STATE OF RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Rhode Island 2023 Annual Monitoring Network Plan

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Table of Contents

List of Tables

List of Figures

Acronyms and Abbreviations

AIRS-AQS	Aerometric Information Retrieval System - Air Quality System
AQI	Air Quality Index
BAM	Beta Attenuation Monitor
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DEM	Department of Environmental Management (RI)
DOH	Department of Health (RI)
EIS	Emissions Inventory System
EMP	Enhanced Monitoring Plan
EPA	Environmental Protection Agency
FEM	Federal equivalent method
FRM	Federal reference method
GC	Gas chromatograph
HAPs	Hazardous air pollutants
MADEP	Massachusetts Department of Environmental Protection
MDL	Method detection limit
MSA	Metropolitan statistical area
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
NATTS	National Air Toxics Trends Station
NCORE	National Core Multi-pollutant Monitoring Station
NO2	Nitrogen dioxide
NOx	Nitrogen oxides
OAQPS	Office of Air Quality Planning and Standards
ORD	Office of Research and Development
OTR	Ozone Transport Region
PAMS	Photochemical Assessment Monitoring Stations
PAH	Polycyclic Aromatic Hydrocarbon
PM10	Particulate matter < 10 microns
PM2.5	Particulate matter < 2.5 microns
QAPP	Quality assurance project plan
O3	Ozone
SIPs	State implementation plans
SLAMS	State and Local Air Monitoring Station
SOP	Standard operating procedure
SO2	Sulfur dioxide
STN	Speciation Trends Network
SVOC	Semi-Volatile Compound
VOC	Volatile Organic Compound

Introduction and Regulatory Background

This document will serve as Rhode Island's 2023 Annual Monitoring Network Plan, prepared by the Rhode Island Department of Environmental Management, in accordance with Section 58.10 (a) of Title 40 of the Code of Federal Regulations (40 CFR 58.10(a)), which requires states to submit a monitoring network plan to the United States Environmental Protection Agency (EPA) in July of each year. The plan provides a description of the state's current monitoring network, demonstrates that the network conforms to EPA requirements, and discusses any plans to remove or move a monitoring station in the 18 months following the plan submittal. The Annual Monitoring Network Plan must be posted for public comment 30 days prior to submittal to the EPA. Note, Rhode Island's 5- Year Network Assessment was submitted to EPA on July 24, 2020.

Port of Providence

RIDEM submitted a grant application for a 2020 Community-Scale Air Toxics Monitoring Grant (EPA-OAR-OAQPS-20-05), which was awarded in August 2020 by EPA. The full scale of the project, which began in June 2021, aims to characterize air toxic emissions near the Port of Providence. Populations near the Port of Providence include surrounding environmental justice areas, residences, schools, businesses, and hospitals. Air quality near the Port is impacted by air pollution generated from diesel trucks, marine vessels, oil and gas storage and distribution, asphalt and cement processing, metals recycling, natural gas and utility service, and large heating plants. *It is important to note that RIDEM is continuously seeking strategies to evaluate air quality in this Environmental Justice Area, with this and future studies. Currently RIDEM has some opportunities with funding from the American Rescue Plan to continue exploring monitoring capabilities and activities around the Port. Some of the possible projects involve a permanent monitoring site, monitoring for PM 10, and portable or more strategic VOC monitoring.*

To best capture emissions from port-related activities five monitoring locations were selected around the Port based on proximity to the Port and prevailing wind directions. The original sites selected included 455 Wickenden (Vartan Gregorian School), 89 Washington Ave (neighborhood site), and 200 Terminal Rd (in Port worst case site) all in Providence and 525 Veterans Memorial Parkway in East Providence, however, due to issues at the Vartan site and the Washington Ave site these two sites needed to be relocated, further discussion is below, leaving the following as the final monitoring locations:

SITE	Address	MONITORING OBJECTIVE	PARAMETERS
Providence Community Health Center	695 Eddy Street Providence	Upwind of I-95 and near industrialized portion of Allens Ave in medical district	Low-cost PM 2.5/NO_2 Meteorology VOC 1 in 6
Providence Animal Shelter	200 Terminal Road Providence	Centrally located near the center of Port, heavy truck traffic, industrialized	Low-cost PM 2.5/NO_2 Meteorology VOC 1 in 6
Seastreak Ferry Terminal	25 India Street Providence	Northern edge of Narragansett Bay, downwind of Port (on prevailing W/SW flow)	Low-cost PM 2.5/NO_2 VOC 1 in 6
Residential	215 Ohio Avenue Providence	Population Exposure in Washington Park	Low-cost PM 2.5/NO_2 VOC 1 in 6
SUEZ Pump Station	525 Veterans Memorial Parkway East Providence	East Bay with possible impacts downwind of the Port	Low-cost PM 2.5/NO_2 Meteorology VOC 1 in 6

Issues at the Vartan Gregoria Elementary School included tampering with the equipment, vandalism, and ultimately theft of the power supply cords, requiring RIDEM to find a new location. The move was officially made during September 2021 to the Seastreak Ferry Depot, located right along the northern portion of Narragansett Bay, which proved to be a better location in terms of capturing flows from the Port. The Seastreak location proved to be secure and allowed less possible interference of emissions from I-195 as it is located south of I-195, while the prior Vartan site was north of the freeway, which may have captured highway emissions with prevailing flows.

RIDEM also had to relocate from a private residence on Washington Avenue to a private residence on Ohio Avenue during October 2021 due to logistical challenges.

MONITORING EQUIPMENT

PM2.5/NO_2

Clarity Node-S air sensors were selected for monitoring PM2.5 and NO_2. The units are self-powered, weatherproof, and contain cellular modems to push continuous data to their custom interface showing real time data with data downloads. The PM2.5 data has been shown to correlate acceptably with FRM/FEM data after applying correction factors. Prior to deployment, RIDEM collocated all five Clarity units to our Near Road location on Park/Hayes Street Providence for approximately 30 days during Oct 2020. This time allowed Clarity staff to analyze the data and create custom correction factors for each unit using the Near Road BAM PM2.5, temperature, and relative humidity.

The Clarity Node-S units were all deployed the same day on 11/20/20.

- RIDEM was able to achieve 2 years of data capture for the Clarity-Nodes through November 2022.
- The contract for the Clarity Nodes ended November 2022.
- RIDEM still has possession of the hardware, but subscription to cellular modems have been discontinued.
- As noted above, due to logistical challenges, 2 sites had to be moved mid-study.
- A Clarity monitor failed at Vartan on July 25, 2021 due to clogged intake and was replaced after the move to Sea Streak on October 19, 2021.
- A Clarity at Ohio Ave failed on September 26, 2022 due to clogged intake. The unit was not replaced before end of study, as there was a wait for new equipment which would have gone beyond the end of the study.

Upon ending the Clarity Node-S field monitoring, RIDEM staff met with Clarity techs to discuss the data set. Clarity staff evaluated the PM2.5 data and determined the data for the monitoring period was stable and no longer needed any calibration or collocation. Clarity did recommend performing a collocation of the sensors to FRM/FEM equipment at Near Road for purposes of NO_2 data. The sensors were deployed on the week of 1/19/23.Updated calibration factors will be applied to the NO_2 at the end of this collocation with the Thermo 42i NO_x monitor at Near Road. However, the NO_x monitor at Near Road has been experiencing issues. Even calibrated NO_x data has not been shown to correlate well with FEM/FRM data, and RIDEM is working with Clarity to determine how to evaluate calibrated NO_2 data gathered in this study.

Meteorological Equipment

For meteorological equipment, Rainwise MK4-C units were selected for use at three locations, Providence Animal Shelter, Suez, and the Providence Community Health Center. Rainwise equipment was deployed from June 2021 through October 2022. The parameters measured included temperature, dewpoint, wind direction, wind speed, wind gusts, and barometric

pressure. Like Clarity Node-S, the Rainwise data was pushed by a cellular modem to an interface with real time and downloadable data capability. The data was evaluated for quality and downloaded weekly from the online database.

The Rainwise equipment also experienced technical problems including:

- Lost Rainwise communication at Animal Shelter on January 26, 2022 – repaired by February 24, 2022
- Lost Rainwise communication at Suez on January 19, 2022 – repaired by February 16, 2022

VOC Monitoring Equipment

Five monitoring shelters were deployed to house Xonteck Model 910 VOC samplers. 24-hour VOC samples were collected at each site every 6th day according to the monitoring schedules at the existing NATTS and NCore sites. Sampling began on June 3, 2021, with a focus on volatile organic compounds, benzene and 1,3 butadiene found in diesel exhaust and petroleum products. VOC samples are obtained every sixth day on the same schedule and method as PAMs VOC sampling using Method TO-15A by the Air Pollution Laboratory using an Agilent GC/MS. The same parameters measured at the NATTS and NCore sites will be evaluated for the study for comparison to the permanent site data in the analysis. VOC sampling ending October 2022. See Table 12 for the full listing of targeted compounds. ***RIDEM is working to contract NESCAUM staff to do the analysis of this data.***

The new GC was installed on June 23, 2021, with the Entech preconcentrator being upgraded July 21-23, 2021. There were issues tuning the new instrument including communication issues, software problems, and the need for reinstallation of a computer. The system was officially calibrated on July 27, 2021 with cans run on the system on July 28, 2021.

