



DEPARTMENT OF THE ENVIRONMENT

AMBIENT AIR MONITORING NETWORK PLAN for CALENDAR YEAR 2023



Prepared for:
U.S. Environmental Protection Agency

Prepared by:
Ambient Air Monitoring Program
Air and Radiation Administration
Maryland Department of the Environment

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MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard | Baltimore, MD 21230 | www.mde.maryland.gov
410-537-3000 | 800-633-6101 | TTY Users: 800-735-2258
Lawrence J. Hogan, Jr., *Governor* | Boyd K. Rutherford, *Lt. Governor*
Ben Grumbles, *Secretary*



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On the cover: Lake Montebello monitoring station

Photo credit – Ryan Auvil

ACRONYMS AND DEFINITIONS

AADT	Annual Average Daily Traffic
AQS	Air Quality System
AQS ID	9-digit site identification number in AQS database
ARA	MDE's Air and Radiation Administration
BAM	Beta Attenuation [Mass] Monitor-for measuring continuous particulate matter
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAPS	Cavity Attenuated Phase Shift (Direct NO ₂ method)
CASTNET	Clean Air Status and Trends Network
CBSA	Core Based Statistical Area
CFR	Code of Federal Regulations
CSA	Combined Statistical Area
CSN	Chemical Speciation Network
CO	Carbon Monoxide
DRR	Data Requirement Rule
DPW	Department of Public Works (Baltimore City)
EGU	Electrical Generating Unit
EMP	Enhanced Monitoring Plan
EPA	United States Environmental Protection Agency
ERG	Eastern Research Group, Research Triangle Park, NC (Carbonyls lab)
FE-AADT	Fleet Equivalent Annual Average Daily Traffic
FEM	Federal Equivalent Method-EPA approved method designated as equivalent to the Federal Reference Method (FRM) for a specific pollutant to compared to the applicable NAAQS
FID	Flame Ionization Detector
FRM	Federal Reference Method-EPA approved reference method necessary for a specific pollutant to be compared to the applicable NAAQS
GC	Gas Chromatograph
HAPS	Hazardous Air Pollutants
IMPROVE	Interagency Monitoring of PROtected Visual Environments
IR	Infrared (radiation)
MDE	Maryland Department of the Environment
MSA	Metropolitan Statistical Area
NAA	Non-Attainment Area
NAAQS	National Ambient Air Quality Standards-used for determining attainment status
NCore	National Core multi-pollutant monitoring stations
NEI	National Emissions Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
nm	Nanometer, measure of length; 1 nm equals 10 ⁻⁹ meter
µm	Micrometer, measure of length; 1 µm equals 10 ⁻⁶ meter
NO	Nitrogen Oxide
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen (ozone precursor)
NO _y	Total Reactive Nitrogen Species (ozone precursor)

O ₃	Ozone
OAQPS	EPA's Office of Air Quality Planning & Standards
PAMS	Photochemical Assessment Monitoring Station
Pb	Lead
PM _{2.5}	Particulate matter with an aerodynamic diameter less than or equal to 2.5 μm
PM ₁₀	Particulate matter with an aerodynamic diameter less than or equal to 10 μm
PM _{10-2.5}	Pronounced "PM coarse" - Particulate matter with an aerodynamic diameter less than or equal to 10 μm minus particulate matter with an aerodynamic diameter less than or equal to 2.5 μm
PQAO	Primary Quality Assurance Organization
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
SIP	State Implementation Plan
SLAMS	State or Local Air Monitoring Stations
SO ₂	Sulfur Dioxide
SOP	Standard Operating Procedure
SPM	Special Purpose Monitor
STN	PM _{2.5} Speciation Trends Network
TSP	Total suspended particulate
UV	Ultraviolet
VOCs	Volatile Organic Compounds

1. INTRODUCTION

In 1970, Congress passed the Clean Air Act (CAA) that authorized the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants shown to threaten human health and welfare. Primary standards were set according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations such as children and asthmatics. Secondary standards were set according to criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, buildings, etc.). As part of the CAA, both local and state air quality agencies are required to maintain and operate ambient air quality monitoring networks.

The six pollutants that currently have NAAQS are: ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), particulate matter (PM_{2.5} and PM₁₀), and lead (Pb). They are commonly called the "criteria" pollutants. When air quality does not meet the NAAQS for one of the criteria pollutants, the area is said to be in "non-attainment" with the NAAQS for that pollutant.

On October 26, 2015, EPA promulgated a rule (80 Fed. Reg. 65292) strengthening the primary and secondary NAAQS for ground-level ozone to 70 parts per billion (ppb), based on extensive scientific evidence about ozone's effects on public health and welfare. The updated standards will improve public health protection, particularly for at-risk groups including children, older adults, people of all ages who have lung diseases such as asthma, and people who are active outdoors, especially outdoor workers. They also will improve the health of trees, plants, and ecosystems. On June 4, 2018, EPA promulgated a rule (83 Fed. Reg. 25776) establishing attainment designations for the strengthened 2015 primary and secondary NAAQS for ozone. The following Maryland counties have been designated Marginal Nonattainment: Anne Arundel, Carroll, Harford, Howard, Cecil, Calvert, Charles, Frederick, Montgomery, Prince George's, Baltimore County, and the City of Baltimore. All other Maryland counties have been designated Attainment/Unclassifiable.

On December 16, 2014, EPA approved Maryland's request to re-designate the Baltimore Non-attainment Area to "Attainment" for the 1997 annual PM_{2.5} NAAQS. This Area also attains the 2008 PM_{2.5} annual standard and continues to attain that standard. The Baltimore Attainment Area includes the following: Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties, and Baltimore City.

A Core Based Statistical Area (CBSA) is a U.S. geographic area defined by the Office of Management and Budget (OMB) that centers on an urban center of at least 10,000 people and adjacent areas that are socioeconomically tied to the urban center by commuting. The term "CBSA" refers collectively to both metropolitan statistical areas (MSA's) and micropolitan statistical areas. The OMB released new standards based on the 2010 Census on February 28, 2013. For the purposes of the Maryland Air Monitoring Network, the terms CBSA and MSA are interchangeable. The names and boundaries of the MSA's in Maryland are shown in Table 1-1 and Figure 1-2. Counties outside of Maryland are included in the map because they are part of the MSA; however, this document will only address monitors located in Maryland.

Table 1-1 Maryland's MSA's. Source: Federal reserve Economic Data, estimates as of May 5, 2021.

MSA Name	Population	Maryland Counties in the MSA
Baltimore-Towson, MD	2,800,189	Carroll, Baltimore County, Baltimore City, Harford, Howard, Anne Arundel, Queen Anne's
Hagerstown-Martinsburg, MD-WV	291,144	Washington
Washington-Arlington-Alexandria, DC-VA-MD-WV	6,324,629	Frederick, Montgomery, Prince George's, Charles, Calvert
Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD	6,107,906	Cecil
Salisbury, MD-DE	423,481	Somerset, Wicomico, Worcester

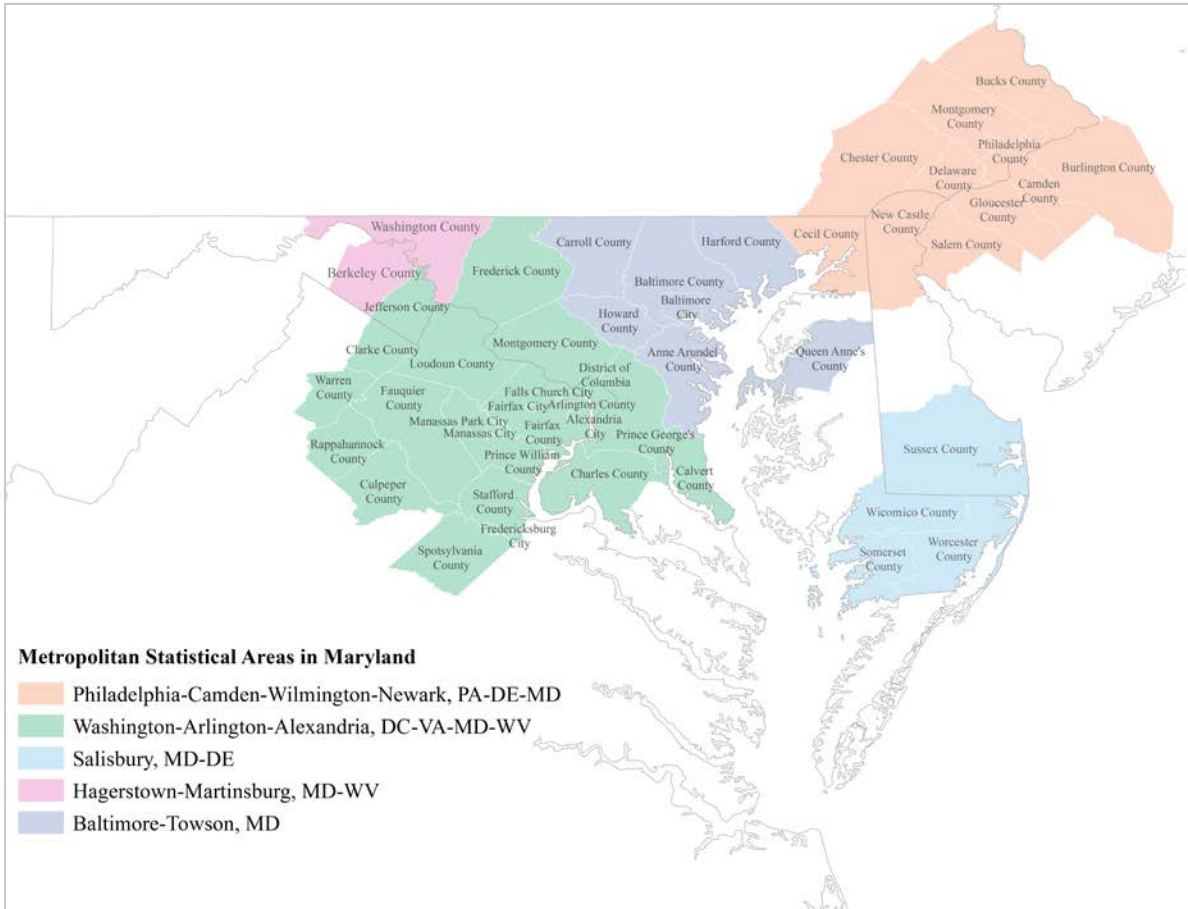


Figure 1-1 Map showing MSA's in Maryland.

The original EPA ozone precursor revisions to the air monitoring regulations (40 CFR Part 58) required by Title 1, Section 182 of the 1990 Clean Air Act Amendments (CAAA) were promulgated on February 12, 1993. The CAAA requires that the States incorporate enhanced monitoring for ozone, speciated volatile organic compounds (VOC's), oxides of nitrogen (NO_x), carbonyls, and surface as well as upper air meteorological parameters (MET) into their State Implementation Plan (SIP). The Part 58 regulations refer to these enhanced monitoring stations as photochemical assessment monitoring stations (PAMS). The PAMS monitoring rules were revised along with the new 2015 ozone NAAQS in 2015. The final rule streamlines and modernizes the PAMS network to use monitoring resources most efficiently. States are required to comply with revised PAMS monitoring by June 1, 2021. There are no ambient standards for any of the VOC's.

Section 112 of the CAA currently identifies 187 hazardous air pollutants (HAPS), also referred to as air toxics, and requires EPA to regulate facilities that emit one or more of these air toxics. EPA Region III has developed a Cooperative Air Toxics Monitoring Program, and MDE operates several air toxics sites as part of the program. MDE also provides analytical support for other sampling sites in EPA Region III.

As part of the CAA, states are required to submit an annual network plan to the U.S. EPA for review and approval. Since 2007, EPA has required State and Local Air Pollution Control Agencies to make this plan available for public inspection at least thirty days prior to formal submission to EPA.

MDE is also required to certify the air quality monitoring data by May 1 for the previous calendar year's data. MDE's 2021 air quality monitoring data were certified on March 16, 2022

2. REQUIREMENTS FOR MONITORING NETWORK DESCRIPTIONS

In October 2006, the U.S. EPA issued final regulations concerning state and local agency ambient air monitoring networks. These regulations require an annual monitoring network plan that includes the information described below. The annual monitoring network plan as described in §58.10 must contain the following information for existing and proposed sites:

- The Air Quality System (AQS) site identification number
- The location, including street address and geographical coordinates
- The sampling and analysis method(s) for each measured parameter
- The operating schedules for each monitor
- Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal
- The identification of sites that are suitable and sites that are non-suitable for comparison against the annual PM_{2.5} NAAQS as described in §58.30
- The monitoring objective and spatial representative scale for each monitor
- The Metropolitan Statistical Area (MSA), Core Based Statistical Area (CBSA), Combined Statistical Area (CSA) or other area represented by the monitor

3. MARYLAND AIR MONITORING NETWORK

Maryland currently operates 24 air monitoring sites around the state that measure ground-level concentrations of criteria pollutants, air toxics, meteorological parameters, and research-oriented parameters (Tables 3-1 and 3-2). This total includes two ‘Haze Cams’, cameras exclusively used to monitor visibility, and one IMPROVE network monitor. The IMPROVE (Interagency Monitoring of Protected Visual Environments) network monitor is operated near the Piney Run monitoring station (Figure 3-1). The IMPROVE network monitors measure PM_{2.5}, PM₁₀, PM_{10-2.5}, and speciated PM_{2.5}.

In support of the SO₂ Data Requirements Rule (DRR), three SO₂ monitors were deployed in January 2017 by Verso Luke Paper Mill in western Maryland (for details, please see MDE’s 2021 Air Monitoring Network Plan). These sites were being operated by AECOM, under contract to Verso Luke Mill. MDE was the Primary Quality Assurance Organization (PQAO) for these sites, which included performing annual instrument audits and reporting the data to AQS. The paper mill shut down operations in May 2019, and Verso instructed their contractor to remove the monitoring equipment on June 8, 2020. Verso Luke Mill subsequently surrendered their Permit to Operate. No further monitoring at this location is planned.

Although monitoring takes place statewide, most of the stations are concentrated in the urban/industrial areas that have the highest population and number of pollutant sources. This network is maintained and operated by the Ambient Air Monitoring Program, Air and Radiation Administration (ARA), Maryland Department of the Environment (MDE). A comprehensive air monitoring network map is shown in Fig 3-1. Pollutant-specific network maps are included in each section. Additional topographic and area maps and site descriptions are provided in Appendix A.

