Documentation%20v4.pdf

[43] Eastern Research Group. *2020 National Emissions Inventory Locomotive Methodology*.
https://gaftp.epa.gov/air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf

[44] Eastern Research Group. *2020 National Emissions Inventory Locomotive Methodology*.
https://gaftp.epa.gov/air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf

[45] Eastern Research Group. *2020 National Emissions Inventory Locomotive Methodology*.
https://gaftp.epa.gov/air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf

[46] Eastern Research Group. *2020 National Emissions Inventory Locomotive Methodology*.
https://gaftp.epa.gov/air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf

[47] Eastern Research Group. *2020 National Emissions Inventory Locomotive Methodology*.
https://gaftp.epa.gov/air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf

[48] 40 CFR 51.900(v)

- For aircraft emissions, MDE assumed activity is year-round, and therefore divided annual emissions by 365 days/year.
- For rail emissions, MDE assumed activity is year-round, and therefore divided annual emissions by 365 days/year.