In addition to issues with the GC/MS, the VOC equipment itself was not without problems. The fleet of Xonteck samplers consisted of previously owned and newly purchased units through the grant. The purchase of the new units was complicated by the pandemic, lack of communication with the Xonteck staff, and issues with the new equipment upon delivery resulting in major delays in getting the new units. Once received, some of the new units showed toluene contamination, poorly installed and loose-fitting parts, and issues requiring the APL to return to the manufacturer.

Additionally, there were some issues of data capture in the field. The operator witnessed missed or failed runs due to power failures, flow rate issues, or low final pressure in cannisters. The RIDOH Air Pollution Laboratory has processed all the data, and it's been delivered to NESCAUM staff to begin analysis.

Community Outreach Activities

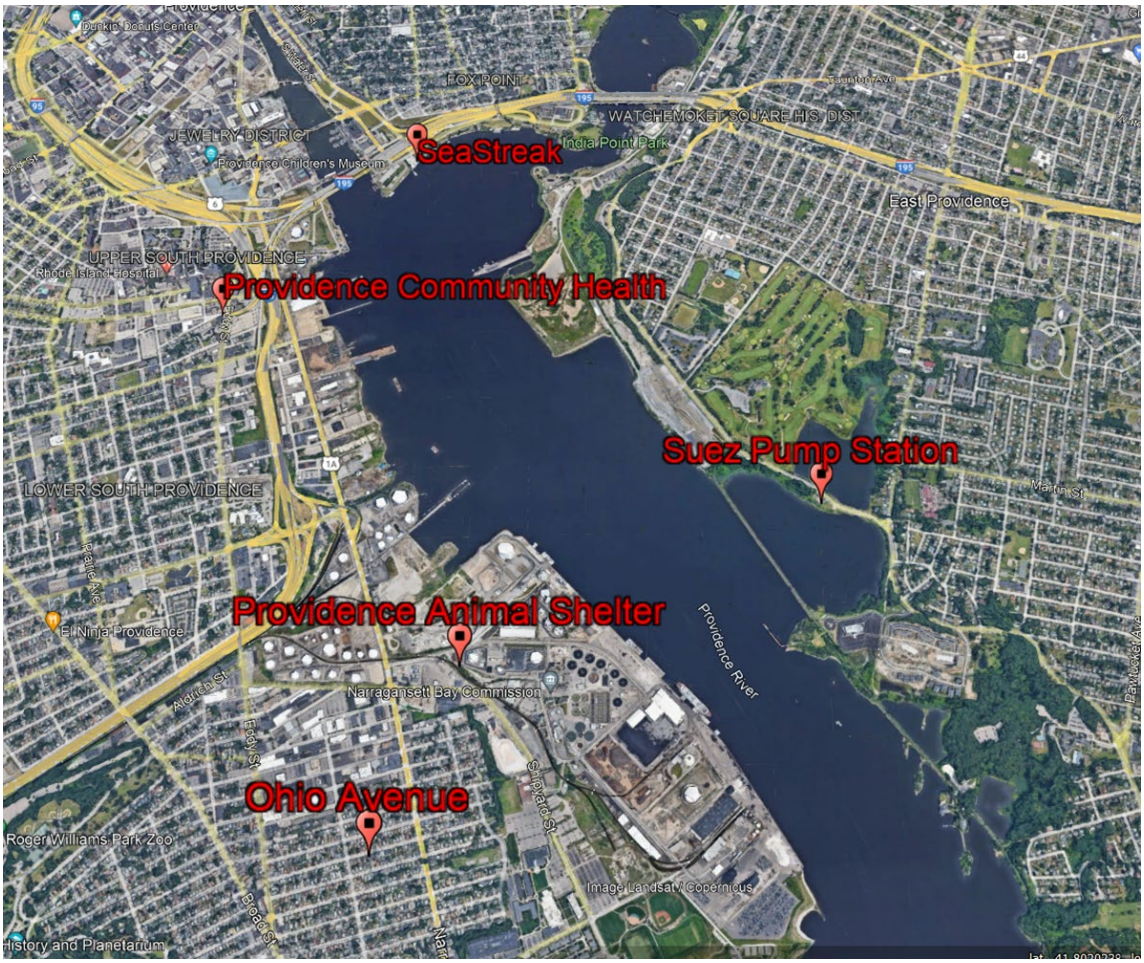
Presentations on this project were conducted on the following dates for the following audiences.

- Port Community Working Group – 8/18/2022
- Port Community Working Group – 12/7/2022

Direct contact was made to provide updates on the project to a variety of stakeholders, and to get input and support for further monitoring initiatives based on preliminary data collected. As a result of communication with stakeholders and community members a specific Air Quality Monitoring working group to discuss this project and other air quality issues surrounding the Port of Providence and the city was formed . The kickoff Zoom meeting occurred on 2/8/23 and included community members, NGOs, a variety of staff from RIDEM, RIDOH, and Brown University. The group aims to meet again in the fall of 2023.

A website specific to this project went live at the start of the study. The site describes the project background, has an interactive map of Port emission sources, links to emissions inventory data, and mapped real time PM 2.5 data while the Clarity Node-S units were operating. http://www.dem.ri.gov/programs/air/port-providence.php

Figure 1: Community Scale Monitoring Locations



Additional Port Activities

The comprehensive study also includes a survey of all sources in the area for chemical and fuel use and compliance inspections at all facilities located in the Port area. The strategy also includes routine staff odor checks, compliance inspections, and a regular presence in the Port of Providence by inspectors.

A joint mobile monitoring effort with RIDEM and led by EPA, included the use of a DART (data acquisition in real time) mobile monitoring system, which measured TVOC and meteorology from September 13-17, 2021, around the state of Rhode Island, with a focus on the Port. Additionally, a more robust monitoring effort using a GMAP mobile monitoring platform was conducted September 27-29, again statewide, but with a focus on the Port. Both projects provided information on emission sources around the Port, and informed future compliance inspections and planning for future monitoring. Although a DART platform is not available in the open market, RIDEM is exploring ways to monitor VOCs on a mobile platform or with emerging low-cost options.

Following completion of sampling, a full report will be completed with community outreach, presentations, and sharing of the findings to all interested parties including possible next steps for monitoring.

Other Low-Cost Monitoring Activities

Following the historic smoke events experienced during June 2023, the Purple Air network was a valuable to track smoke plumes on a more granular spatial scale. There were days smoke was most often highest along coastal RI. Additionally, the Purple Air map revealed there were some monitoring gaps in both the northwest and extreme southern coastal portions of the state that could be of value in tracking, predicting, and monitoring smoke plumes from wildfire smoke events. Although this most recent event was historic and rare, it was very impactful and RIDEM would be able to fill these spatial gaps at very little cost.

Rhode Island Monitoring Network

The Rhode Island Department of Environmental Management (RIDEM), in conjunction with the Rhode Island Department of Health (RIDOH), operate a network of air monitoring stations to measure ambient concentrations of pollutants for which the EPA has established a National Ambient Air Quality Standard (NAAQS). Those pollutants, which are known as criteria pollutants, include ozone (O_3), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO2), carbon monoxide (CO) and lead. The criteria pollutant monitoring sites are part of the EPA's State or Local Air Monitoring Stations network (SLAMS).

In addition, RIDEM and RIDOH monitor ambient levels of toxic air pollutants and ozone precursors, which are compounds that react in the atmosphere to form ground-level ozone. The State operates one monitoring site that is part of the National Air Toxics Trends Sites (NATTS) network (CCRI), one that is part of the Photochemical Assessment Monitoring Stations (PAMS) network (East Providence), one that is part of the $PM_{2.5}$ Speciation Trends Network (STN), and one that is part of the network of core multipollutant monitoring stations (NCORE).

Table 1 summarizes the NAAQS and Table 2 and 3 list the locations of the six air monitoring sites operating in the State in 2021 and operate currently, along with the parameters monitored and methods. The locations of those sites are shown in Figure 15. These sites have been approved by EPA Region 1 as meeting applicable siting criteria, as specified in Subpart B of 40 CFR Part 58. All criteria pollutants are monitored, as required in the CFR, using Federal Reference Methods (FRMs) or Federal Equivalent Methods (FEMs) and monitors are operated according to the procedures specified in Quality Assurance Project Plans (QAPPs)[1] that have been approved by EPA. Sites are in the Providence-New Bedford-Fall River, RI-MA Metropolitan Statistical Area (MSA), which encompasses all of Rhode Island as well as Bristol County in Massachusetts.