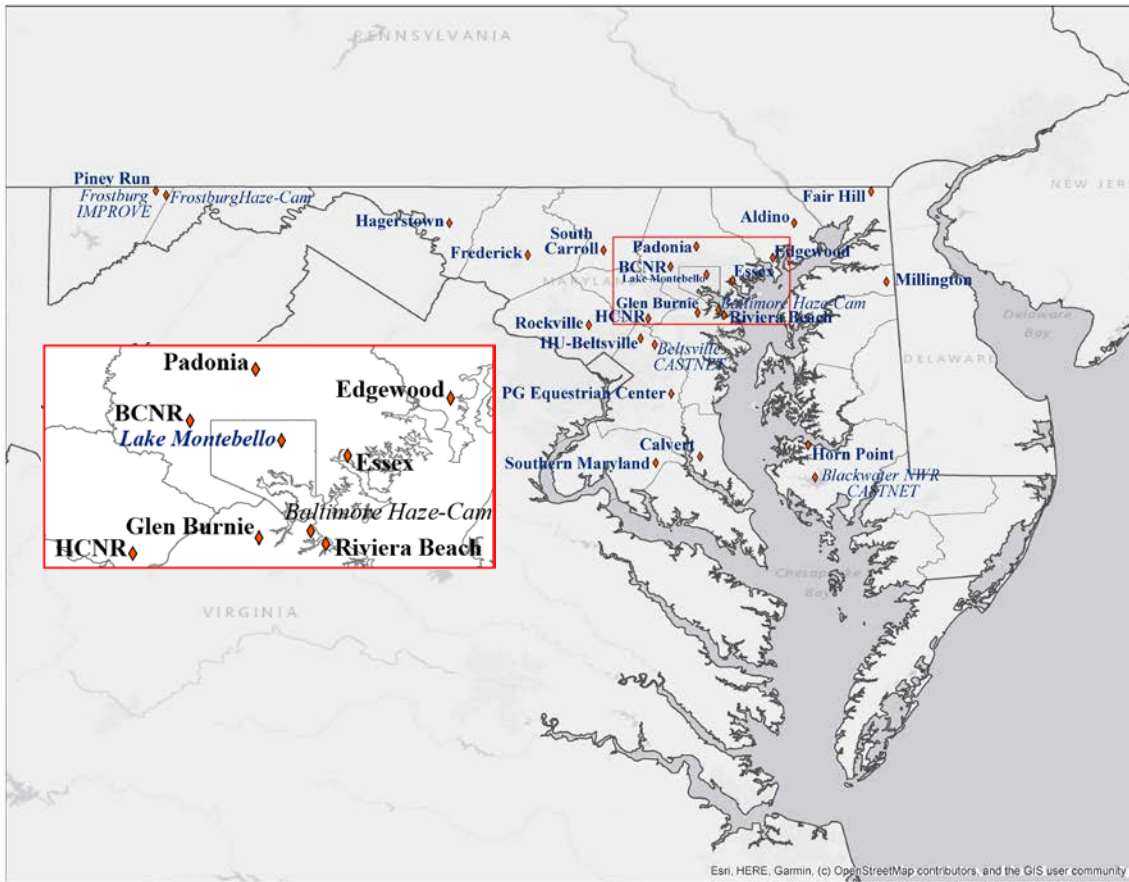


Figure 3-1 Maryland's current air monitoring network map

In addition to the ambient air monitoring stations operated and quality assured by MDE, two CASTNET sites are located in Maryland: Blackwater National Wildlife Refuge and Beltsville (Figure 3-1). CASTNET, the Clean Air Status and Trends Network, is a long-term environmental monitoring network with 90 sites located throughout the US and Canada. The sites are managed and operated by EPA's Clean Air Markets Division (CAMD) in cooperation with the National Parks Service (NPS) and other federal, state, and local partners. The network was established under the 1991 Clean Air Act Amendments (CAAA) to assess trends in acidic deposition due to emission reduction programs, such as the Acid Rain Program, NO_x Budget Trading Program, and the Clean Air Interstate Rule (CAIR). CASTNET measures ambient concentrations of sulfur and nitrogen species as well as rural ozone concentrations. Results from CASTNET are used to report on geographic patterns and temporal trends in acidic pollutants, deposition, and regional ozone concentrations.

Maryland's 2022 Annual Network Plan was approved by EPA on November 9, 2021 (see Appendix B.)

The 2023 Network Plan continues some of the changes begun in previous years' plans, reflecting a shift in monitoring emphasis, with some pollutants becoming less of a concern and others becoming a higher priority. Detailed explanations of these proposals can be found in the "Changes Proposed" sections for the individual pollutants. This plan includes proposals for the following changes:

- Discontinue monitoring for SO₂ at Riviera Beach. In 2016, the EPA designated portions of Anne Arundel County and Baltimore County as non-attainment for the 2010 1-hour SO₂ NAAQS. This designation was based on modeled, not monitored, SO₂ concentrations. In order to better evaluate actual ambient SO₂ concentrations, a source-oriented SO₂ monitor was established at Riviera Beach Elementary School as a Special Purpose Monitor on January 12, 2018. Over three years of operation, the SO₂ concentrations measured at this site have never exceeded the 1-hour standard (75 ppb). The preliminary 2020 Design Value is 24 ppb, less than 33% of the Standard.

As of June 1, 2020, one of the Wagner Units at the Fort Smallwood Complex has been removed from supplying electricity to the grid and fuel switched from coal to natural gas. It is only permitted to operate to supply heat to the plant when necessary. Effective under a consent order as of January 1, 2021, the other Wagner and Brandon Shores Units at the complex have had many emissions and operational limits imposed and will cease combustion of coal by 2026. For these reasons MDE proposes to terminate SO₂ monitoring at Riviera Beach upon EPA Region III approval to do so.

3.1 General Network Information

The following tables include information required as part of the monitoring network description. General information (e.g. site name, AQS identification number, latitude, longitude, etc.) can be found in Table 3-1. Specific information related to each parameter measured at air monitoring sites is given in Tables 3-2 and 3-3. Meteorological parameters measured are included in Table 3-4. Monitoring method descriptions can be found in Table 3-5. Parameters measured as part of the air toxics, PAMS, IMPROVE, and speciated PM_{2.5} mass are listed in Table 3-6.

Table 3-1 General Information for Current Maryland Ambient Air Monitoring Sites

Site Name, AQS ID	Street Address	City, County	Zip Code	Latitude, Longitude (NAD83)	Location Setting	Nearest Road	Traffic Count (2017)	Distance from Nearest Road (m)	CBSA/MSA
Aldino, 240259001	3538 Aldino Rd.	Churchville, Harford	21028	39.563333, -76.203889	Suburban	Aldino Rd.	1,411	156	Baltimore-Towson
Baltimore County Near Road 240050009	4380 Old Court Rd.	Pikesville, Baltimore County	21208	39.371679, -76.746814	Suburban	I-695/I-795	190,812	20	Baltimore-Towson
Baltimore Haze Cam	Raven Power, 1000 Brandon Shores Dr.	Curtis Bay, Anne Arundel	21226	39.181513, -76.537625	Urban	NA	NA	NA	NA
Beltsville CASTNET, 240339991	Powder Mill Rd.	Laurel, Prince George's	20708	39.0284, -76.8171	Rural	*	*	*	Wash-Arlington-Alexandria
Blackwater NWR CASTNET, 240199991	Blackwater National Wildlife Refuge	Cambridge, Dorchester	21613	38.445, -76.1114	Rural	*	*	*	Cambridge (Micro)
Calvert, 240090011	350 Stafford Rd.	Barstow, Calvert	20610	38.536722, -76.617194	Rural	Hallowing Pt. Rd. – Rt. 231	20,690	789	Wash-Arlington-Alexandria
Edgewood, 240251001	Edgewood Chemical Biological Center (APC), Waehli Rd.	Edgewood, Harford	21010	39.410191, -76.296946	Rural	Wise Rd.	4,532	210	Baltimore-Towson
Essex, 240053001	600 Dorsey Ave.	Essex, Baltimore County	21221	39.310833, -76.474444	Suburban	Woodward Dr.	2,190	16	Baltimore-Towson
Fair Hill, 240150003	Fair Hill Natural Resource Mgmt. Area 4493 Telegraph Rd.	Elkton, Cecil	21921	39.702982, -75.864771	Rural	Telegraph Rd. (RT 273)	8,173	24	Philadelphia-Camden-Wilmington
Frederick Airport, 240210037	180 E. Treatment Plant Rd.	Frederick, Frederick	21701	39.422760, -77.375190	Suburban	Monocacy Blvd.	11,923	809	Wash-Arlington-Alexandria
Frostburg Haze-Cam	E. Garrett Co. Vol. Fire Dept. 401 Finzel Rd.	Finzel, Garrett	21532	39.686467, -78.966917	Rural	NA	NA	NA	NA
Frostburg IMPROVE	Frostburg Reservoir	Finzel, Garrett	21532	39.705896, -79.012117	Rural	Rt. 40 National Pike	2,054	2,064	NA
Glen Burnie, 240031003	AA Co. Public Works 7409 Balt-Annap. Blvd.	Glen Burnie, Anne Arundel	21061	39.169533, -76.627933	Suburban	Baltimore-Annapolis Blvd.	17,725	89	Baltimore-Towson
Hagerstown, 240430009	18530 Roxbury Rd.	Hagerstown, Washington	21740	39.564178, -77.720244	Rural	Sharpsburg Pike	9,161	910	Hagerstown-Martinsburg

Site Name, AQS ID	Street Address	City, County	Zip Code	Latitude, Longitude (NAD83)	Location Setting	Nearest Road	Traffic Count (2017)	Distance from Nearest Road (m)	CBSA/MSA
Horn Point, 240190004	UMd Horn Point Lab 2020 Horns Point Rd	Cambridge, Dorchester	21613	38.587525, -76.141006	Rural	Hudson Road	3,990	1,185	Cambridge (Micro)
Howard Co. Near Rd, 240270006	I-95 S Welcome Center	Laurel, Howard	20723	39.143130 -76.846110	Suburban	I-95	203,912	16	Baltimore-Towson
HU-Beltsville, 240330030	Howard Univ., Beltsville Lab., 7501 Muirkirk Rd.	Beltsville, Prince George's	20705	39.055277, -76.878333	Suburban	Muirkirk Road	10,820	397	Wash-Arlington-Alexandria
Lake Montebello, 245105253	Baltimore City DPW 3900 Hillen Road	Baltimore City	21218	39.33746, -76.58905	Urban	Hillen Road	26,450	46	Baltimore-Towson
Millington, 240290002	Millington WMA- 33626 Massey-MD Line Rd.	Massey, Kent	21650	39.305021, -75.797317	Rural	RT 330, Massey-DE Line Rd.	1,065	121	NA
Padonia, 240051007	103 Galloway Ave	Cockeysville, Baltimore County	21030	39.460478 -76.633534	Suburban	York Road	36401	94	Baltimore-Towson
PG Equestrian Ctr, 240338003	14900 Pennsylvania Ave.	Upper Marlboro, Prince George's	20772	38.811940, -76.744170	Rural	Pennsylvania Ave.	54,981	170	Wash-Arlington-Alexandria
Piney Run, 240230002	Frostburg Reservoir, Finzel	Finzel, Garrett	21532	39.705950, -79.012000	Rural	Rt. 40 National Pike	2,054	2,064	NA
Riviera Beach, 240032002	Riviera Bch Elem Sch, 8515 Jenkins Road	Pasadena, Anne Arundel	21122	39.158883, -76.511367	Suburban	Riviera Drive	7,924	314	Baltimore-Towson
Rockville, 240313001	LE Smith Env Educ Ctr, 5110 Meadows Ln.	Rockville, Montgomery	20855	39.114313, -77.106876	Rural	Muncaster Mill Road	17,572	499	Wash-Arlington-Alexandria
South Carroll, 240130001	South Carroll H.S. 1300 W Old Liberty Rd.	Sykesville, Carroll	21784	39.444294, -77.042252	Rural	W. Liberty Rd.	10,561	227	Baltimore-Towson
Southern Maryland, 240170010	14320 Oaks Rd.	Charlotte Hall, Charles	20622	38.508547, -76.811864	Rural	Burnt Store Rd.	2,841	2,167	Wash-Arlington-Alexandria

Note: Blank cells indicate no data available. NA means not applicable. Traffic count data are AADT 2013, MD State Hwy Administration.

* See EPA CASTNET Annual Network Plan <https://www.epa.gov/castnet/ozone>

Table 3-2 Monitor Information for Current Maryland Ambient Air Monitoring Sites

Site Name & AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Measurement Scale	Monitor Objective	Monitor Network/Type	Schedule
Aldino, 240259001	Ozone (O ₃)	04/20/1990	047	4.4	Urban	Highest Concentration	SLAMS	H, S
Baltimore County Near Road 240050009	Direct NO ₂ (CAPS)	01/01/2019	212	4.4	Microscale	Source Oriented/Highest Conc	SLAMS	H
Baltimore Haze Cam Brandon Shores	Visibility	04/01/2007	NA	NA	NA	Public Notification	NA	NA
Beltsville CASTNET, 240339991	Ozone (O ₃)	04/01/2011	047	10	Regional	Regional Transport	CASTNET	H
Blackwater NWR CASTNET, 240199991	Ozone (O ₃)	01/01/2011	047	10	Regional	Regional Transport	CASTNET	H
Calvert, 240090011	Ozone (O ₃)	04/01/2005	087	4.6	Urban	Population Exposure	SLAMS	H, S
Edgewood, 240251001	Ozone (O ₃)	03/10/1980	047	4.5	Urban	Highest Concentration	SLAMS	H, S
	PM _{2.5} - Hourly	09/01/2011	170	5.1	Neighborhood	Population Exposure	SLAMS	H
Essex, 240053001	Air Toxics	01/01/1990	150	4	Neighborhood	Population Exposure	Other	6
	Carbon Monoxide (CO)	02/15/2006	593	4.4	Middle	Highest Concentration	SLAMS	H
	Direct NO ₂ (CAPS)	08/10/2017	212	4.4	Neighborhood	Population Exposure	SLAMS	H
	Nitric Oxide (NO)	11/16/2017	699	10	Neighborhood	Maximum Precursor	PAMS	H
	Reactive Oxides of Nitrogen (NO _x)	11/16/2017	699	10	Neighborhood	Maximum Precursor	PAMS	H
	NO _y - NO	11/16/2017	699	4.4	Neighborhood	Maximum Precursor	PAMS	H
	Ozone (O ₃)	01/01/1972	087	4.4	Neighborhood	Highest Conc, Pop. Expos	SLAMS	H
	PM _{2.5} - Local Conditions	01/01/1999	145	5.1	Neighborhood	Population Exposure	SLAMS	6
	PM _{2.5} - Speciation	07/08/2004	812	5.0	Neighborhood	Population Exposure	Trends Speciation	3
	Sulfur Dioxide (SO ₂)	07/01/2003	600	4.4	Neighborhood	Highest Concentration	SLAMS	R
PAMS VOCS	01/01/1992	126, 142, 102*	4	Neighborhood	Max Precursor, Highest Conc	PAMS / SLAMS	6; S:H,3	
Fair Hill, 240150003	Ozone (O ₃)	01/01/1992	087	4.5	Urban	Regional Transport	SLAMS	H, S
	PM _{2.5} - Hourly	07/01/2010	170	4.7	Neighborhood	Population Exposure	SLAMS	H

Site Name & AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Measurement Scale	Monitor Objective	Monitor Network/Type	Schedule
Frederick Airport, 240210037	Ozone (O ₃)	07/09/1998	087	4.6	Urban	Population Exposure	SLAMS	H, S
Frostburg IMPROVE, 240239000	IMPROVE Parameters	03/01/2004	NA	4.0	Regional	Public Notification	NA	3
Frostburg Haze Cam	Visibility	10/01/2005	NA	NA	NA	Public Notification	NA	NA
Glen Burnie, 240031003	Ozone (O ₃)	04/01/2016	087	5	Neighborhood	Population Exposure	SLAMS	H, S
	PM ₁₀ - STP	08/22/2008	127	2.1	Neighborhood	Population Exposure	SLAMS	6
	PM ₁₀ - STP	08/22/2008	127	2.1	Neighborhood	Population Exposure	QA-Collocated	6
Hagerstown, 240430009	Ozone (O ₃)	04/01/1999	087	4.6	Urban	Highest Conc/ Population Exposure	SLAMS	H, S
	PM _{2.5} - Hourly	07/01/2010	170	5.1	Urban	Highest Conc	SLAMS	H
Horn Point, 240190004	Ozone (O ₃)	04/01/2012	087	4	Regional	General/Background	SLAMS	H
	PM _{2.5} - Hourly	04/01/2012	170	4	Regional	General/Background	SLAMS	H
	Sulfur Dioxide (SO ₂)	04/01/2012	600	4	Regional	General/ Background	SLAMS	R
Howard County Near Road, 240270006	Air Toxics	04/01/2014	150	4	Microscale	Source Oriented/Highest Conc	SLAMS	6
	Black Carbon	08/01/2015	894	4	Microscale	Source Oriented/Highest Conc	SPM	H
	Ultrafine Particle Counter	01/01/2017	173	4	Microscale	Source Oriented/Highest Conc	SPM	H
	Carbon Monoxide (CO)	04/01/2014	593	4	Middle Scale	Source Oriented/Highest Conc	SLAMS	H
	Nitric Oxide (NO)	04/01/2014	599	4	Microscale	Source Oriented/Highest Conc	SLAMS	H
	Nitrogen Dioxide (NO ₂)	04/01/2014	599	4	Microscale	Source Oriented/Highest Conc	SLAMS	H
	Oxides of Nitrogen (NO _x)	04/01/2014	599	4	Microscale	Source Oriented/Highest Conc	SLAMS	H
	PM _{2.5} - Hourly	04/01/2014	170	4.5	Microscale	Source Oriented/Highest Conc	SLAMS	H

Site Name & AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Measurement Scale	Monitor Objective	Monitor Network/Type	Schedule
HU-Beltsville, 240330030	Carbon Monoxide (CO)	01/01/2007	593	4.6	Urban	General/Background	SLAMS/NCore	H
	Air Toxics	05/05/2005	150	4	Neighborhood	Population Exposure	Other	6
	Direct NO ₂ (CAPS)	11/1/2019	212	4.6	Urban	General/Background	SLAMS/NCore	H
	Ozone (O ₃)	05/01/2005	087	4.6	Urban	Highest Conc./ Population Exposure	SLAMS/NCore	H
	PM _{2.5} Speciation	12/05/2004	812	4.6	Urban	Population Exposure General/Background	SLAMS/NCore	3
	PM ₁₀ – STP	07/25/2010	127	4.6	Neighborhood	Population Exposure	SLAMS/NCore	3
	PM _{10-2.5} - Local Conditions	07/25/2010	176	4.6	Neighborhood	Population Exposure	SLAMS/NCore	3
	PM _{2.5} - Local Conditions	07/10/2004	145	4.6	Urban	Population Exposure	SLAMS/NCore	3
	PM _{2.5} - Local Conditions	07/31/2010	145	4.6	Urban	Population Exposure	QA-Collocated	12
	PM _{2.5} – Hourly	07/01/2010	170	4.5	Urban	Population Exposure	SLAMS/NCore	H
	Black Carbon	12/01/2007	894	4	NA	NA	SPM	H
	Sulfur Dioxide (SO ₂)	09/29/2006	560	4.6	Urban	General/Background	SLAMS/NCore	R
	VOCS	05/05/2005	126	4	Urban	Upwind/Background	Old PAMS/EMP	6; S: 3
Lake Montebello, 245105253	Ozone (O ₃)	1/20/2022	087	4.5	Neighborhood	Population Exposure	SLAMS	H, S
	Air Toxics	1/20/2022	150	4.5	Neighborhood	Population Exposure	Other	6
	Nitric Oxide (NO)	1/20/2022	599	4.5	Middle	Highest Concentration	SLAMS	H
	Nitrogen Dioxide (NO ₂)	1/20/2022	599	4.5	Middle	Highest Concentration	SLAMS	H
	Oxides of Nitrogen (NO _x)	1/20/2022	599	4.5	Middle	Highest Concentration	SLAMS	H
	PM ₁₀ – STP	1/20/2022	127	4.5	Middle	Population Exposure	SLAMS	6
	PM _{2.5} - Local Conditions	1/20/2022	145	4.5	Middle	Highest Concentration	SLAMS	3
	PM _{2.5} - Hourly	1/20/2022	170	4.5	Middle	Highest Concentration	SLAMS	H
Millington, 240290002	Ozone (O ₃)	06/19/1989	087	4.5	Urban	Population Exposure	SLAMS	H, S
	PM _{2.5} - Hourly	07/01/2010	170	5	Neighborhood	Population Exposure	SLAMS	H

Site Name & AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Measurement Scale	Monitor Objective	Monitor Network/Type	Schedule
Padonia, 240051007	Ozone (O ₃)	01/01/1979	087	4.4	Neighborhood	Population Exposure	SLAMS	H, S
	PM _{2.5} - Hourly	01/01/2016	170	4.8	Neighborhood	Population Exposure	SLAMS	H
	PM _{2.5} - Local Conditions	01/01/1999	145	4.8	Neighborhood	Population Exposure	SLAMS	12
PG Equestrian Center, 240338003	Ozone (O ₃)	04/01/2002	087	4.4	Urban	Population Exposure	SLAMS	H, S
Piney Run, 240230002	Carbon Monoxide (CO)	09/01/2007	593	4.4	Regional	Regional Transport	SLAMS/NCORE	H
	Direct NO ₂ (CAPS)	07/12/2019	212	4.6	Regional	Regional Transport	SLAMS/NCORE	H
	Nitric Oxide (NO)	05/01/2004	699	10	Regional	Regional Transport	SLAMS/NCORE	H
	NO _y – NO	05/01/2004	699	10	Regional	Regional Transport	SLAMS/NCORE	H
	Reactive Oxides of Nitrogen (NO _y)	05/01/2004	699	10	Regional	Regional Transport	SLAMS/NCORE	H
	Ozone (O ₃)	04/01/2004	087	4.4	Regional	Regional Transport	SLAMS/NCORE	H
	PM _{2.5} – Hourly	07/01/2010	170	4.9	Regional	Regional Transport	SLAMS/NCORE	H
	Sulfur Dioxide (SO ₂)	04/01/2004	600	4.6	Regional	Population Exposure	SLAMS/NCORE	R
Riviera Beach, 240032002	Sulfur Dioxide (SO ₂)	1/12/2018	060	4	Neighborhood	Highest Concentration	SLAMS	R
Rockville, 240313001	Ozone (O ₃)	01/01/1980	087	4.6	Urban	Population Exposure	SLAMS	H, S
	PM _{2.5} - Hourly	07/01/2010	170	5.3	Neighborhood	Population Exposure	SLAMS	H
South Carroll, 240130001	Ozone (O ₃)	07/14/1983	087	4.5	Urban	Population Exposure	SLAMS	H, S
Southern Maryland, 240170010	Ozone (O ₃)	10/02/1984	087	4.6	Regional	General Background	SLAMS	H, S

Sampling Schedule is coded as follows: 1 – every day, 2 – every 2 hours, 3 – every 3rd day, 6 - every 6th day, 12 – every 12th day, H – every hour, every day, R – both every hour and every five minutes every day, S – seasonally measured only. F means passive filter collected every 2 weeks. NA means not applicable for the cell. *Method Code 102 refers to carbonyl analyses performed by ERG.

Table 3-3 Monitor Counts by Site (Cross-reference to Table 3-2)

Site Name	Ozone	Carbon Monoxide	Sulfur Dioxide	CAPS Direct NO2	Oxides of Nitrogen (NOx)	Reactive Oxides of N (NOy)	PM2.5 – Hourly FEM	PM10 STP (24-hr FRM)	PM10-2.5 LC 24-hr FRM)	PM2.5 LC (24-hr FRM)	PM2.5 Speciation	PAMS VOCS	HAPS / Air Toxics	IMPROVE Parameters	Ultrafine Particle Count	Aethalometer	Camera	Total
Aldino	1																	1
Baltimore Co. Near Rd				1														1
Baltimore Haze Cam																	1	1
Beltsville CASTNET	1		1															2
Blackwater NWR CASTNET	1																	1
Calvert	1																	1
Edgewood	1						1											2
Essex	1	1	1	1		1			1	1	2	1						10
Fair Hill	1						1											2
Frederick Airport	1																	1
Frostburg Haze Cam																	1	1
Frostburg Improve													1					1
Glen Burnie	1							2										3
Hagerstown	1						1											2
Horn Point	1		1				1											3
Howard County Near Rd		1			1		1					1		1	1			6
HU-Beltsville	1	1	1	1			1	1	2	1	1	1			1			13
Lake Montebello	1				1		1	1	1			1						6
Millington	1						1											2
Padonia	1						1		1									3
PG Equestrian Center	1																	1
Piney Run	1	1	1	1		1	1											6
Riviera Beach			1															1
Rockville	1						1											2
South Carroll	1																	1
Southern Maryland	1																	1
Total	20	4	6	4	2	2	11	4	1	5	2	3	4	1	1	2	2	74

Table 3-4 Count of Meteorological Parameters Measured in the Maryland Network

AQS State County Site	Local Site Name	Barometric Pressure-64101	Temp-62101	Rain-65102	Relative Humidity-62201	Solar Radiation-63301	Ultraviolet Radiation-63302	Wind Direction-61104	Wind Speed-61103	Radar Wind Profiler	Total
240259001	Aldino	1	1	1	1			1	1		6
240050009	Baltimore County Near Rd	1	1	1	1			1	1		6
240251001	Edgewood	1	1	1	1			1	1		6
240053001	Essex	1	1	1	1	1	1	1	1		8
240150003	Fair Hill	1	1	1	1			1	1		6
240031003	Glen Burnie	1	1	1	1			1	1		6
240430009	Hagerstown	1	1	1	1			1	1		6
240190004	Horn Point	1	1	1	1			1	1	1	7
240270006	Howard County Near Rd	1	1	1	1			1	1		6
240330030	HU-Beltsville	1	1	1	1	1		1	1	1	8
240290002	Millington	1	1	1	1			1	1		6
240051007	Padonia	1	1	1	1			1	1		6
240338003	PG Equestrian Center	1	1	1	1			1	1		6
240230002	Piney Run	1	1	1	1	1		1	1	1	8
240032002	Riviera Beach	1	1	1	1			1	1		6
240313001	Rockville	1	1	1	1			1	1		6
240130001	South Carroll	1	1	1	1			1	1		6
Total		17	17	17	17	3	1	17	17	3	109

Table 3-5 Monitoring Methods and AQS Codes used in the Maryland Ambient Air Monitoring Network

Parameter	Parameter Code	Method Code	Sample Analysis Description
HAPS / Air Toxics*	NA	150	Cryogenic Pre-concentration: GC/MS
Black Carbon	84313	894	API Teledyne 633 Aethelometer
Carbon Monoxide, trace	42101	593	Gas Filter Correlation Teledyne API T300U
Direct NO ₂	42602-4	212	API T500U - CAPS (Cavity Attenuated Phase Shift)
Nitric Oxide and Nitrogen Dioxide (NO _x)	42601-2, 42602, 42603	599	Gas Phase Chemiluminescence, Teledyne API T200U
Nitric Oxide and Reactive Oxides of Nitrogen (NO _y – NO)	42601, 42612, 42600	699	Chemiluminescence, Teledyne API T200U NO _y
PAMS VOCS*	NA	102	DNHP followed by HPLC (AMS Lab, Phila., PA)
	NA	126	Cryogenic Pre-concentration Trap GC/FID
	NA	142	Pre-concentration Trap/Thermal, Auto GC (Markes-Agilent)
Ozone	44201	047	Ultraviolet Photometry (Thermo 49C)
	44201	087	Ultraviolet Radiation Absorption (API T400)
PM ₁₀	81102	127	Gravimetric Partisol Model 2025i (Thermo)
PM _{2.5}	88101	145	Gravimetric, Partisol Plus 2025i
PM _{2.5} continuous	88101-3	170	FEM, Beta Attenuation
PM _{10-2.5} (PM Coarse)	86101	176	PAIRED Gravimetric Difference, Partisol Plus 2025i
PM _{2.5} Species* Constituents: Trace elements	NA	811	Energy Dispersive XRF using Teflon filter
PM _{2.5} Species* Constituents: Ions	NA	812	Ion Chromatography using Nylon filter
PM _{2.5} Species* Constituents: Organics	NA	813	Thermo-Optical Transmittance using Quartz filter
PM _{2.5} Speciation mass	88502-5	810	Gravimetric, Met One SASS using Teflon
IMPROVE Parameters*	NA	NA	Four module, Improve Protocol analysis
Sulfur Dioxide	42401	060	Pulsed Fluorescence (43i and Airpointer)
Sulfur Dioxide, trace	42401	560	Pulsed Fluorescence, 43C-TLE/43I-TLE
	42401	600	Ultraviolet Fluorescence API T100U
Ultrafine Particle Counter	87101	173	Ultrafine Particle Counter
Visibility	NA	NA	Camera (Haze Cam)

*See Table 3-6 for constituents belonging to these groups. NA means not applicable for the cell. Parameter occurrence code (POC) 1 unless otherwise noted.