Summary of Recent and Proposed Changes in the Rhode Island Monitoring Network

- The relocation of Near Road (NEW AQS ID 440070040) was completed April 2022. The site experienced several early problems but became operational and reporting data in October 2022.

- In February 2022, EPA awarded RIDEM an ARP Direct Award for requests for funding to upgrade the East Providence Trailer. A full update of this process can be reviewed under the East Providence site information section later in this document. It is anticipated work on the new structure will begin summer of 2024.

- The original EPA 2B Ozone Analyzer on loan as part of their sensor loan program was replaced at East Matunuck during May 2023 with a newer unit, as the original 2B had been experiencing issues.

- ARP funding was used to purchase two new Met One BAM's. The ordering process for new equipment is lengthy and due to an imminent need at the Vernon Street location, a BAM that was not in use was installed at Vernon Street as we were awaiting arrival of the new Met One BAM. When the new BAM arrived, we had been experiencing issues with the older units at Alton Jones and East Providence. Therefore, a decision was made to

[1] RI DEM and RI DOH, "QAPP for Criteria Pollutants Including Particulates and NCORE Parameters, Revision 1.0," approved by EPA March 2018, revised November 2021 and "QAPP: Air Toxics and PAMS Monitoring Programs, Revision 6.1," approved by EPA March 2018, revised November 2021.

quickly replace these units with the newly received units in order to continue to collect data at all locations.

- RIDOH delivered a Met One BAM at the Vernon Street location in February 2022. The site began reporting to AirNOW during June 2023.

RIDEM understands that all network modifications that involve discontinuation or moving of any sites are subject to EPA approval, even if the remaining network meets EPA's minimum requirements.

Table 1: National Ambient Air Quality Standards (NAAQS)

POLLUTANT (links to historical tables of NAAQS reviews)	AVERAGING TIME	PRIMARY STANDARD	SECONDARY STANDARD
Sulfur Dioxide (SO_2)	3-Hour[A]	None	0.5 ppm (1300 µg/m³)
	1-Hour[B]	0.075 ppm (75 ppb)	None
Carbon Monoxide (CO)	8-Hour[A]	9 ppm	None
	1-Hour[A]	35 ppm	None
Ozone (O_3)	8-Hour[C]	0.070 ppm (70 ppb)	Same as Primary Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm (53 ppb)	Same as Primary Standard
	1-Hour[D]	100 ppb	None
Particulate Matter (PM_{10})	24-Hour[E]	150 µg/m³	Same as Primary Standard
Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean[F]	12.0 µg/m³	15.0 µg/m³
	24-Hour[G]	35 µg/m³	Same as Primary Standard
Lead (Pb)	Rolling 3-Month Average	0.15 µg/m³	Same as Primary Standard

Primary standards protect against adverse health effects.
Secondary standards protect against welfare effects such as damage to crops, vegetation, and buildings.

[A] Not to be exceeded more than once a year.

[B]To attain the 1-hour NAAQS, the 3-year average of the 99th percentile of the daily maximum 1-hour average SO_2 level at each monitor must not exceed 75 ppb.

[C] The ozone NAAQS is violated when the average of the 4th highest daily eight-hour concentration measured in 3 consecutive years exceeds 0.070 ppm (70 ppb).

[D] To attain the 1-hour NO_2 NAAQS, the 3-year average of the 98th percentile of the daily maximum 1-hour average NO_2 concentration at each monitor must not exceed 100 ppb.

[E] To attain the PM_{10} standard, the 24-hour concentration at each site must not exceed 150 µg/m³ more than once per year, on average over 3 years.

[F]To attain the PM2.5 annual standard, the 3-year average of the weighted annual means of the 24-hour concentrations must not exceed the NAAQS value.

[G] To attain the PM2.5 24-hour standard, the 3-year average of the 98th percentile of 24-hour concentrations must not exceed 35 µg/m3.

µg/m³ = micrograms per cubic meter
mg/m³ = milligrams per cubic meter
ppb = parts per billion
ppm = parts per million

Table 2: Monitoring Site Information

Site	PM2.5 (FRM), 1:3	PM2.5 (FRM, Collocated),1:6	PM2.5 (Continuous - FEM)	PM10/PM- (Hi Vol), 1:6	PM10/PM- (Hi Vol), Collocated), 1:6	PM10/PM-Coarse(lo-Vol), 1:3	Polycyclic aromatic hydrocarbons (PAH), 1:6	Speciation, PM2.5, SASS (CSN), 1:3	PM2.5 Carbon (URG) (CSN),1:3	Ozone	SO2	CO	Direct NO_2	$NO/NO_2/NOx$	NO/NOy	VOCs 24-HR Canister (NATTS, State)	VOCs Hourly PAMS	Black Carbon	Black Carbon, Collocated	Carbonyls, 1:6, Collocated 1:12	Carbonyls, PAMS 8-hr	Particle Counter	Wind Speed and Direction	Ceilometer	Temperature	Dew Point / Rel. Humidity	Barometric Pressure	Solar Radiation	UV Radiation	Precipitation
Vernon Street	X	X	X													X													
EPA Labs			X							S													X		X				
East Prov.	X		X	X		X		X	X	X	X	X	X	X	X	X	S	X	X	X	S	S	X	X	X	X	X	S	S	S
CCRI			X	X *	X **		X									X		X		X		X	X		X	X	X			
Alton Jones			X							S						X							X		X	S	X	S		
Near Road			X									X		X				X				X								
East Matunuck										S																				

X = Existing
S= Seasonal (June 1-August 31)
S= Seasonal (March 1 – September 30)
* Includes metals
** Includes collocated metals 1:12

Table3: Additional Monitoring Site Information

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
Vernon Vernon Street Pawtucket	440070026	41.874683° -71.379936°	$PM_{2.5}$	Lo Vol	Reference
			$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			VOC	Canisters, GC/FID/MS	Reference
USEPA Laboratory 27 Tarzwell Drive Narragansett	440090007	41.495060° -71.423713°	Ozone	U.V. Photometric	Reference
			$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Temperature	Spot Reading	N/A
Myron Francis School 64 Bourne Avenue E. Providence	440071010	41.840954° -71.360976°	Oxides of Nitrogen	Chemiluminescence (low range)	Reference
			Nitrogen Dioxide		
			NO/NO_y	Chemiluminescence (low range)	Reference
			Carbon Monoxide	Gas Filter Correlation (low range)	Equivalent
			Sulfur dioxide	Pulsed Fluorescence (low range)	Equivalent
			Ozone	U.V. Photometric	Reference
			$PM_{2.5}$	Lo Vol	Reference
			$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			Speciated $PM_{2.5}$	Speciation Monitor	N/A
			Coarse PM ($PM_{10-2.5}$)	Lo Vols (PM_{10} & $PM_{2.5}$)	Reference
			Black Carbon	Aethalometer	N/A
			VOC	Canisters, GC/FID/MS	Reference
			VOC	Continuous GC	Reference
			Carbonyls	HPLC Cartridges	Reference
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Barometric Pressure	Barometer	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Solar Radiation	Pyranometric	N/A
			UV Radiation	UV Photometric	N/A
			Precipitation	Bucket/Continuous	N/A
			Direct NO_2	Cavity Attenuated Phase Shift (CAPS)	Equivalent

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
			Ceilometer	LIDAR	N/A
			NO_2 and Ozone	NASA Pandora Spectrometer	N/A
CCRI Liston Campus 1 Hilton Street Providence	440070022	41.807523° -71.413920°	$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			PM_{10}/Metals	Hi Vol	Reference
			VOC	Canisters, GC/FID/MS	Reference
			Carbonyls	HPLC Cartridges	Reference
			Black Carbon	Aethalometer	N/A
			Semi-volatiles	PUF/XAD, GC/MS	N/A
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Particle Count	Water Based Condensation	N/A
Alton Jones Campus Victory Highway West Greenwich	440030002	41.615316° -71.720032°	Ozone	U.V. Photometric	Reference
			VOC	Canisters, GC/FID/MS	Reference
			$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Barometric Pressure	Barometer	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Solar Radiation	Pyranometric	N/A
Near-Road Site Wellington Avenue Cranston	440070040	41.769880° -71.428489°	Oxides of Nitrogen	Chemiluminescence (low range)	Reference
			Nitrogen Dioxide		
			Carbon Monoxide	Gas Filter Correlation (low range)	Equivalent
			$PM_{2.5}$	Beta Attenuation/Cont	Equivalent
			Black Carbon	Aethalometer	N/A
			Particle Count	Water Based Condensation	N/A
East Matunuck State Beach Pavilion 950 Succotash Road South Kingstown	440090008	41.377451° -71.52485°	Ozone	U.V. Photometric	Equivalent

Network Evaluation

Following is a discussion, by pollutant, of:

- The current monitoring network,
- The NAAQS and a comparison of recent measurements with the NAAQS,
- Whether that network meets EPA's monitoring criteria,
- Whether new sites are needed,
- Whether any existing sites are no longer needed, and
- Plans for modification of the network in the next 18 months.