Table 3-6 Constituent Compounds and Species Measured in Maryland

CONSTITUENT GROUP	COMPOUNDS IN THE CONSTITUENT GROUP
HAPS / Air Toxics	Dichlorodifluoromethane, Chloromethane, 1,2-Dichloro-1,1,2,2-tetrafluoroethane, Chloroethene, 1,3-Butadiene, Trichlorofluoromethane, Acrolein, Acetone, Methylene Chloride, 1,1,2-Trichloro-1,2,2-trifluoroethane, 2-methoxy-2-methyl-Propane, Hexane, Chloroform, Tetrahydrofuran, 1,2-Dichloroethane, 1,1,1-Trichloroethane, Benzene, Carbon tetrachloride, Cyclohexane, 1,2-Dichloropropane, Trichloroethene, Heptane, Cis-1,3-Dichloro-1-Propene, Trans-1,3-Dichloro-1-Propene, Toluene, 1,2-Dibromoethane, Tetrachloroethylene, Chlorobenzene, Ethylbenzene, m & p- Xylene, Styrene, 1,1,2,2-Tetrachloroethane, o-Xylene, 1-Ethyl-4-Methylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, 1,4-Dichlorobenzene
IMPROVE Parameters	Air temperature, Aluminum, Ammonium ion, Ammonium Nitrate, Ammonium sulfate, Arsenic, Bromine, Calcium, Chloride, Chlorine, Chromium, Copper, Elemental carbon, Humidity, Hydrogen, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrate, Nitrite, Organic carbon, Phosphorus, PM ₁₀ , PM _{2.5} , Potassium, Relative Humidity, Rubidium, Selenium, Silicon, Sodium, Strontium, Sulfate, Sulfur Dioxide, Sulfur, Titanium, Vanadium, Zinc, and Zirconium
PAMS VOC's	Acetaldehyde, Acetone, Acrolein, Formaldehyde, Methyl Ethyl Ketone, Methyl Isobutyle Ketone, Propionaldehyde, Ethene, Ethyne, Ethane, Propene, Propane, Isobutane, 1-Butene, Butane, T-2-Butene, C-2-Butene, Isopentane, 1-Pentene, Pentane, Isoprene, T-2-Pentene, C-2-Pentene, 2,2-Dimethylbutane, Cyclopentane, 2,3-Dimethylbutane, 2-Methylpentane, 3-Methylpentane, 1-Hexene, Hexane, Methylcyclopentane, 2,4dimethylpentane, Benzene, Cyclohexane, 2-Methylhexane, 2,3dimethylpentane, 3-Methylhexane, 2,2,4tmpentane, Heptane, Methylcyclohexane, 2,3,4-Tmpentane, Toluene, 2-Methylheptane, 3-Methylheptane, Octane, Ethylbenzene, M&P-Xylene, Styrene, O-Xylene, Nonane, Isopropylbenzene, Propylbenzene, 1-Ethyl-3-Mbenzene, 1-Ethyl-4-Mbenzene, 1,3,5tmbenzene, 1-Ethyl-2-Mbenzene, 1,2,4tmbenzene, Decane, 1,2,3-Trimbenzene, M-Diethylbenzene, P-Diethylbenzene, Undecane, Dodecane, Total HC, PAMSHC, 1,3-Butadiene, Alpha-pinene, Beta-pinene
PM _{2.5} Chemical Species	Aluminum, Ammonium Ion, Antimony, Arsenic, Barium, Bromine, Cadmium, Calcium, Cerium, Cesium, Chloride, Chlorine, Chromium, Cobalt, Copper, Elemental Carbon, Indium, Iron, Lead, Magnesium, Manganese, Nickel, Organic Carbon, Phosphorus, Potassium, Potassium Ion, Rubidium, Selenium, Silicon, Silver, Sodium, Sodium Ion, Strontium, Sulfate, Sulfur, Tin, Titanium, Total Nitrate, Vanadium, Zinc, Zirconium

4. SPECIFIC POLLUTANT NETWORK DESCRIPTIONS AND REQUIREMENTS

4.1 Carbon Monoxide (CO) – General Description and Sampling Method

Carbon monoxide is measured by infrared absorption photometry. Air is drawn continuously through a sample cell where infrared light passes through it. Carbon monoxide molecules in the air absorb part of the infrared light, reducing the intensity of the light reaching a light sensor. The light is converted into an electrical signal related to the concentration of carbon monoxide in the sample cell. The Maryland CO monitoring network is shown in Figure 4.1.

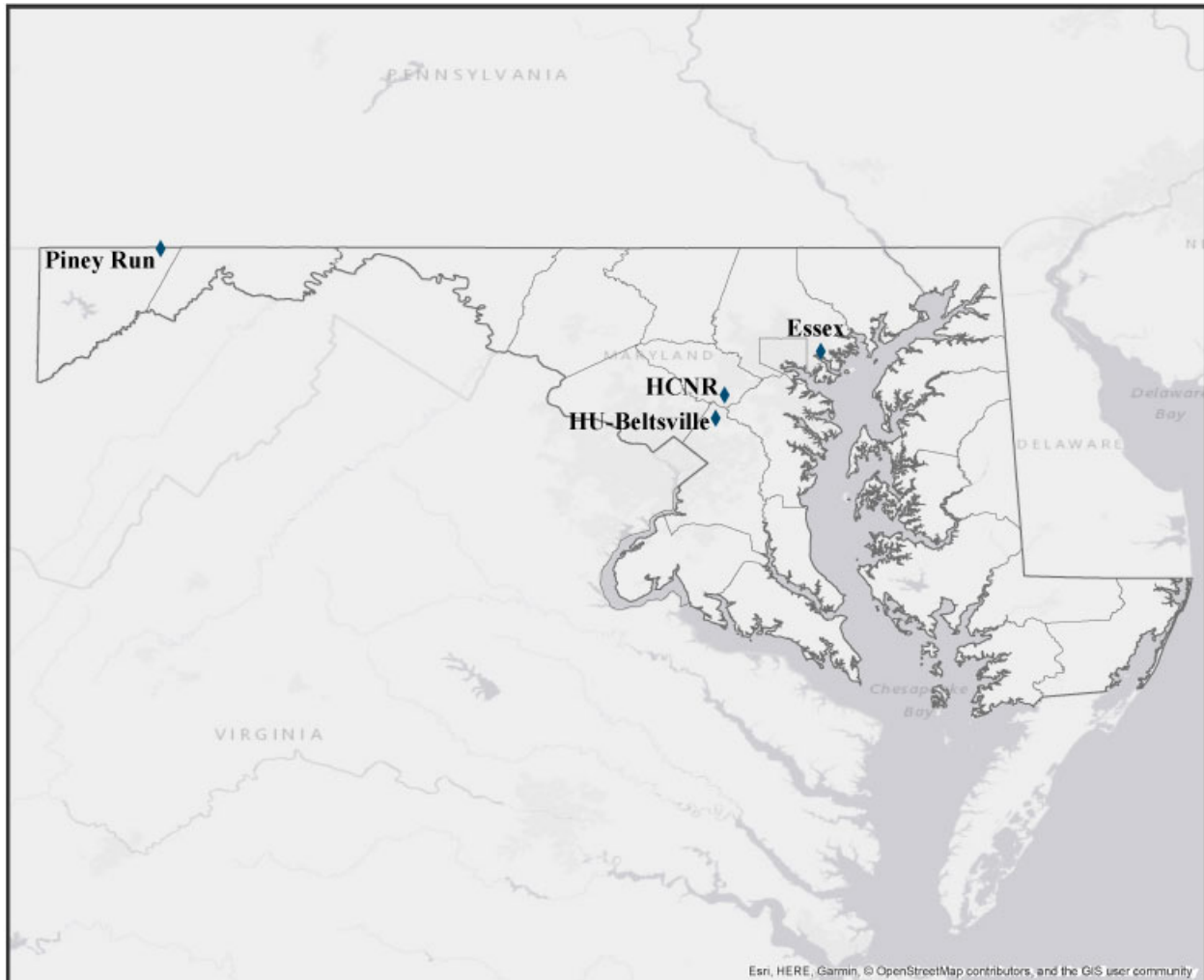


Figure 4-1 Maryland's CO monitoring network.

4.1.1 Monitoring Requirements

EPA revised the minimum monitoring requirements for CO on August 12, 2011. One CO monitor is required to be collocated with a near-road NO₂ in urban areas having a population of 1 million or more. MDE added a CO monitor to the near road NO₂ monitoring site at the Interstate 95 South (I-95S) rest area between MD-32 and MD-216. This monitor began collecting data April 1, 2014. Operation of the existing CO sites in Maryland is required until MDE requests discontinuation of a site in the Annual Network Plan and the EPA Regional Administrator approves the request.

Table 4-1 CO Monitoring Requirements

Requirement	Appendix D 40 CFR Part 58	Required in Maryland	Number of monitors active in Maryland
One CO monitor collocated with a Near Road NO ₂ monitor in an urban area with a population > 1 million	4.2.1	1	1
One CO monitor at each NCore site	3(b)	2	2

In addition to the three CO monitors referenced in the table above, Maryland operates a CO monitor at Essex, as part of the PAMS monitoring requirements.

4.1.2 Sources

CO is formed when carbon in fuel is not completely burned. The EPA estimates that approximately 60% of all CO emissions are from motor vehicle exhaust. Other sources include waste incinerators, wood stoves, furnaces, and some industrial processes. Concentrations are highest along heavily traveled highways and decrease significantly the further away the monitor is from traffic. Therefore, CO monitors are usually located close to roadways or in urban areas.

4.1.3 Changes Planned for 2022-2023

No changes planned.

4.2 Lead (Pb) – General Description and Sampling Method

Lead is collected by gravimetric PM₁₀ samplers as described in Section 4.5; then the filters are sent to a lab to be analyzed for lead by the x-ray fluorescence method. If a lead-PM₁₀ monitor measures three-month average levels greater than or equal to 0.10 µg/m³, then MDE must install and operate a lead-TSP monitor within six months.

4.2.1 Monitoring Requirements

The latest revision to the lead (Pb) NAAQS was finalized on October 15, 2008, lowering the primary and secondary standards from 1.5 µg/m³ to 0.15 µg/m³. Revisions to the lead monitoring regulations were finalized on December 27, 2010 as follows:

Table 4-2 Lead Monitoring Requirements

Requirement	Appendix D 40 CFR Part 58	Required in MD	Number in MD
One source-oriented SLAMS site located to measure the maximum Pb concentration resulting from each non-airport Pb source which emits 0.50 or more tons per year (tpy)	4.5(a)	0	0
One source-oriented SLAMS site located to measure the maximum Pb concentration resulting from airport which emits 1.0 or more tpy	4.5(a)	0	0

On March 28, 2016, EPA published 40 CFR Part 58 Revisions to Ambient Monitoring Quality Assurance and Other Requirements; Final Rule. This rule revision eliminated the requirement in section 3 of appendix D to measure Pb at urban NCore sites either as Pb in Total Suspended Particles (Pb-TSP) or as Pb PM₁₀. In order to discontinue Pb measurements at urban NCore sites, Part II.I Network Design Requirements of the publication states:

“With specific regard to Pb monitoring at urban NCore sites, monitoring agencies should request permission from the EPA Regional Administrator to discontinue non-source oriented monitoring following the collection of at least 3 years of complete data at each affected site.”

MDE terminated the Pb monitor at HU-Beltsville due to low concentrations (see the 2018 Monitoring Network Plan.)

4.2.2 Sources

Pb is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been motor vehicles and industrial sources. As a result of EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector dramatically declined by 95 percent between 1980 and 1999, and levels of lead in the air decreased by 94 percent between 1980 and 1999. Today, the highest levels of lead in air are usually found near lead smelters. Other stationary sources are waste incinerators, utilities, lead-acid battery manufacturers and general aviation airports. Soil can pick up lead from exterior paint, or other sources such as past use of leaded gas in cars. There are no sources in Maryland that emit more than ½ ton (1,000 pounds) of lead per year.

4.2.3 Changes Planned for 2022-2023

No changes planned.

4.3 Nitrogen Dioxide (NO₂) – General Description and Sampling Method

Nitrogen dioxide is produced during high-temperature burning of fuels. Sources include motor vehicles and stationary sources that burn fossil fuels such as power plants and industrial boilers. Until recently, it has only been possible to measure NO₂ indirectly. First, nitrogen oxide (NO) is measured using the chemiluminescence reaction of nitric oxide (NO) with ozone (O₃). Air is drawn into a reaction chamber where it is mixed with a high concentration of ozone from an internal ozone generator. Any NO in the air reacts with the ozone to produce NO₂. Light emitted from this reaction is detected with a photomultiplier tube and converted to an electrical signal proportional to the NO concentration.

Total nitrogen oxides (NO_x) are measured by passing the air through a converter where any NO₂ in the air is reduced to NO before the air is passed to the reaction chamber. By alternately passing the air directly to the reaction chamber, and through the converter before the reaction chamber, the analyzer alternately measures NO and NO_x. The NO₂ concentration is equal to the difference between NO_x and NO. Reactive oxides of nitrogen (NO_y) are measured in a similar manner to NO_x, except that NO is measured by bypassing the converter. The combination of NO₂ and NO_z can be then determined by difference. This procedure is similar to the current methodology used to measure NO_x, however, the converter temperature is higher in order to more completely convert NO_z species, and the converter has been moved to very near the sample inlet to avoid line losses of “sticky” NO_y species such as HNO₃.

Direct NO₂ monitoring using cavity-attenuated phase shift (CAPS) technology has been deployed to the Baltimore County Near Road, Essex, HU-Beltsville, and Piney Run sites. CAPS NO₂ monitors provide a direct absorption measurement of nitrogen dioxide. Unlike standard chemiluminescence-based monitors, these instruments require no conversion of NO₂ to another species and thus are not sensitive to other nitrogen-containing species. As resources allow, CAPS technology will replace the remaining NO_x analyzer at the Lake Montebello site.

4.3.1 Monitoring Requirements

The last revision to the NO₂ NAAQS was finalized on January 22, 2010, setting a new 1-hour NAAQS at 100 ppb and retaining the previous annual average NAAQS at 53 ppb. On December 30, 2016, EPA published 40 CFR Part 50 Revision to the Near-Road NO₂ Minimum Monitoring Requirements, which eliminated the requirement for a near-road monitoring station in CBSA’s having populations between 500,000 and 1,000,000 persons.

Table 4-3 NO₂ Monitoring Requirements

Requirement	Appendix D 40 CFR Part 58	Required in Maryland	Number of monitors active in Maryland
Near Road NO ₂ monitoring in CBSA with a population > 2,500,000	4.3.2(a)	2	2
Area-wide NO ₂ monitoring in CBSA with a population > 1,000,000	4.3.3	1	2
Regional Administrator required monitoring	4.3.4	Variable	0

The Maryland NO₂ monitoring network is shown in Figure 4-2.

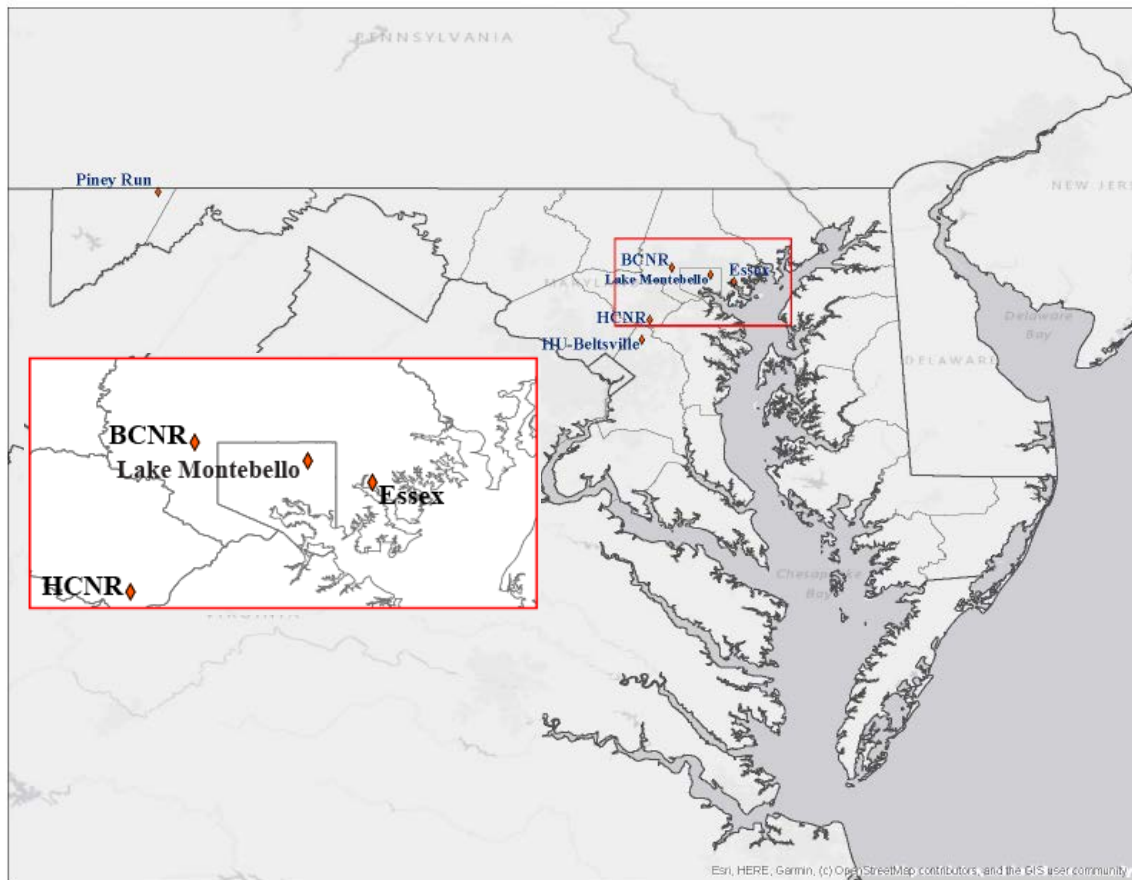


Figure 4-2 Maryland's NO₂ monitoring network.