Ozone (O3)

The sites in the current ozone monitoring network are listed in Table 4 below.

Table 4: Rhode Island Ozone Monitoring Sites

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Alton Jones Campus Victory Highway West Greenwich	Regional	Upwind background Population exposure	Continuous Ozone Season March-September
USEPA Laboratory 27 Tarzwell Drive Narragansett	Regional	Population exposure	Continuous Ozone Season March-September
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (PAMS, NCORE)	Maximum precursor emissions impact Population exposure	Continuous Year-Round
East Matunuck State Beach Pavillion 950 Succotash Road, South Kingstown	Regional	Upwind background Population exposure Coastal and Long Island Sound	Continuous Ozone Season March-September

The ozone NAAQS is 70 ppb over an 8-hour average. A site is in violation of that NAAQS when the average of the 4th highest daily eight-hour ozone concentration measured in 3 consecutive years (the design value) at that site exceeds 70 ppb.

Ozone design values (DVs) have been generally decreasing for the past five years, although Narragansett and East Providence have flatlined for 2016-2018 and 2017-2019 DVs. Based on the 2014-2016 design values, all counties in Rhode Island have been classified as Attainment/Unclassifiable for the 2015 standard.

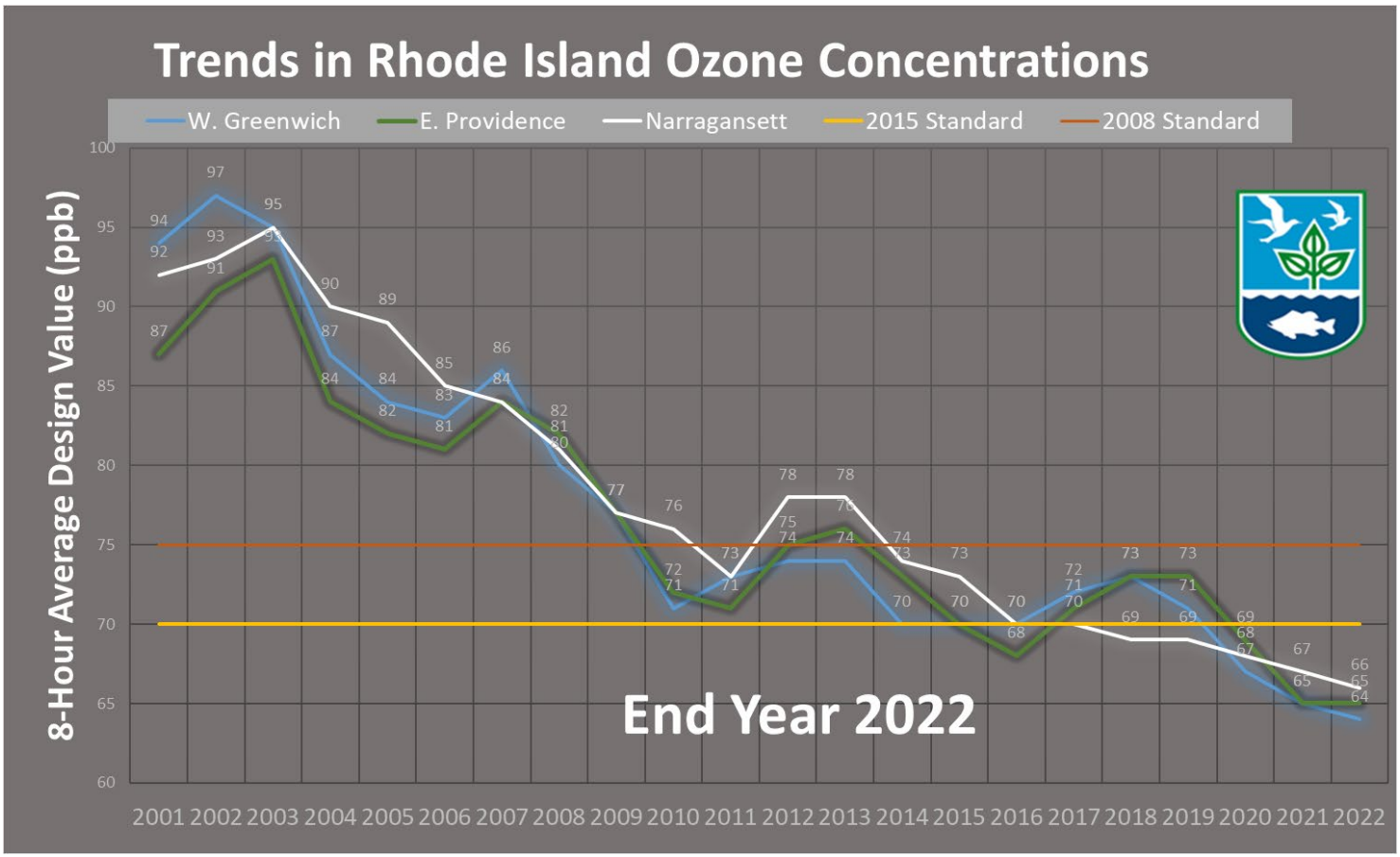
2022 Ozone Design Values

Table 5: Ozone Design Values (ppb)

	W. Greenwich	Narragansett	E. Providence
2002 - 2004	87	90	84
2003 - 2005	84	89	82
2004 - 2006	83	85	81
2005 - 2007	86	84	84
2006 - 2008	80	81	82
2007 - 2009	77	77	77
2008 - 2010	71	76	72
2009 - 2011	73	73	71
2010 - 2012	74	78	75
2011 - 2013	74	78	76
2012 - 2014	70	74	73
2013 - 2015	70	73	70
2014- 2016	70	70	68
2015- 2017	72	71	70
2016- 2018	73	69	73
2017- 2019	71	69	73
2018-2020	67	68	69
2019-2021	65	67	65
2020-2022	64	66	65

The 2020 season was the first year RIDEM achieved AQS level data at East Matunuck by installing a heating system for the cold early weeks of ozone monitoring in April/May in attempts to maintaining a stable warm enough temperature in the uninsulated lifeguard tower. The main issue was maintaining temperature and performance of the calibrator, along with siting criteria for the 2B. Another challenge with East Matunuck site is that early in the season is logistical, as access to the lifeguard tower can be difficult. However, even with these challenges, the site is fully operational during the peak of the ozone season and is the more critical time of year RIDEM is hoping to capture. For the 2020 season, the 4th highest value was 67 ppb, 64 ppb for 2021, and 75 ppb for 2022, for a preliminary design value of 68 ppb for 2020-2022.

Figure 2: Ozone Design Value Trends 2001-2022



Since EPA's rules require Rhode Island to operate at least two ozone monitors, the State has two more monitors than the minimum number required. Continued operation of all existing monitors is important and will not be changing for the following reasons:

- Ozone concentrations continue to reach unhealthy levels several days each summer, with moderate levels on many days.
- The four sites represent three distinct geographical and micro-climates that are affected by different localized weather patterns and can experience very different ozone levels on some days.
- The availability of real-time ozone data from the four ozone sites enables RIDEM to issue and track area-specific health advisories as appropriate and understand and provide residents with real-time information about ozone concentrations and associated health risks in their region of the state.
- The East Matunuck site has continued to provide critical information on transport of ozone along Long Island Sound corridor and the immediate coastline. This site has also experienced two recent seasons with the **highest daily 8-hr average in the entire Northeast**.

As part of RIDEM's EMP, additional ozone monitoring will again be conducted during 2023 as described in the EMP section of this plan. RIDEM continues to use an EPA 2B ozone monitor on loan through their Sensor Loan Program for the East Matunuck site. The 2B monitor has proven to be reliable and is much quieter, as the lifeguard tower is often occupied. There are no other changes planned in the next 18 months. Refer to the Enhanced Monitoring portion of this document regarding possible future plans of the East Matunuck monitor.

Carbon Monoxide (CO)

The current CO monitoring network is listed in Table 6 below.

Table 6: Carbon Monoxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood	Maximum precursor emissions impact Population exposure	Continuous Year-Round
Near-Road Site Hayes and Park Streets Providence	Microscale	Maximum emissions Near-road	Continuous Year-Round

The NAAQS for CO are:

- 35 ppm as a 1-hour average, not to be exceeded more than once per year (design value is the highest annual 2nd maximum 1-hour concentration) and
- 9 ppm as an 8-hour average, not to be exceeded more than once per year (design value is the highest annual 2nd maximum non-overlapping 8-hour concentration)

The CO design values for Rhode Island are:

Near Road 2022:

- 1.9 ppm – 1-hour average, 5% of NAAQS (new site)
- 1.8 ppm – 1-hour average, 5% of NAAQS (old site)
- 1.4 ppm – 8-hour average, 15% of NAAQS (old site)
- 1.3 ppm – 8-hour average, 14% of NAAQS (new site)

East Providence 2022:

- 1.3 ppm – 1-hour average, 3% of NAAQS
- 1.0 ppm – 8-hour average, 11% of NAAQS

The CO NAAQS has not been exceeded in Rhode Island since 1984. Since 2001, all CO levels recorded in Rhode Island have been in the "Good" category of the EPA's Air Quality Index (AQI).

EPA's regulations do not specify a minimum number of CO monitors that must be operated in a state, except that CO monitoring is required at NCORE sites (40 CFR 58, Appendix D 3(b)) and EPA regulations require a certain number of CO monitors to be operating near road based upon population. Since the East Providence site is both a PAMS site and the State's NCORE site, carbon monoxide monitoring will continue at that site using a low range monitor, consistent with NCORE requirements.

Near-road sites are required in all urban areas which, like the Providence-New Bedford-Fall River, RI-MA MSA, have a population of 1,000,000 or more. Near-road CO monitoring was not required until January 1, 2017; however, Rhode Island began operating a low-range CO monitor at a site adjacent to Interstate Route 95 that meets the above near-road specifications in April 2014. This site has been located off Wellington Avenue near the gantry in Cranston on the northbound side of the highway. Relocation was completed during April 2022 and the site became operational in during October of 2022.

No other changes to the CO monitoring network are planned in the next 18 months.

Sulfur Dioxide (SO_2)

The current SO_2 monitoring network is listed in in Table 7 below.

Table 7: Sulfur Dioxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood	NCORE	Continuous Year-Round

The NAAQS for SO_2 are:

- 75 ppb, 1-hour average. The design value is the average of the 99th percentile maximum daily hour measured in 3 consecutive years.
- 0.5 ppm (500 ppb), 3-hour average (secondary standard) not to be exceeded more than once per year.

The SO_2 design value (2020 – 2022) in Rhode Island is as follows:

- 2 ppb -- 1-hour average 2% of primary NAAQS – East Providence monitor

The SO_2 NAAQS has never been exceeded in the State. One-hour design values for SO_2 have been below 75 ppb since 1994. All measurements have been in the "Good" range of the AQI since 2007.

EPA's 2006 amended monitoring regulation requires SO_2 monitoring only at NCORE sites. However, the 2010 SO_2 NAAQS rule requires at least one SO_2 monitor in the Providence-New Bedford-Fall River RI, MA MSA, which includes all of Rhode Island and Bristol County, Massachusetts. That SO_2 monitor must be sited to meet one or more of the following objectives: (1) characterizing concentrations around emissions sources, (2) measuring the highest concentrations in an area, (3) determining population exposure, (4) establishing general background levels and (5) evaluating regional transport.

The State of Massachusetts also operates an SO_2 monitor in the Providence Warwick RI-MA MSA, located in Fall River. Per EPA, this monitor is the required monitor in the MSA. SO_2 monitors are required according to a population weighted emissions index (PWEI) which is based on the most recent population and emission information, and this will likely be investigated during the next 5-year network assessment.

Nitrogen Dioxide (NO_2)

The current NO_2 monitoring network is listed in Table 8 below.

Table 8: Nitrogen Dioxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (PAMS)	Population exposure	Continuous Year-Round True NO_2 during PAMS season only
Near-Road Site Wellington Avenue Cranston	Microscale	Maximum emissions Near-road	Continuous Year-Round

The NO_2 NAAQS are:

- 100 ppb – 1-hour average. The design value is the average of the 98th percentile maximum daily hour measured in 3 consecutive years.
- 0.053 ppm (53 ppb) - annual average

The 1-hour average design values for 2020-2022 are:

- 38 ppb – 1-hour average, 38% of NAAQS - East Providence
- 38 ppb – 1-hour average, 38% of NAAQS – New Near Road (invalid)
- 44 ppb – 1-hour average, 44% of NAAQS – Old Near Road (invalid)

The annual averages for 2022 are:

- 6 ppb annual average, 11% of NAAQS – East Providence
- 14 ppb annual average, 26% of NAAQS – New Near Road (invalid)

Because of shutdown for relocation, the old Near Road site (Park/Hayes) and New Near Road Site (Wellington) did not achieve enough data capture and has invalid design values. The NO_2 NAAQS have never been exceeded in Rhode Island. Since there was no short-term NAAQS for NO_2 until the standard was amended in 2010, this pollutant was not used for the Air Quality Index (AQI) before

that date. The amended NO_2 NAAQS rule, which was published on February 9, 2010, establishes hourly concentrations of 54 -100 ppb as the range for a "Moderate" AQI[2].

The 2010 amended NO_2 NAAQS requires Rhode Island to operate two NO_2 monitoring sites, one at "a location of expected highest NO_2 concentrations representing the neighborhood or larger spatial scales" and a second monitor at a near-road location where maximum microscale-representative concentrations are expected.

The East Providence location fulfills the neighborhood monitoring scale for NO_2 and operates year-round to fulfill the neighborhood or larger spatial scale requirements. To fulfill PAMS requirements, Direct/True NO_2 is monitored at East Providence June 1 to August 31. A low range monitor that measures NO and NO_y (total reactive nitrogen oxides) has been operated at the East Providence site since January 2011, consistent with the NCORE requirements.

In April 2014, RIDEM began operating a near-road site on the east side of the Interstate Route 95 near downtown Providence, monitoring for NO_2/NO_x, CO, $PM_{2.5}$ and black carbon to characterize those pollutants from the highway, downwind of the climatological prevailing wind direction. Construction of the northbound highway and bridge forced the relocation of the site to the Wellington Avenue site in Cranston.

[2]USEPA, "Primary National Ambient Air Quality Standards for Nitrogen Dioxide: Final Rule, "FR 75(26):6474, 9 February 2010. http://www.epa.gov/ttn/naaqs/standards/nox/fr/20100209.pdf

Particles smaller than 10 microns (PM_{10})

The current PM_{10} monitoring network is listed in Table 9 below.

Table 9: PM_{10} Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
CCRI Liston Campus 1 Hilton Street Providence	Neighborhood (NATTS)	Population exposure Highest concentration	24-hour 1 in 6 day Co-located 1 in 6 day
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (NCORE)	Population exposure (Lead discontinued 6/30/16) and $PM_{10-2.5}$)	24-hour 1 in 3 ($PM_{10-2.5}$)

The PM_{10} NAAQS is:

- 150 µg/m^3 – 24-hour average, not to be exceeded more than once per year on average over 3 years (design value is 4th high value in a 3-year period)

The highest 24-hour average value for PM_{10} recorded at a Rhode Island site for the past 3 years is:

2020 33 µg/m^3 – 24-hour average, 22% of NAAQS, recorded at East Providence
2021 32 µg/m^3 – 24-hour average, 21% of NAAQS, recorded at East Providence
2022 49 µg/m^3 – 24-hour average, 32% of NAAQS, recorded at CCRI Liston

The PM_{10} NAAQS has never been exceeded in Rhode Island. Since PM_{10} is measured using a filter-based method, results are not immediately available and cannot be used for Air Quality Index calculations. PM_{10} levels appear to have slightly decreased over the past decade.

EPA's monitoring regulations require areas like the Providence-New Bedford-Fall River, RI-MA Metropolitan Statistical Area (MSA), which has a population greater than 1,000,000 and measured PM_{10} concentrations below 80% of the NAAQS, to operate a minimum of 2 - 4 PM_{10} monitoring sites.

PM_{10} is measured at the East Providence NCORE site once every three days using a lo-vol sampler. The PM_{10} measurements are used, in conjunction with $PM_{2.5}$ measurements at that site, for calculating $PM_{10-2.5}$ levels. PM_{10} samples collected at CCRI Providence are analyzed for metals to fulfill NATTS requirements. These 2 PM_{10} monitors adequately characterize exposure of the

sensitive populations in urban areas to PM_{10} and fulfill the minimum monitoring requirement of the MSA.

Fine Particulate Matter (PM2.5)

The current Federal Reference Method/Federal Equivalent Method (FRM/FEM) $PM_{2.5}$ monitoring network is listed in Table 10 below.