Near Road Monitoring

There are three MSA's with populations greater than 2,500,000 that are either wholly in Maryland, or that Maryland is a part of, that each qualify for two near road NO₂ monitors (Table 1-1). For the Baltimore-Towson, MD MSA, MDE is currently operating two near road NO₂ monitoring stations: the Howard County Near Road site, located on I-95 S between Routes 32 and 216, and the Baltimore County Near Road site, located at the Maryland Transit Administration maintenance facility at the interchange of I-695 and I-795.

For the Washington-Arlington-Alexandria, DC-VA-MD-WV MSA, the requirements will be met by monitors installed in Washington, DC by the District of Columbia Department of the Environment (DOEE) and in Virginia by the Virginia Department of Environmental Quality (VADEQ). For the Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD MSA, the requirements are being met by monitors installed by the Philadelphia Air Management Service (AMS).

Area Wide Monitoring

There are three MSA's with populations greater than 1,000,000 that are either wholly in Maryland, or that Maryland is a part of, that each qualify for one community wide NO₂ monitor (Table 1-1). MDE's NO₂ monitors at the Essex and Lake Montebello sites fulfill this requirement for the Baltimore-Towson, MD MSA.

For the Washington-Arlington-Alexandria, DC-VA-MD-WV MSA, the requirements are met by monitors installed in Washington, DC by the District of Columbia Department of the Environment (DOEE) and in Virginia by VADEQ. For the Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD MSA, the requirements are met by monitors installed by Philadelphia AMS.

Sensitive and Vulnerable Populations

EPA Region III has not required MDE to install any additional monitors to meet this requirement.

Additional NO₂ Monitoring Requirements

Each State is required to operate one NCore site. This is discussed in more detail in Section 4.10. Maryland runs two NCore stations, Piney Run and HU-Beltsville, both of which monitor NO₂.

4.3.2 Sources

Oxides of nitrogen are produced during high-temperature burning of fuels. Sources of NO_x include motor vehicles and stationary sources that burn fossil fuels such as power plants and industrial boilers.

4.3.3 Changes Planned for 2022-2023

No changes planned.

4.4 Ozone (O₃) – General Description and Sampling Method

Ozone is measured by ultraviolet absorption photometry. Air is drawn continuously through a sample cell where ultraviolet light passes through it. O₃ molecules in the air absorb part of the ultraviolet light, reducing the intensity of the light reaching a light sensor. The light is converted into an electrical signal related to the concentration of O₃ in the sample cell.

On October 1, 2015, EPA strengthened the NAAQS for ground-level ozone to 70 parts per billion (ppb), based on extensive scientific evidence about ozone’s effects on public health and welfare. The updated standard improves public health protection, particularly for at-risk groups including children, older adults, people of all ages who have lung diseases such as asthma, and people who are active outdoors, especially outdoor workers. They also will improve the health of trees, plants, and ecosystems. The implementation of the 2015 Ozone NAAQS included expanding the ozone season in Maryland from March 1 through October 31, beginning March 1, 2017.

4.4.1 Monitoring Requirements

Ozone monitoring requirements are determined by the MSA population and design value, as specified in Table D-2 of 40 CFR Part 58 Appendix D. Table 4-4 shows that the MDE monitoring network meets or exceeds the minimum requirements. Since ozone levels decrease significantly in the colder periods of the year in many areas, ozone is only required to be monitored during the designated “ozone season”. The implementation of the 2015 Ozone NAAQS includes expanding the ozone season in Maryland from March 1 through October 31 starting in 2017.

Table 4-4 Number of Ozone SLAMS Sites Required

MSA Name	Population	Monitors Deployed by State ^A						Total Monitors	Required ≥ 85% NAAQS
		DE	DC	MD	VA	WV	PA		
Baltimore-Towson, MD	2,800,189	0	0	7	0	0	0	7	4
Hagerstown-Martinsburg, MD-WV	291,144	0	0	1	0	1	0	2	1
Washington-Arlington-Alexandria, DC-VA-MD-WV	6,324,629	0	3	7	6	0	0	16	3
Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD	6,107,906	4	0	1	0	0	7	12	3
Salisbury, MD-DE	423,481	2	0	0	0	0	0	2	2
Total		6	3	16	6	1	7	39	13

A - Based on tables available at <https://www.epa.gov/air-trends/air-quality-design-values>. All areas had their maximum site >= 85% Ozone NAAQS.

The Maryland O₃ monitoring network is shown in Figure 4-3.

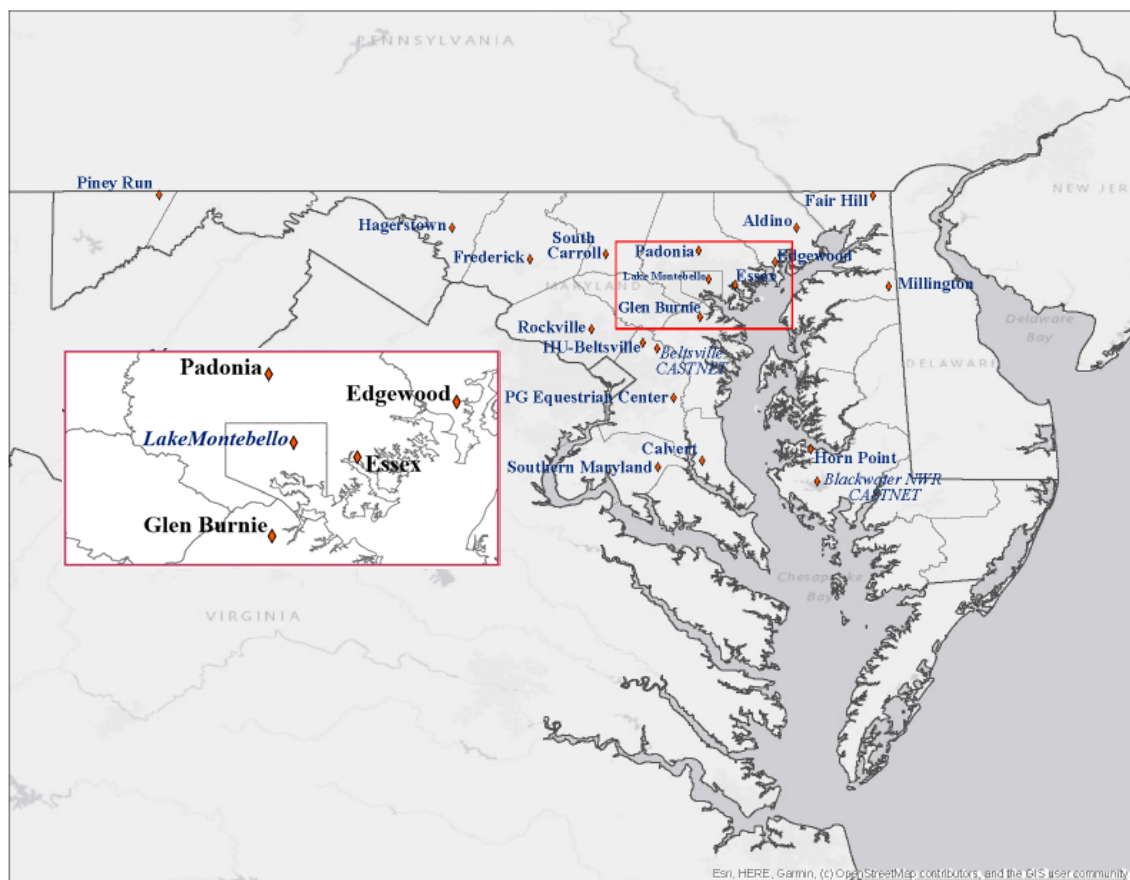


Figure 4-3 Maryland's O₃ monitoring network.

Within an O₃ network, at least one O₃ site for each MSA must be designed to record the maximum concentration for that particular metropolitan area. More than one maximum concentration site may be necessary in some areas. Since O₃ requires appreciable formation time, the mixing of reactants and products occurs over large volumes of air, and this reduces the importance of monitoring small-scale spatial variability. The appropriate spatial scales for O₃ sites are neighborhood, urban, and regional.

The prospective maximum concentration monitor site should be selected in a direction from the city that is most likely to observe the highest O₃ concentrations, more specifically, downwind during periods of photochemical activity. For the Baltimore-Towson, MD MSA, Essex, Edgewood, and Aldino are assigned this designation. For the Washington-Arlington-Alexandria, DC-MD-VA-WV MSA, HU-Beltsville, Beltsville-CASTNET and PG Equestrian Center are assigned this designation for the Maryland portion of the MSA. For the Martinsburg-Hagerstown, MD-WV MSA, Hagerstown is assigned this designation.

Additional O₃ Monitoring Requirements

Additional O₃ monitoring stations are located throughout Maryland to characterize population exposure to ozone. For the Baltimore-Towson, MD MSA, Padonia, Glen Burnie, Lake Montebello, and South Carroll are assigned this designation. For the Washington-Arlington-Alexandria, DC-MD-VA-WV MSA, Rockville, Frederick, and Calvert are assigned this designation, while the Southern Maryland site is in place to characterize the general background concentration. Piney Run, the rural NCore site, helps characterize regional ozone transport. On the Eastern Shore, Horn Point is in place to characterize the general background concentration and help notify the public about poor AQI conditions; Blackwater CASTNET is designated as a highest concentration monitor; and the Millington ozone monitor is not required at all but serves as an important tool in notifying the public of AQI forecasts.

4.4.2 Sources

Ozone is not emitted directly from a pollution source but is formed in the lower atmosphere by the reaction of nitrogen oxides (NO_x) and volatile organic compounds (VOC's) in the presence of sunlight and warm temperatures. Sources of nitrogen oxides include automobiles, power plants and other combustion activities. VOC's can come from automobiles, gasoline vapors, and a variety of large and small commercial and industrial sources that use chemical solvents, paint thinners, and other chemical compounds. NO_x and VOC's or "precursors of ozone" can travel for many miles before chemical reactions in the atmosphere form O₃.

4.4.3 Changes Planned for 2022-2023

No changes planned.

4.5 Particulate Matter (PM₁₀) – General Description and Sampling Method

MDE uses manual gravimetric monitors to measure PM₁₀ mass concentrations. Gravimetric samplers draw air through a specially designed inlet that excludes particles larger than 10 microns in diameter for a period of 24 hours. The particles are collected on a Teflon filter that is weighed to determine the particulate mass. These samplers report the air volume measured during the sampling period allowing the concentration (mass/volume) to be calculated.

4.5.1 Monitoring Requirements

The number of required PM₁₀ monitors in each CBSA is determined by the CBSA population and design value, as specified in Table D-5 of Appendix D to 40 CFR Part 58. Table 4-5 shows that the MDE monitoring network meets or exceeds the minimum requirements.

Table 4-5 Number of PM₁₀ SLAMS Sites

MSA Name	Population	Monitors Required ^A	Active Monitors in MD/Total ^B
Baltimore-Towson, MD	2,800,189	2-4	2/2
Hagerstown-Martinsburg, MD-WV	291,144	0-1	0/0
Washington-Arlington-Alexandria, DC-VA-MD-WV	6,324,629	2-4	1/5
Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD	6,107,906	2-4	0/2
Salisbury, MD-DE	423,481	0-1	0/0

A – All of the listed MSA’s have PM₁₀ ambient concentrations well below 80% of the PM₁₀ NAAQS.

B –Based on tables available at <https://www.epa.gov/air-trends/air-quality-design-values>.

Minimum Requirements for Collocated PM₁₀

A minimum of 15% (round up), or at least one of the PM₁₀ monitors must be collocated as specified in 40 CFR Part 58 Appendix A 3.3.4. MDE has 3 PM₁₀ monitors and two are collocated (at Glen Burnie), thereby meeting this requirement. The Maryland PM₁₀ monitoring network is shown in Figure 4-4.

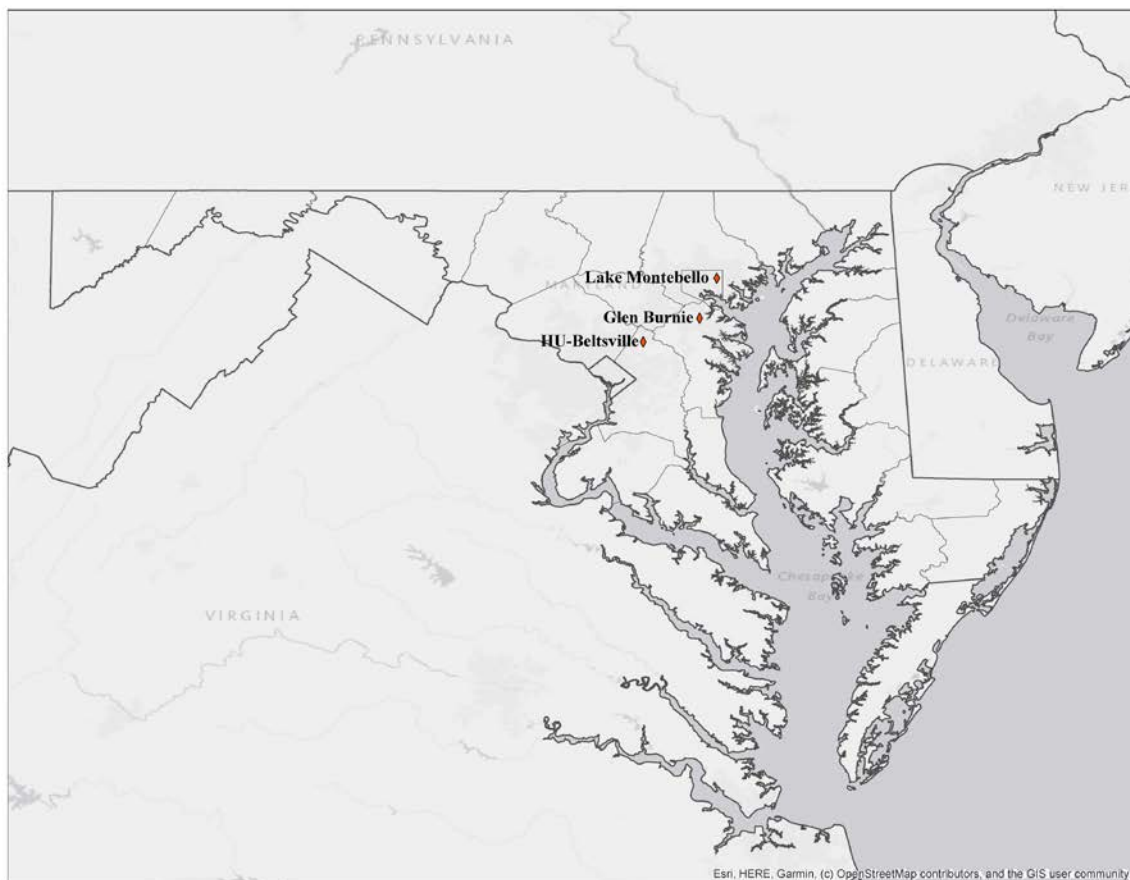


Figure 4-4 Maryland's PM₁₀ monitoring network.