Table 10: $PM_{2.5}$ Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Vernon Trailer Vernon Street Pawtucket	Middle	Population exposure	24-hour Continuous FEM 1 in 3 days FRM
CCRI Liston Campus 1 Hilton Street Providence	Neighborhood	Population exposure Highest concentration	24-hour Continuous FEM
Myron Francis School 64 Bourne Avenue E. Providence	Urban	Population exposure Highest concentration	24-hour Continuous FEM, 1 in 3 days FRM
Alton Jones Campus Victory Highway West Greenwich	Regional	Population exposure General/Background Regional Transport	24-hour Continuous FEM
USEPA Laboratory 27 Tarzwell Drive Narragansett	Regional	Population exposure	24-hour Continuous FEM
Near Road Site Wellington Avenue Cranston	Microscale	Near-road	24-hour Continuous FEM

A filter based FRM (Method 145) $PM_{2.5}$ unit is the primary sampler at the Vernon site. As mentioned earlier in this document, RIDOH deployed a BAM at the Vernon site during 2022. The unit was not initially pushing data to AirNOW as internet was not installed but is now currently pushing hourly data. FEM (Method 170) continuous $PM_{2.5}$ monitors are used as the primary samplers at West Greenwich, Narragansett, East Providence, CCRI, and the new Near-Road site in Cranston. Co-located filter based FRM samplers are operated at the Vernon and East Providence sites for quality assurance purposes (Method 145).

The $PM_{2.5}$ NAAQS are:

- 35 µg/m^3 - 24-hour average (design value is the 3-year average of the 98th percentile 24-hour concentration)
- 12 µg/m^3 - annual average (design value is calculated by averaging the daily concentrations

from each quarter, averaging these quarterly averages to obtain an annual average, and then averaging the annual averages for three consecutive years)

The highest $PM_{2.5}$ values for 2021 are:

- 19 µg/m3 – 24-hour average, 54% of NAAQS, recorded at Near Road
- 8.2 µg/m3 – annual average, 68% of NAAQS, recorded at Near Road

The highest $PM_{2.5}$ values for 2022 are:

- 19 µg/m3 – 24-hour average, % of NAAQS, recorded at Vernon St/Near Road (invalid)
- 8.1 µg/m3 – annual average, % of NAAQS, recorded at Near Road (invalid)

Table 11: Design values for $PM_{2.5}$

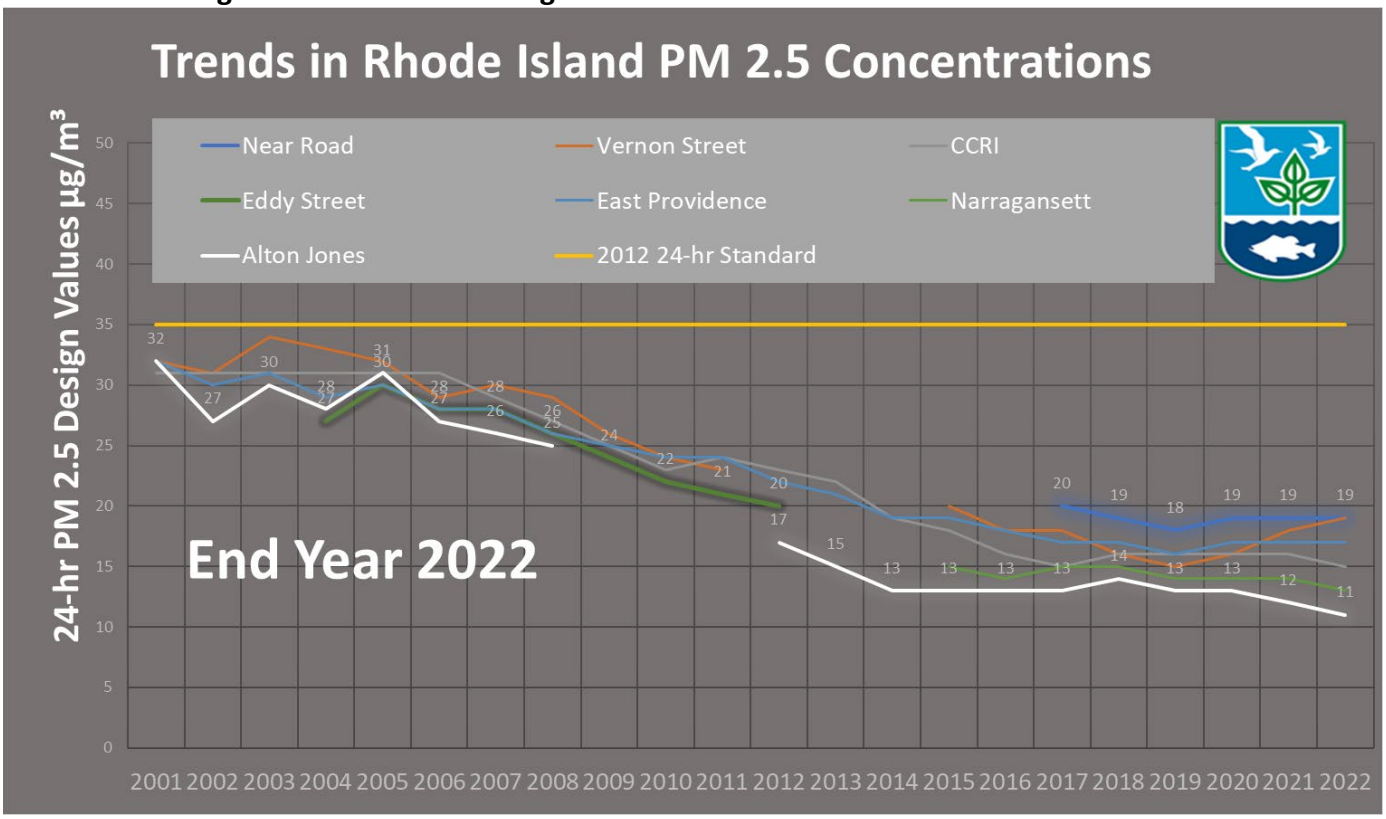
*** Design values are for the monitors formerly located at Urban League**

**** Design value for 2022 invalid due to relocation and lack of data capture**

SITE	24-hour DV 2018-2020	24-hour DV 2019-2021	24-hour DV 2020-2022	Annual DV 2018-2020	Annual DV 2019-2021	Annual DV 2020-2022
Vernon Vernon Street Pawtucket	16	18	19	7.0	7.9	7.9
CCRI Liston Campus* 1 Hilton Street Providence	16	16	15	6.0	5.9	6.0
Myron Francis School 64 Bourne Avenue E. Providence	17	17	17	6.3	6.2	6.4
Alton Jones Victory Highway West Greenwich	13	12	11	4.9	4.6	4.5
USEPA Laboratory 27 Tarzwell Drive Narragansett	14	14	13	4.5	4.5	4.3
Near Road Site** Providence (Old)	19	19	19	8.5	8.2	8.1

Historically, annual average levels have been consistently highest at the Vernon Street site, which is adjacent to I-95, and higher at the East Providence and Urban League sites than at the rural West Greenwich site. $PM_{2.5}$ levels continue to slowly decrease each year. The 2020-2022 design values of $PM_{2.5}$ data at Near Road are the highest in the monitoring network and have been for the past three years of design values. The design values for all sites have generally remained level with only slight variations.

Figure 3: PM 2.5 Design Value Trends from 2001-2022



EPA regulations require a minimum of two $PM_{2.5}$ Rhode Island monitoring sites to characterize the following:

- Community-wide air quality
- Background $PM_{2.5}$ levels in the RI
- Regional transport of $PM_{2.5}$

Although Rhode Island operates more $PM_{2.5}$ sites than required, each site fulfills a specific informational need or EPA requirement. The West Greenwich site fulfills EPA's requirements for measurement of background and regional transport concentrations of $PM_{2.5}$ into the state. The 24-hour and annual $PM_{2.5}$ design values for the Vernon Street, Pawtucket site, which is immediately adjacent to Interstate Rte. 95, tend to be higher than those at the other sites. The Near Road site has been the highest design values since it began in 2014. The East Providence monitor cannot be removed because $PM_{2.5}$ monitoring is required at NCORE sites, and the CCRI and Narragansett monitors fulfill the need for air quality data for urban and coastal areas of the State, respectively.

As discussed above, Near Road $PM_{2.5}$ monitoring began in April 2014 and continued until construction of the I-95N viaduct forced relocation. Infrastructure and relocation of the new Wellington Avenue Near Road site in Cranston was completed in early April 2022. Immediately upon installation, the site experienced a fire during summer 2022. Repairs were made and the site became fully operational during October 2022.

RIDEM relocated the Urban League monitor to the Community College of Rhode Island, Liston Campus in June 2019. Since CCRI could not accommodate all the equipment from the Urban League site, the filter based FRM $PM_{2.5}$ from that location was moved to Vernon Street for co-locating with the existing FRM on April 1, 2017.

RIDEM has assigned the FEM $PM_{2.5}$ monitor at East Providence to be the primary monitor and uses the FEM and FRM data from that site to evaluate FEM-FRM comparability. The advantages of using the East Providence, rather than the West Greenwich site for this purpose include:

- $PM_{2.5}$ levels at the East Providence site, although still substantially below the NAAQS, tend to be higher than those at the West Greenwich site.

- Since the East Providence FRM runs 1 in 3 days, it generates more comparative data than West Greenwich.

Historical data has demonstrated that the East Providence FEM and FRM measurements have better correlation and less bias than is observed at the W. Greenwich site.

There are no other changes to the $PM_{2.5}$ network anticipated in the next 18 months.

Speciation Monitoring

The EPA's $PM_{2.5}$ Speciation Trends Network (STN) is designed to characterize metal, ion and carbon constituents of $PM_{2.5}$. Per NCORE requirements, the speciation equipment, including the carbon sampler, has been in operation at the East Providence NCORE site in January 2011 and is now being operated there on a 1-in-3 schedule. Speciation filters are analyzed by an EPA contractor.

Lead (Pb)

As specified in the lead NAAQS rule, sampling of lead was previously conducted on a one-in-six-day schedule. EPA deleted the requirement to monitor for non-source Pb at NCORE sites from Appendix D of 40 CFR part 58.16 and to allow monitoring agencies to request permission to discontinue non-source monitoring following the collection of at least 3 years of data at urban NCORE sites. Since ambient lead monitoring was conducted in the State for more than 3 years and the lead levels were consistently considerably lower than the NAAQS since the inception of monitoring, RI DEM was granted permission to discontinue monitoring as of June 30, 2016.

Ozone Precursor and Air Toxics Measurements

Photochemical Assessment Monitoring Stations (PAMS)

The Clean Air Act Amendments of 1990 (CAAA) required serious, severe and extreme ozone nonattainment areas to establish enhanced monitoring networks to measure ozone and ozone precursors. In response to that mandate, the US EPA promulgated rules in 1993 that required the establishment of a network of Photochemical Assessment Monitoring Stations (PAMS) to measure ozone, NO_x, volatile organic compounds (VOCs), carbonyls, and meteorological parameters in serious and above nonattainment areas. This network was designed to provide comprehensive data on trends in ambient concentrations of ozone and ozone precursors and to evaluate the spatial and diurnal variability of those pollutants to track the formation and transport of ozone across large areas and to evaluate the effectiveness of strategies implemented to reduce levels of that pollutant.

PAMS Monitoring Implementation Network Plan

RIDEM operated two Photochemical Assessment Monitoring Stations (PAMS) sites in the air monitoring network in 2017, at the West Greenwich and East Providence sites. West Greenwich is no longer designated a PAMS site. The NCORE site located at Francis School in East Providence continues to serve as the location of the required PAMS site and will measure the following parameters described below. An inventory of equipment used at the site is provided in Table 13.

The following PAMs pollutant were monitored during the 2022 PAMs season and will continue during the 2023 PAMs season:

- The NCORE site located at Francis School in East Providence serves as the PAMS site and will measure parameters described below.

- 24-hour speciated VOC samples are collected every sixth day year-round at the Alton Jones and East Providence site. As of June, July and August of 2017, VOC samples were collected hourly at East Providence using an Auto-GC. Hourly VOC sampling will again continue June-August for 2023 at East Providence. A complete list of the targeted compounds is found in Table 12. For 2023, hourly speciated VOC measurements continue to be measured with an auto-gas chromatograph (GC) using Chromatec GC 866 Airmo VOC.

- 24-hour carbonyl samples are collected every sixth day year-round at the East Providence site using an ATEC 8000 Sampler. Three 8-hour carbonyl samples per day will be collected every third day during June, July, and August for 2023. A complete list of the target carbonyl compounds may be found in Table 12. The TO-11A test method is used, as in the National Air Toxics Trends (NATTS)[3] program.

- Rhode Island has measured reactive nitrogen oxides (NO and NO_y) at East Providence since January 2011 to fulfill NCORE requirements. New EPA regulations required NO, NO_y, true NO_2 and mixing height measurements at required PAMS sites during the ozone season. True NO_2 and mixing heights began in 2019 and will continue for 2023. True NO_2 is measured by cavity attenuated phase shift (CAPS) spectroscopy with a Teledyne API T500U. NO and NO_y are measured using a Thermo 42iY.

- Ozone is measured at the West Greenwich and Narragansett sites March through September beginning in 2017. Ozone is measured year-round at East Providence to fulfill NCORE requirements. For 2022 and 2023, ozone monitoring couldn't begin until April due to difficulty in accessing the seasonal lifeguard tower at East Matunuck.

- Surface meteorological parameters are measured at West Greenwich, Narragansett, and East Providence year-round.

- RIDEM continues to measure wind direction, wind speed, temperature, humidity, atmospheric pressure, precipitation, solar radiation, and ultraviolet radiation at East Providence. For measuring mixing height, a Vaisala CL51 ceilometer was purchased in August 2018 and was installed at East Providence in 2019. The RIDOH has worked with the University of Maryland Baltimore to push real time ceilometer data to UMBC for image processing. Real time images have been extremely helpful in tracking the boundary layer and wildfire smoke in the area and are available online.
  https://ucn-portal.org/site/prov/

[3] See NATTS Technical Assistance Document for TO-11A method

Table 12: PAMS Target Compound List

Priority Chemical Parameters (Required)	AQS Parameter Code	Compound Class	Optional Chemical Parameters	AQS Parameter Code	Compound Class
1,2,3-trimethylbenzene	45225	aromatic	1,3,5-trimethylbenzene	45207	aromatic
1,2,4-trimethylbenzene	45208	aromatic	1-pentene	43224	olefin
1-butene	43280	olefin	2,2-dimethylbutane	43244	paraffin
2,2,4-trimethylpentane	43250	paraffin	2,3,4-trimethylpentane	43252	paraffin
Acetaldehyde	43503	carbonyl	2,3-dimethylbutane	43284	paraffin
Benzene	45201	aromatic	2,3-dimethylpentane	43291	paraffin
cis-2-butene	43217	olefin	2,4-dimethylpentane	43247	paraffin
Ethane	43202	paraffin	2-methylheptane	43960	paraffin
Ethylbenzene	45203	aromatic	2-methylhexane	43263	paraffin
Ethylene	43203	olefin	2-methylpentane	43285	paraffin
Formaldehyde	43502	carbonyl	3-methylheptane	43253	paraffin
Isobutane	43214	paraffin	3-methylhexane	43249	paraffin
Isopentane	43221	paraffin	3-methylpentane	43230	paraffin
Isoprene	43243	olefin	Acetone	43551	carbonyl
m&p-xylenes	45109	aromatic	Acetylene	43206	alkyne
m-ethyltoluene	45212	aromatic	cis-2-pentene	43227	olefin
n-butane	43212	paraffin	Cyclohexane	43248	paraffin
n-hexane	43231	paraffin	cyclopentane	43242	paraffin

Priority Chemical Parameters (Required)	AQS Parameter Code	Compound Class	Optional Chemical Parameters	AQS Parameter Code	Compound Class
n-pentane	43220	paraffin	isopropylbenzene	45210	aromatic
o-ethyltoluene	45211	aromatic	m-diethlybenzene	45218	aromatic
o-xylene	45204	aromatic	methylcyclohexane	43261	paraffin
p-ethyltoluene	45213	aromatic	Methylcyclopentane	43262	paraffin
Propane	43204	paraffin	n-decane	43238	paraffin
Propylene	43205	olefin	n-heptane	43232	paraffin
Styrene	45220	aromatic	n-nonane	43235	paraffin
Toluene	45202	aromatic	n-octane	43233	paraffin
trans-2-butene	43216	olefin	n-propylbenzene	45209	aromatic
Ozone	44201	criteria pollutant	n-undecane	43954	paraffin
true NO_2	42602	criteria pollutant	p-diethylbenzene	45219	aromatic
total non-methane organic carbon	43102	total VOCs, non-methane	trans-2-pentene	43226	olefin
			α-pinene	43256	monoterpene olefin
			β-pinene	43257	monoterpene olefin
			1,3 butadiene	43218	olefin
			benzaldehyde	45501	carbonyl
			carbon tetrachloride	43804	halogenated
			Ethanol	43302	alcohol
			Tetrachloroethylene	43817	halogenated