4.5.2 Sources

Major sources of PM₁₀ include steel mills, power plants, motor vehicles, industrial plants, unpaved roads, and agricultural tilling. The wide variety of PM₁₀ sources means that the chemical and physical composition of coarse particles is highly variable.

4.5.3 Changes Planned for 2022-2023

No changes planned.

4.6 Fine Particulate Matter (PM_{2.5}) – General Description and Sampling Method

MDE uses both FRM manual gravimetric and FEM automated monitors (BAM's) to measure PM_{2.5} mass concentrations. For the FRM manual gravimetric sampling, a very sharp cut cyclone (VSSC) is attached to the inlets of these monitors to exclude particles having diameters greater than 2.5 microns. Otherwise, the monitors work as described for PM₁₀ gravimetric monitoring. Some of the gravimetric monitors are specially equipped to collect PM_{2.5} samples, which are later analyzed into concentrations of the samples' chemical constituents or species. See Table 3-6 for list of speciated PM_{2.5} mass. MetOne Super SAAS samplers, URG 3000N, and IMPROVE samplers are used for the collection of samples for the chemical speciation of PM_{2.5}. The samplers collect 3 to 4 filter samples simultaneously every third day for a period of 24 hours. These samples are then sent to an EPA contract laboratory for chemical analyses. There are over 50 species consisting of ions, metals, and carbon species quantified by the analyses (Table 3-6).

For the FEM continuous monitoring, the PM_{2.5} Beta Attenuation Monitor (BAM) automatically measures and records dust concentrations with built-in data logging. The principal of beta ray attenuation is used to provide a simple determination of mass concentration. An external pump pulls a measured amount of air through a filter tape for a one-hour period. The filter tape, impregnated with ambient dust, is placed between the source and the detector thereby causing the attenuation of the measured beta-particle signal. The degree of attenuation of the beta-particle signal is used to determine the mass concentration of particulate matter on the filter tape and hence the hourly volumetric concentration of particulate matter in the ambient air.

4.6.1 Monitoring Requirements

The number of required PM_{2.5} monitors in each MSA is determined by the MSA population and design value, as specified in Table D-5 of Appendix D to 40 CFR Part 58. Table 4-6 shows that the MDE monitoring network meets or exceeds the minimum requirements.

Table 4-6 Number of PM_{2.5} SLAMS Sites Required

MSA Name	Population	2020 Annual Design Value (µg/m ³)	2020 Daily Design Value (µg/m ³)	Required SLAMS Monitors	Monitors Active in MD/Total ^{A,B}	Required [^] 85% NAAQS
Baltimore-Towson, MD	2,800,189	7.9	20	3	5/5	3
Hagerstown-Martinsburg, MD-WV	291,144	8.2	23*	1	1/2	1
Washington-Arlington-Alexandria, DC-VA-MD-WV	6,324,629	8.7	22	2	2/11	3
Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD	6,107,906	10.8*	28*	3	1/21	2
Salisbury, MD-DE	423,481	7.0	17*	0	0/1	0

A - Based on tables available at <https://www.epa.gov/air-trends/air-quality-design-values>.

B- Total number of monitors includes those located in other States.

* Highest values not observed in Maryland.

The Maryland PM_{2.5} monitoring network is shown in in Figure 4-5.

Ambient Air Monitoring Network Plan for Calendar Year 2023

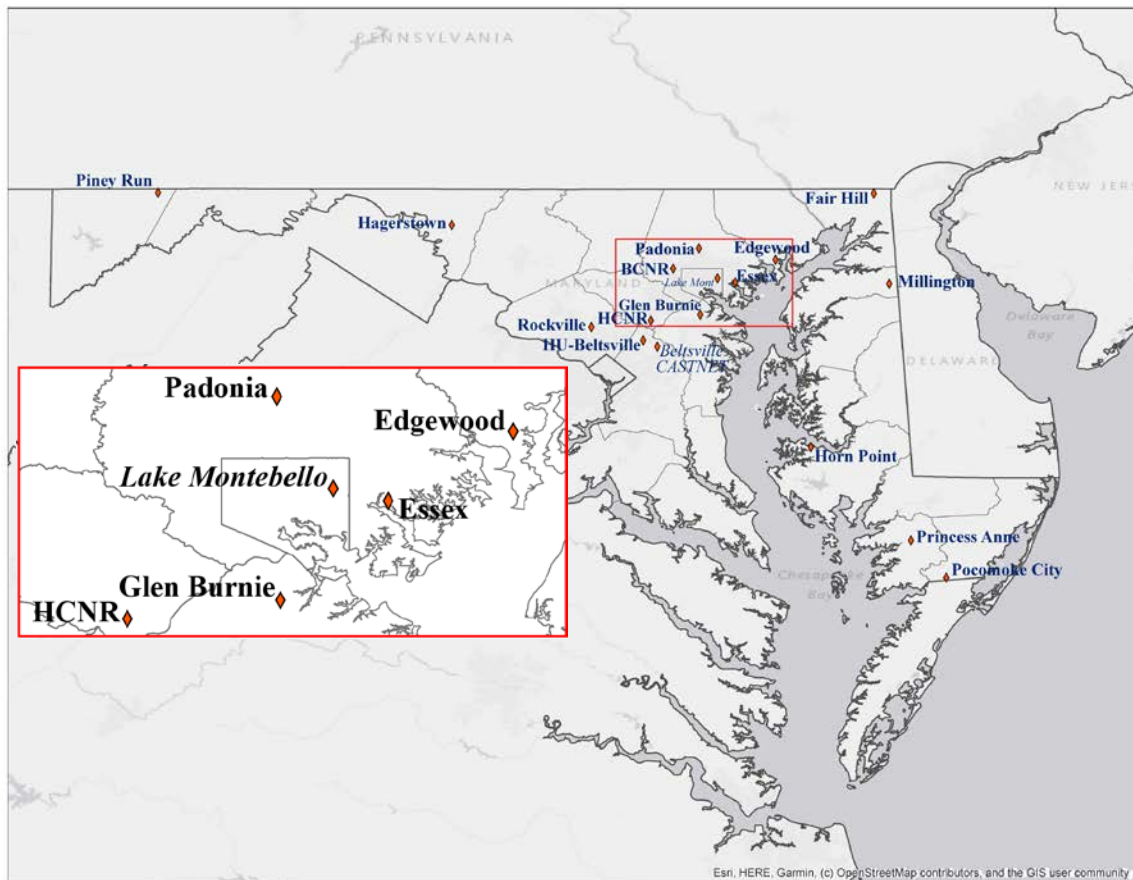


Figure 4-5 Maryland's PM_{2.5} monitoring network.

Minimum Requirements for Collocated PM_{2.5}

Collocation requirements for PM_{2.5} are based on the number of PM_{2.5} monitors within a Primary Quality Assurance Organization (PQAO) and by measurement method (FRM or FEM) as specified in 40 CFR Part 58 Appendix A 3.2.5 and Appendix D 4.7.2. MDE is its own PQAO so all monitors in Maryland are counted in the collocation requirements. A minimum of 15% (round up) of the monitors must be collocated. MDE has 12 PM_{2.5} monitoring stations; therefore 2 must be collocated. MDE currently operates three collocated PM_{2.5} monitors, one FRM-FRM (Howard U), one FRM-FEM, where the FRM is primary, (Lake Montebello), and one FEM-FRM, where the FEM is primary, (Padonia).

Requirements for Continuous PM_{2.5} Monitoring

At least one-half (round up) of the minimum number of sites per MSA must operate continuous PM_{2.5} monitors. MDE operates 11 continuous PM_{2.5} monitors, four in the Baltimore-Towson, MD MSA; two in the Washington-Arlington-Alexandria, DC-VA-MD-WV MSA; one in the Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD MSA; and one in the Hagerstown-Martinsburg, MD-WV MSA. The other three are in areas not designated as MSA's (Figure 3-1; Tables 3-1 and 3-2).

Requirements for Near Road PM_{2.5} Monitoring

For MSA's with a population of one million or greater, at least one PM_{2.5} monitor is to be located at a near road NO₂ station. The Howard County near road site fulfills this requirement for the Baltimore-Towson, MD MSA. MDE does not operate near road NO₂ stations in any other MSA (Section 4.3.1).

Requirements for PM_{2.5} Chemical Speciation

Each state shall continue to conduct chemical speciation monitoring and analyses at sites designated to be part of the PM_{2.5} Chemical Speciation Network (CSN) consisting of PM_{2.5} sites and supplemental sites. MDE conducts chemical speciation monitoring at Essex and HU-Beltsville, but only HU-Beltsville is designated as part of the CSN.

Other Requirements for PM_{2.5} Monitoring

The required monitoring sites must be located to represent area-wide air quality. These will typically be either neighborhood or urban scale, although micro or middle scale may be appropriate in some urban areas. At least one monitoring site must be neighborhood scale or greater in an area of expected maximum concentration and one site must be sited in an area of poor air quality. Each State shall have at least one PM_{2.5} site to monitor for regional background and at least one PM_{2.5} site to monitor for regional transport. Each NCore station must operate a PM_{2.5} monitor. Table 4-7 shows that MDE meets all of these additional requirements.

4.6.2 Sources

PM_{2.5} pollution is emitted from combustion activities, such as industrial and residential fuel burning and motor vehicles. PM_{2.5} can also form in the atmosphere from precursor compounds through various physical and chemical processes.

Table 4-7 Monitor Objective Types and Scales Assigned to PM_{2.5} Monitors in Maryland

Site Name	Measurement Scale	Monitor Objective	MSA
Lake Montebello	Middle Scale	Highest Concentration	Baltimore-Towson, MD
Howard Co. Near Rd	Microscale	Highest Concentration/ Source Oriented	Baltimore-Towson, MD
Padonia	Neighborhood	Population Exposure	Baltimore-Towson, MD
Essex (FRM only)	Neighborhood	Population Exposure	Baltimore-Towson, MD
Edgewood	Neighborhood	Population Exposure	Baltimore-Towson, MD
Hagerstown	Urban Scale	Population Exposure/ Highest Concentration	Hagerstown-Martinsburg, MD-WV
Fair Hill	Regional Scale	Population Exposure	Philadelphia-Camden-Wilmington, PA-DE-MD
Rockville	Neighborhood	Population Exposure	Washington-Arlington-Alexandria, DC-VA-MD-WV
HU-Beltsville	Urban Scale	Population Exposure	Washington-Arlington-Alexandria, DC-VA-MD-WV
Horn Point	Regional Scale	Population Exposure	NA
Millington	Neighborhood	Population Exposure	NA
Piney Run	Regional Scale	Regional Transport	NA

4.6.3 Applicability of FEM Data for Comparison to the NAAQS and Reporting the AQI

MDE operates both FRM and FEM PM_{2.5} monitors (Table 3-2). Pursuant to the January 15, 2013 revisions to PM_{2.5} monitoring requirements, MDE recommends that all of the FEM monitors currently operating in the MDE monitoring network remain eligible for comparison to the PM_{2.5} NAAQS and for reporting the AQI. This recommendation applies retrospectively to FEM data collected since the first quarter of 2012, and prospectively for data collected in 2021 and 2022. MDE will re-evaluate this recommendation for FEM data collected in the 36 months prior to January 1, 2021 and 2022 in next year's Annual Network Plan.

4.6.4 Changes Planned for 2022-2023

No changes planned.

4.7 Sulfur Dioxide (SO₂) – General Description and Sampling Method

Sulfur dioxide (SO₂) is measured with a fluorescence analyzer. Air is drawn through a sample cell where it is subjected to high intensity ultraviolet light. This causes the sulfur dioxide molecules in the air to fluoresce and release light. The fluorescence is detected with a photo multiplier tube and converted to an electrical signal proportional to the SO₂ concentration. The Maryland SO₂ monitoring network is shown in figure 4-6.

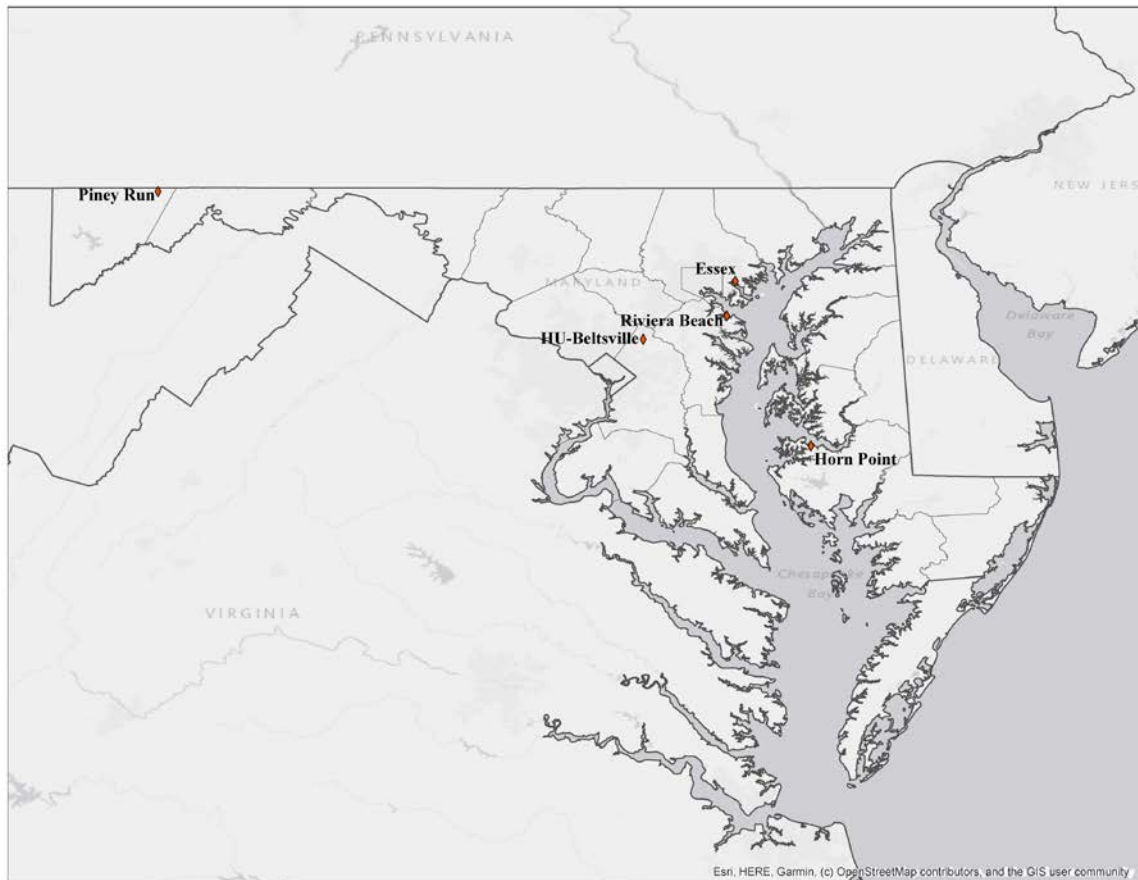


Figure 4-6 Maryland's SO₂ monitoring network

On August 10, 2015, the U.S. EPA finalized the SO₂ Data Requirements Rule (DRR) for air agencies to characterize air quality around sources that emit 2,000 tons per year (tpy) or more of SO₂. On January 5, 2016, MDE notified EPA Region III of six SO₂ emissions sources located in Maryland for which air quality will be characterized. These sources are listed in Table 4-8, along with 2014 emissions data, which were the basis for the application of the DRR.

Table 4-8 Maryland's List of Sources Subject to the Final 1-hour SO₂ Data Requirements Rule.

Facility Name	CAMD SO ₂ (tons)	MDE Data System (TEMPO) SO ₂ (tons)
Brandon Shores	3,145.09	12,757.31*
CP Crane	1,887.16	1,890.04
Chalk Point	3,928.48	3,933.20
Herbert A Wagner	9,610.26	12,757.31*
Verso Luke Mill	N/A	16,999.39
Morgantown	2,961.76	3,134.47

Note that every other source in Maryland emits less than 1,000 tpy of SO₂, per TEMPO 2014 data.

* This is the total for Ft. Smallwood, including both Brandon Shores and HA Wagner

CAMD: Clean Air Markets Division

In support of the SO₂ Data Requirements Rule (DRR), three SO₂ monitors were deployed in January 2017 by Verso Luke Paper Mill, two in Western Maryland and one in West Virginia (for details, please see MDE's 2021 Air Monitoring Network Plan). These sites were being operated by AECOM, under contract to Verso Luke Mill. MDE was the Primary Quality Assurance Organization (PQAO) for these sites, which included performing annual instrument audits and reporting the data to AQS. The paper mill shut down operations in May 2019. On May 7, 2020 Verso Luke Mill surrendered all air quality operating permits and EPA Region III subsequently approved termination of the SO₂ monitoring requirements. Monitoring ended on June 8, 2020 and the equipment was removed. No further monitoring at these locations is planned.

On June 30, 2016, the EPA designated portions of Maryland's Anne Arundel County and Baltimore County as non-attainment for the 2010 1-hour SO₂ NAAQS. The NAA extends approximately 26.8 kilometers (16.6 miles) from the Herbert A. Wagner's Unit 3 stack, which is located at 39.17765N latitude and 76.52752W longitude (see Maryland 2018 Monitoring Network Plan.) This designation was based on modeled, not monitored, SO₂ concentrations. In order to better evaluate actual ambient SO₂ concentrations, a source-oriented SO₂ monitor was established at Riviera Beach Elementary School as a Special Purpose Monitor on January 12, 2018.

4.7.1 Monitoring Requirements

The minimum number of required SO₂ monitors in each MSA is proportional to the product of the total amount of SO₂ emissions in the MSA and its population, as specified in 40 CFR Part 58, Appendix D, Section 4.4. The resulting value is defined as the Population Weighted Emissions Index (PWEI). SO₂ emissions shown in Table 4-9 are from the 2011 National Emissions Inventory (NEI).

Table 4-9 Minimum SO₂ Monitoring Requirements

MSA Name	2020 Population Estimate ^A	2014 NEI SO ₂ (tons/year) ^B	PWEI (millions of people-tons per year)	Monitors Required	Monitors Active in MD/Total ^C
Baltimore-Towson, MD	2,800,189	18,452	51,644	1	1/1
Hagerstown-Martinsburg, MD-WV	291,144	2,096	553	0	0/0
Washington-Arlington-Alexandria, DC-VA-MD-WV	6,234,629	13,237	81,170	1	1/5
Salisbury, MD-DE	423,481	1,252	501	0	0/1
Philadelphia-Camden-Wilmington-Newark, PA-NJ-DE-MD	6,107,906	12,934	78,518	1	0/7

^APopulation from Federal Reserve Economic Data, estimates as of May 5, 2021

^BNEI from 2014 Sector summaries <https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data>

^CTotal monitors in an MSA is based on tables available at <https://www.epa.gov/air-trends/air-quality-design-values>

Other SO₂ Monitoring Requirements

The Regional Administrator may require additional SO₂ monitoring stations above the minimum in areas where the minimum requirements are not deemed sufficient to meet monitoring objectives. There are no additional monitors required in Maryland by the Regional Administrator.

Each NCore station must operate a SO₂ monitor. This requirement is met at both the HU-Beltsville and Piney Run monitoring stations.

4.7.2 Sources

The main sources of SO₂ are combustion of coal and oil (mostly from electrical generating units (EGUs), refineries, smelters, and industrial boilers). Nationally, two-thirds of all SO₂ emissions are from EGUs. Coal operated EGUs account for 95% of these emissions.

4.7.3 Changes Planned for 2022-2023

MDE proposes to discontinue monitoring for SO₂ at Riviera Beach. In 2016, the EPA designated portions of Anne Arundel County and Baltimore County as non-attainment for the 2010 1-hour SO₂ NAAQS. This designation was based on modeled, not monitored, SO₂ concentrations. In order to better evaluate actual ambient SO₂ concentrations, a source-oriented SO₂ monitor was established at Riviera Beach Elementary School as a Special Purpose Monitor on January 12, 2018. Over three years of operation, the SO₂ concentrations measured at this site have never exceeded the 1-hour standard (75 ppb). The preliminary 2020 Design Value is 24 ppb, less than 33% of the Standard.

As of June 1, 2020, one of the Wagner Units at the Fort Smallwood Complex has been removed from supplying electricity to the grid and fuel switched from coal to natural gas. It is only permitted to operate to supply heat to the plant when necessary. Effective under a consent order as of January 1, 2021, the other Wagner and Brandon Shores Units at the complex have had many emissions and operational limits imposed and will cease combustion of coal by 2026. For these reasons MDE proposes to terminate SO₂ monitoring at Riviera Beach upon approval from EPA Region III.

4.8 Photochemical Assessment Monitoring Stations (PAMS) – General Description and Sampling Method

The purpose of the PAMS program is to provide an air quality database that will assist in evaluating and modifying control strategies for attaining the ozone NAAQS. The selection of parameters to be measured at a PAMS site varies with the site's ozone nonattainment designation (moderate, serious, severe, or extreme) and whether the site is upwind or downwind of ozone precursor source areas. The parameters are O₃, NO, NO_x, NO₂, NO_y, and speciated volatile organic compounds (VOC's). The Maryland PAMS monitoring network is shown in Figure 4-7.

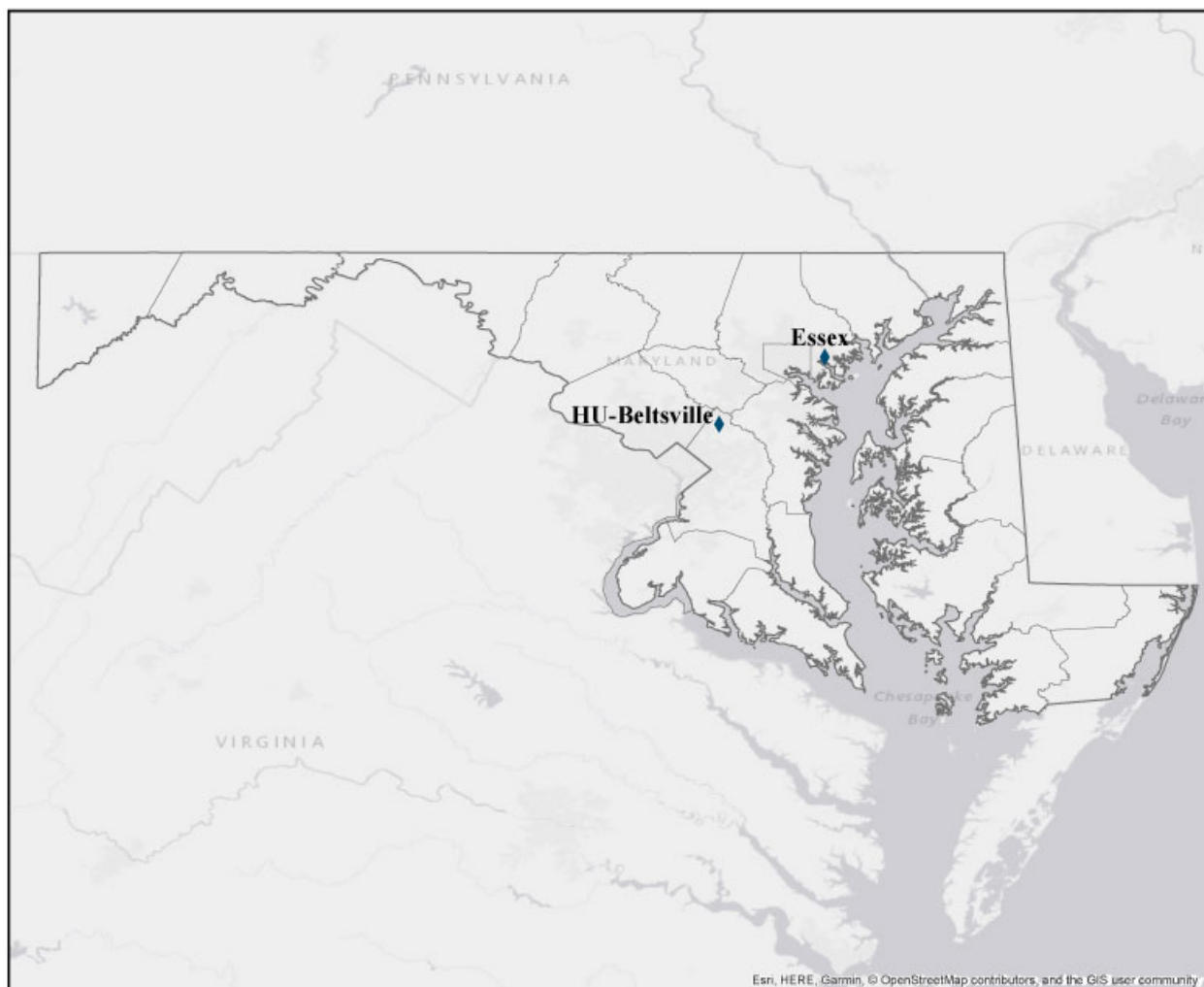


Figure 4-7 Maryland's PAMS monitoring network.

On October 1, 2015, the PAMS monitoring rule (40 CFR Part 58, Appendix D, Section 5) was revised in conjunction with the strengthening of the ozone NAAQS. States have until June 1, 2021 to meet these new requirements. MDE's PAMS Quality Assurance Project Plan was approved by the EPA on February 3, 2021.

Based on 40 CFR part 58, Appendix D, State air monitoring agencies were required to begin making the revised PAMS measurements at their NCore location(s) by June 1, 2019. EPA proposed a two-year extension to this deadline on May 31, 2019 because many states had not yet received the equipment and training needed to implement the new requirements. A final rule extending the start date from June 1, 2019 to June 1, 2021 was signed on December 20, 2019 and published in the Federal Register on January 8, 2020. Agencies may elect to start the revised PAMS requirements sooner if they so choose. MDE has all the necessary equipment and began collecting the required PAMS measurements June 1, 2020. A CL51 ceilometer is in the process of being relocated to the Essex site.

MDE was granted a waiver (Appendix D to the 2018 Monitoring Network Plan) to terminate the collection of PAMS data at HU-Beltsville in support of enhanced PAMS monitoring at Essex. This change, which included relocating the Total Reactive Nitrogen Species (NO_y) monitor from Howard U to Essex, was approved on May 31, 2017.

Methods used to sample and analyze VOC's and NO_y follow (NO/NO_x and O₃ have already been described in Sections 4.3 and 4.4, respectively):

- Ambient air is collected in three 8-hour canister samples every 3rd day during PAMS season (June – August) using a XonTech Model 910A Canister Sampler with a Model 912 multi-canister sampling adapter. The canisters are returned to the laboratory for analysis on an EnTech/Agilent GC/FID system.
- Ambient air is collected year round in 24-hour canister samples every sixth day using a XonTech Model 910A/Atec Model 2200 Canister Sampler. The canisters are returned to the laboratory for analysis on an EnTech/Agilent GC/FID system. These are the same canister samples listed in section 4.9 below but analyzed for the PAMS list of compounds.
- Ambient air is collected and analyzed on-site every hour (June – August) using a Markes-Agilent auto GC.
- Ambient air is sampled hourly for NO_y using an API T200U NO_y low level oxides of nitrogen analyzer.

4.8.1 Monitoring Requirements and Locations for Revised PAMS Monitoring Rule

Under the October 1, 2015 revisions to the PAMS monitoring rule, state and local monitoring agencies are required to collect and report PAMS measurements at each NCore site with a population of 1,000,000 or more beginning June 1, 2021. PAMS measurements include:

- (1) Hourly averaged speciated volatile organic compounds (VOCs);
- (2) Three 8-hour averaged carbonyl samples per day on a 1 in 3 day schedule, or hourly averaged formaldehyde;
- (3) Hourly averaged O₃;
- (4) Hourly averaged nitrogen oxide (NO), true nitrogen dioxide (NO₂), and total reactive nitrogen (NO_y);
- (5) Hourly averaged ambient temperature;
- (6) Hourly vector-averaged wind direction;
- (7) Hourly vector-averaged wind speed;
- (8) Hourly averaged atmospheric pressure;
- (9) Hourly averaged relative humidity;
- (10) Hourly precipitation;
- (11) Hourly averaged mixing-height;
- (12) Hourly averaged solar radiation; and
- (13) Hourly averaged ultraviolet radiation.

MDE has been granted a waiver from the EPA Region III Administrator to collect the required PAMS measurements at the Essex site in lieu of the HU-Beltsville site in order to maintain the 25 year historical record of ozone precursor trends collected at the Essex site, located in the Baltimore-Towson, MD CBSA.

MDE adopted the national PAMS Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOP's), with minor modifications. EPA approval was granted on Feb 3, 2021.

With respect to PAMS instrumentation at the Essex site, MDE utilizes the following:

Hourly Speciated VOC's

Hourly averaged speciated VOC's will be measured, at a minimum, from June through August with a Markes-Agilent Auto GC.

Carbonyls

Carbonyl sampling will be made at a frequency of three 8-hour on a one-in-three day basis from June through August annually using an ATEC Model 8000-2 Eight Channel Automated Carbonyl sampler with co-located independent channel. Samples will be analyzed by ERG laboratory services (RTP, NC) using EPA Method TO-11A, as used in the National Air Toxics Trends (NATTS) program.

Nitrogen Oxides

Hourly averaged NO, NO_y and true NO₂ will be measured, at a minimum, from June through August. True NO₂ will be measured with a Teledyne API Model T500U CAPS NO₂ analyzer. NO and NO_y will be measured using an API T200U NO_y analyzer.

Meteorological Parameters

Hourly averaged temperature, vector-averaged wind speed, vector-averaged wind direction, atmospheric pressure, relative humidity, and precipitation will be measured with a Vaisala Model WXT520.

Hourly averaged solar radiation will be measured with a Kipp and Zonen SPLite instrument. Hourly averaged ultraviolet radiation will be measured with a Kipp and Zonen SUV-5 instrument. Hourly averaged mixing height will be measured with a Viasala Model CL51 ceilometer.

4.8.2 Sources

PAMS VOC's can come from automobiles, gasoline vapors, and a vast variety of large and small commercial, and industrial sources that use chemical solvents, paint thinners and other chemical compounds.

4.8.3 Changes Planned for 2022-2023

No changes planned.

4.8.4 MDE Enhanced Monitoring Plan

EPA developed a Technical Note “Guidance for Photochemical Assessment Monitoring Stations (PAMS) Required Network Implementation Plans and Enhanced Monitoring Plans (EMP’s)” that recommended monitoring organizations submit the EMP by July 1, 2018 along with the annual network plan. In addition to the requirements listed in Section 4.8.1, the October 1, 2015 revisions to the PAMS monitoring rule also require states with moderate and above 8-hour ozone nonattainment areas and states in the Ozone Transport Region to develop and implement an Enhanced Monitoring Plan (EMP) detailing enhanced ozone and ozone precursor monitoring activities to be performed. The regulatory requirement for EMP contained in 50CFR58, Appendix D.5(h) states that “the EMP shall be submitted to the EPA Regional Administrator no later than October 1, 2019” for states in the Ozone Transport Region.

MDE has implemented the following measurements as basic elements of the required EMP:

- Year round ozone monitoring at Piney Run, Essex, HU-Beltsville, and Horn Point as of 2020.
- Additional VOC measurements at HU-Beltsville, as of June 2019, consisting of eight 3-hour canister samples collected every third day June through August.
- PAMS analysis performed on air toxics canisters collected at HU-Beltsville, Essex, Oldtown, and Howard County Near Road.
- Operation of radar wind profilers at Piney Run, HU-Beltsville, and Horn Point as of 2020.

Collection and reporting of these measurements will be contingent on receipt of sufficient additional EPA funding directed specifically towards these EMP activities.

In addition to the activities listed above, MDE is considering the use of low cost sensors to measure ozone at higher spatial resolution as a means to investigate concentration gradients and spatial variability. MDE is also exploring the possibility of pooling future EMP funding with other states within the OTR. The goal in mind is to develop an OTR-wide approach to special intensive studies possibly utilizing aircraft, ozonesondes, LIDAR, unmanned aerial vehicles (UAVs), low cost sensors, and other research measurement platforms.

4.9 Air Toxics – General Description and Sampling Method

Air toxics, or hazardous air pollutants (HAPS), are those pollutants which are known or suspected to cause cancer or other serious health effects, such as reproductive or birth defects, or adverse environmental effects. MDE’s air toxics network measures the toxic VOCs listed in Table 3-6. Air toxics samples are collected for 24 hours in canisters with a XonTech 910A or Atec 2200 canister sampler on an every sixth day schedule. The canisters are returned to the MDE laboratory for analysis on an Entech/Agilent gas chromatograph mass spectrometer system. Maryland’s air toxics monitoring network is show in Figure 4-8.

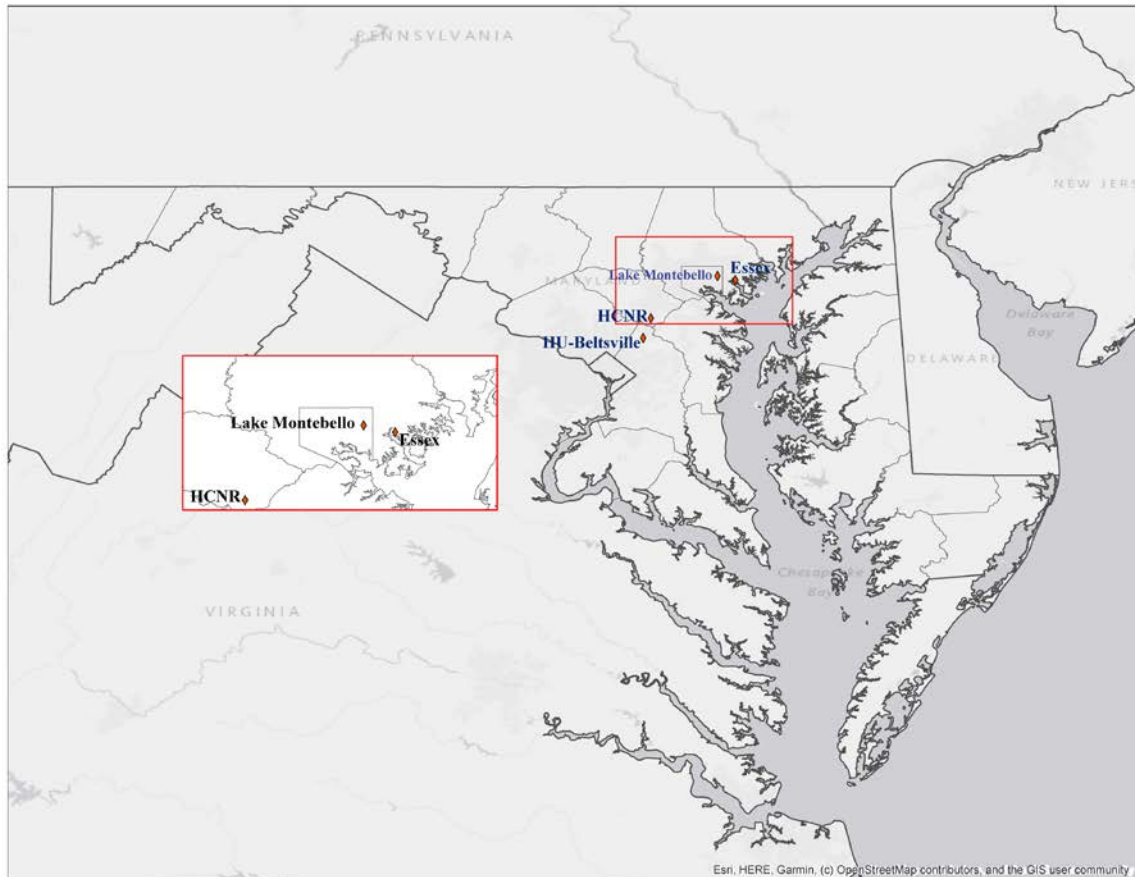


Figure 4-8 Maryland's Air Toxics monitoring network.

4.9.1 Monitoring Requirements

As part of the EPA Region III Cooperative Toxic Monitoring Program, MDE operates four air toxic monitoring stations to assess general urban levels. Toxics are sampled every sixth day year-round.

4.9.2 Monitoring Locations

There are four monitors measuring air toxics in Maryland: Essex, Baltimore County; Lake Montebello, Baltimore City; Howard County Near Road, Howard County; and HU-Beltsville, Prince George's County. Refer back to Table 3-2 Monitor Information for Current Maryland Ambient Air Monitoring Sites, for parameter information and monitoring objective at each monitoring site. For a map of monitoring locations in Maryland refer to Figure 3-1.

4.9.3 Sources

Toxics can come from automobiles, gasoline vapors, and a large variety of large and small commercial and industrial sources that use chemical solvents, paint thinners and other chemical compounds.

4.9.4 Changes Planned for 2022-2023

No changes planned.

4.10 NCore – General Description and Sampling Method

NCore, or National Core multi-pollutant monitoring stations, is the National monitoring network required in the October 17, 2006 revisions to the air monitoring regulations (40 CFR, Part 58). NCore sites are required to measure, at a minimum, PM_{2.5} particle mass using continuous and integrated/filter-based samplers, PM_{10-2.5} particle mass, O₃, SO₂, CO, NO/NO_y, wind speed, wind direction, barometric pressure, rain, relative humidity, and ambient temperature.

Sampling methods for PM_{2.5}, O₃, SO₂, NO/ NO_y are described under the individual pollutant sections throughout this document. Trace level measurement of CO and SO₂ is performed at NCore sites. PM_{10-2.5} is determined by the difference between collocated PM₁₀ and PM_{2.5} FRM samplers. The meteorological parameters (Table 3-4) are measured as follows:

- The Vaisala WXT530 PTU module contains separate sensors for pressure, temperature and humidity measurements. The measurement principle of the pressure, temperature and humidity sensors is based on an advanced RC oscillator and two reference capacitors against which the capacitance of the sensors is continuously measured. The microprocessor of the transmitter performs compensation for the temperature dependency of the pressure and humidity sensors.
- The Vaisala WXT530 uses RAINCAP Sensor 2- technology in precipitation measurement. The precipitation sensor comprises a steel cover and a piezoelectrical sensor mounted on the bottom surface of the cover. The precipitation sensor detects the impact of individual raindrops. Hence, the signal of each drop can be converted directly to accumulated rainfall. An advanced noise filtering technique is used to filter out signals originating from other sources and not raindrops.
- The Vaisala WXT530 uses WINDCAP sensor technology in wind measurement. The wind sensor has an array of three equally spaced ultrasonic transducers on a horizontal plane. Wind speed and wind directions are determined by measuring the time it takes the ultrasound to travel from each transducer to the other two. The wind sensor measures the transit time (in both directions) along the three paths established by the array of transducers. This transit time depends on the wind speed along the ultrasonic path. For zero wind speed, both the forward and reverse transit times are the same. With wind along the sound path, the up-wind direction transit time increases and the down-wind transit time decreases.

MDE operates other meteorological parameters not required by the NCore network, and they are measured as follows:

- The Kipp and Zonen SMP3 instrument is used to measure solar radiation at the Piney Run and HU-Beltsville NCore sites, as well as at Essex. It uses a photodiode detector, which creates a voltage output that is proportional to the incoming radiation. Ultraviolet (UV) radiation is measured at Essex using a Kipp and Zonen SUV-5 instrument.

4.10.1 Monitoring Requirements

Each State is required to operate one NCore site. Urban NCore stations are to be located at the urban or neighborhood scale to provide representative concentrations of exposure expected throughout the metropolitan area. Rural NCore stations are to be located to the maximum extent practicable at a regional or larger scale away from any large local emission source so that they represent ambient concentrations over an extensive area.

4.10.2 Monitoring Locations

MDE operates two NCore stations, at HU-Beltsville and Piney Run. The HU-Beltsville site is considered an Urban NCore site and Piney Run, a Rural NCore site. Refer to Table 3-2 for parameter information and monitoring objective at each site. For a map of monitoring locations in Maryland, refer to Figure 4-9.

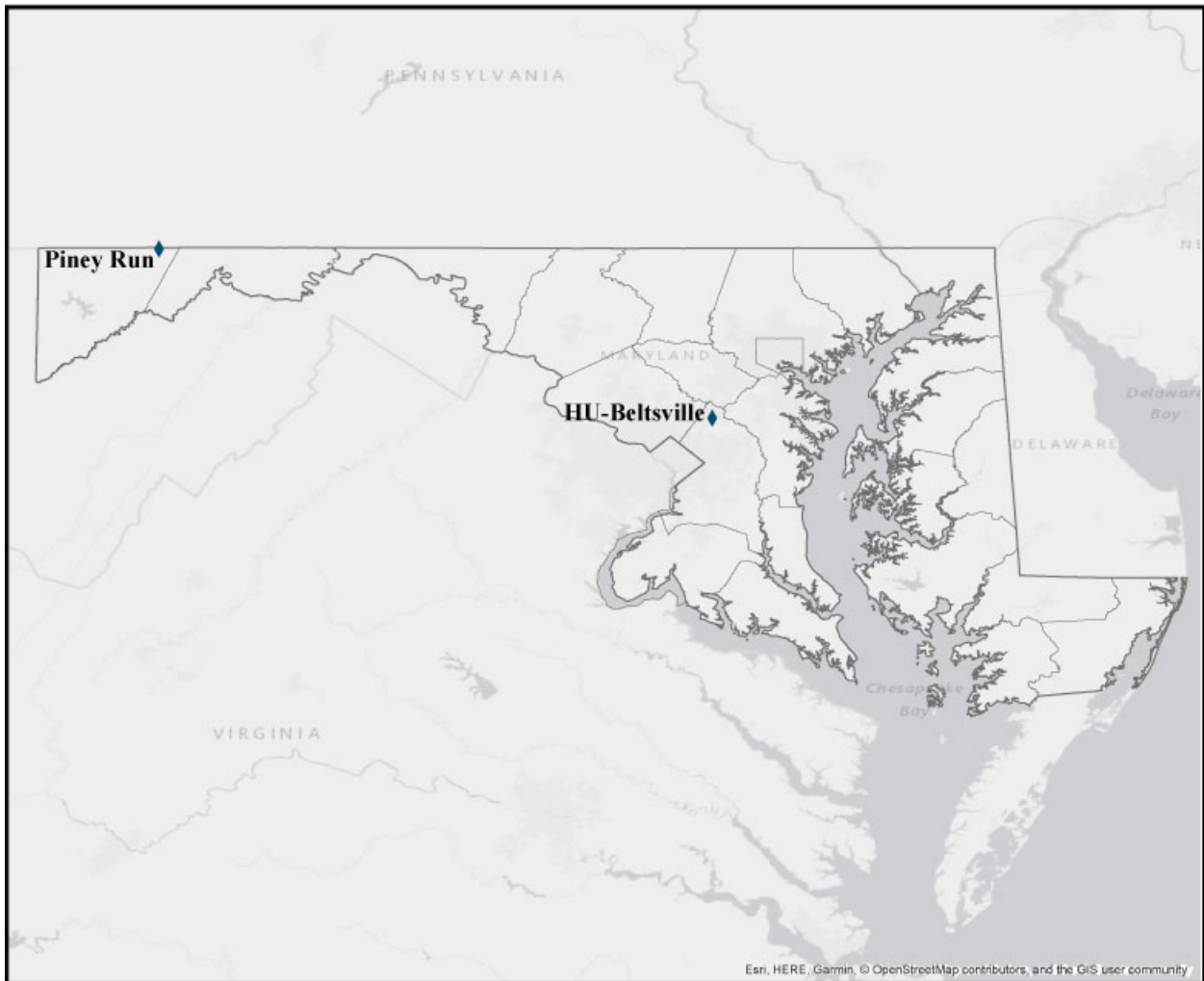


Figure 4-9 Maryland's NCore monitoring network.

4.10.3 Sources

Sources have already been addressed under the individual pollutant sections throughout this document.

4.10.4 Changes Planned for 2022-2023

No changes planned.