Table 13: Equipment Inventory at East Providence Site

NAME	Manufacturer	Model
Black Carbon-Aethalometer	Teldyne	M633
Black Carbon-Aethalometer	Magee	AE16-ER
Carbonyl sampler	Atec	2200
Carbonyl sampler	Atec	2200
Wind direction sensor	MetOne	590S (6929)
Pure air generator	Aadco	737-R-12A
Chemiluminescence NO-NO2-NOx Analyzer	Thermo	42ITL
Sulphur Dioxide analyzer	Thermo	43ITLE
Caron Monoxide analyzer	Thermo	TE48i
Data logger	Agilaire	8832
Hydrogen generator	Packard	H2PD-150NA
Translator module	MetOne	126
Translator module	MetOne	2270
Barometric pressure sensor	MetOne	091
Rain sensor	MetOne	370-8"
Relative Humidity/temp sensor	MetOne	083D-1-35
Met Station Tower	MetOne	
Ultraviolet radiation sensor	EPLAB	TUVR
Wind Speed sensor	MetOne	014A
Solar Radiation pyranometer sensor	LI-COR	LI-200SZ
Chemiluminescence NO-DIF-NOy Analyzer	Thermo	TE42iY
Ozone analyzer	Thermo	TE49i
PM2.5 Sampler	MetOne	1020
PM2.5 Speciation	MetOne	SASS
PM2.5 Partisol-Plus	R&P	2025
PM2.5 Partisol-Plus	R&P	2025
Standard Calibrator,	API	M700E
Standard Calibrator	Environics	6103
Standard-Zero Air	Teledyne	701
VOC sampler	Xontech	910A
VOC sampler	Xontech	910A
Compac II AC units	Marvair	
Compac II AC units	Marvair	
GC custom (processes 24-hr cans)	Agilent	7890A
Mass Spec (processes 24-hr cans)	Agilent	5973N
CAS Auto GC (continuous/PAMS season)	Chromatotec	866
Ceilometer	Vaisala	CL51
Carbonyl Sampler	Atec	8000
True NO_2	Teledyne API	T500U

Enhanced Monitoring Plan Update

RIDEM has developed an Enhanced Monitoring Plan (EMP) for implementing additional applicable PAMS requirements. Full details on the siting for the initial EMP can be reviewed in the 2018 ANP.

Because of the immediate coastal location of the East Matunuck monitor, RIDEM feels this position may uniquely capture ozone plumes migrating over water along Long Island Sound coming ashore. These measurements will enhance the existing network of Rhode Island ozone monitors to complement transport movement into the state from inland, and now, the immediate coastline.

During the 2018 and 2019 PAMs seasons, the East Matunuck ozone analyzer did not meet EPA siting criteria and the data did not meet EPA AQS criteria. For the 2020 season, RIDEM attempted to have the 2B Analyzer meet regulatory grade monitoring by tracking operating temperature, performing required calibration checks, and having established proper inlet configuration outside the lifeguard tower. However, cooler spring temperatures in the unheated building made calibration checks difficult due to instability of the calibrator. Baseboard heating was installed in April of 2021, which has stablized the temperature of the tower. For 2023, RIDEM anticipates once again meeting EPA AQS criteria at East Matunuck. Early season accessibility continues to be an issue in order to have ozone monitoring in place for March.

RIDEM has considered that the coastal stretch of Westerly, Rhode Island may possibly experience very high ozone, which is often hinted in daily air quality models. Specifically, the stretch of Misquamicut lies further south than East Matunuck, and further west, often closest to the higher ozone readings in Coastal Connecticut. After capturing 3 years of data and a Design Value for East Matunuck, RIDEM may explore the logistics of moving the 2B monitor from East Matunuck to Misquamicut. RIDEM continues to operate an EPA 2B monitor on loan from EPA as part of their sensor loan program.

Air Toxics

Rhode Island operates one site that is part of the National Air Toxics Trends Stations (NATTS) network. The primary purposes of the NATTS network are to track trends in ambient air toxics levels, to characterize exposures, and to measure progress toward emission and risk reduction goals.

The Rhode Island NATTS site was originally located on the roof of the Urban League building in an urban residential neighborhood on the south side of Providence, approximately ½ mile west of I-95. This site was chosen as the State's NATTS site because it is not dominated by local sources and because levels of air toxics at this site appear to be representative of those in urban areas in the State.

In early July 2019 relocation to the CCRI Liston Campus was completed. This new location is approximately 315 feet (0.06 miles) to the south and east Urban League.

In keeping with EPA requirements, the following pollutants, at a minimum, are measured at the Rhode Island NATTS site:

Volatile Organic Compounds (VOC)

- Acrolein
- Perchloroethylene (tetrachloroethylene)
- Benzene
- Carbon tetrachloride
- Chloroform
- Trichloroethylene
- 1,3-butadiene
- Vinyl Chloride

Carbonyls

- Formaldehyde
- Acetaldehyde

Metals

- Nickel compounds (PM_{10})
- Arsenic compounds (PM_{10})
- Cadmium compounds (PM_{10})
- Manganese compounds (PM_{10})
- Beryllium (PM_{10})

Semi-Volatile Organic Compounds (SVOC)

- Benzo(a)pyrene
- Napthalene

VOCs, carbonyls and PM_{10} metal samples are analyzed by RIDOH. Semi-Volatile Organic Compounds (SVOC) samples are analyzed by an EPA contractor. Sampling at the NATTS site is conducted for the above parameters for 24-hour periods every sixth day. 24-hour VOC samples are also collected every sixth day at the West Greenwich site, East Providence site, and at the Vernon Street site, which is adjacent to I-95 in Pawtucket. 24-hour carbonyl samples are collected at the East Providence site on the same schedule.

In addition, RIDEM operates aethalometers, which measure black carbon, an indicator of diesel exhaust, at the CCRI NATTS site, the East Providence PAMS/NCORE site, and the Near Road site in Cranston.

As part of an EPA initiative to characterize Ethylene Oxide (EtO) concentrations as part of a national network for sites away from known sources of EtO, measurement of this toxic and

known carcinogen began at the CCRI NATTS site in January 2020. Previous national monitoring efforts in 2018-2019 showed measurable EtO readings away from known sources. The goals of this effort are to increase national analytical capacity of EtO, to support analysis of local monitoring programs, to determine seasonal variability and sources of EtO, and to determine persistence in the atmosphere. No other changes are planned for the ozone precursor or air toxics monitoring sites in the next 18 months.

National Core Multi-Pollutant Monitoring Stations Network

As required in an October 17, 2006, Federal Register notice (FR 71:61236), Rhode Island began operating a site that is part of EPA's network of core multipollutant monitoring (NCORE) stations in January 2011. This network is designed to address the following monitoring objectives:

- Timely reporting of data to the public through AIRNow, air quality forecasting, and other public reporting mechanisms
- Supporting development of emission strategies through air quality model evaluation and other observational methods
- Accessing accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors
- Supporting long-term health assessments that contribute to ongoing reviews of the NAAQS
- Establishing nonattainment/attainment areas by comparison with the NAAQS
- Supporting disciplines of scientific research, including public health, atmospheric and ecological.

The East Providence site is operating as the State's NCORE site. Ozone, low-range NO_2/NO_x, reactive oxides of nitrogen (NO and NO_y), low-range CO, low range SO_2, $PM_{2.5}$ (FRM, FEM continuous, and speciated), coarse PM ($PM_{10-2.5}$), VOCs, carbonyls, black carbon, and meteorological parameters are monitored at that site. $PM_{10-2.5}$ is measured as the difference between lo-vol PM_{10} and lo-vol $PM_{2.5}$ concentrations. True NO_2 is being measured by cavity attenuated phase shift (CAPS) spectroscopy with a Teledyne API T500U CAPS.

As mentioned earlier, RIDEM and RIDOH are currently in the planning stages to replace the current structure at the East Providence location. We are working with the City of East Providence and exploring the market to prepare a request for proposal for the project. The new structure will be in the same location as the current with a similar footprint.

Detailed Site Information:

The following section presents detailed information for each monitoring site, such as: identification code, location, history, monitored parameters, monitoring objectives, history and descriptive information.

Table 14: Myron Francis School – East Providence

Myron Francis School – East Providence			
County	Providence	Latitude	41.840954°
Address	64 Bourne Avenue	Longitude	-71.360976°
AQS Site ID	440071010	Elevation	62 feet
Spatial Scale	Neighborhood/Urban	Year Established	1993
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The Myron Francis school is a neighborhood scale site located in a residential suburban area in East Providence in northeastern Rhode Island on city property. The site is operated by RIDEM as part of the NCORE and PAMS program. South of the site is residential neighborhoods, west is sports fields and recreation space, immediately northeast is a playground and school building, with additional residential neighborhoods due east. Interstate I-195 is approximately 2 miles due south. The trailer is approximately 12'X29'.			
Monitoring Objectives: To collect long term measurements to assess trends as part of the national NCORE and PAMS Networks.			
Planned changes for 2023-2024: Planning and designing a new structure to replace current trailer.			

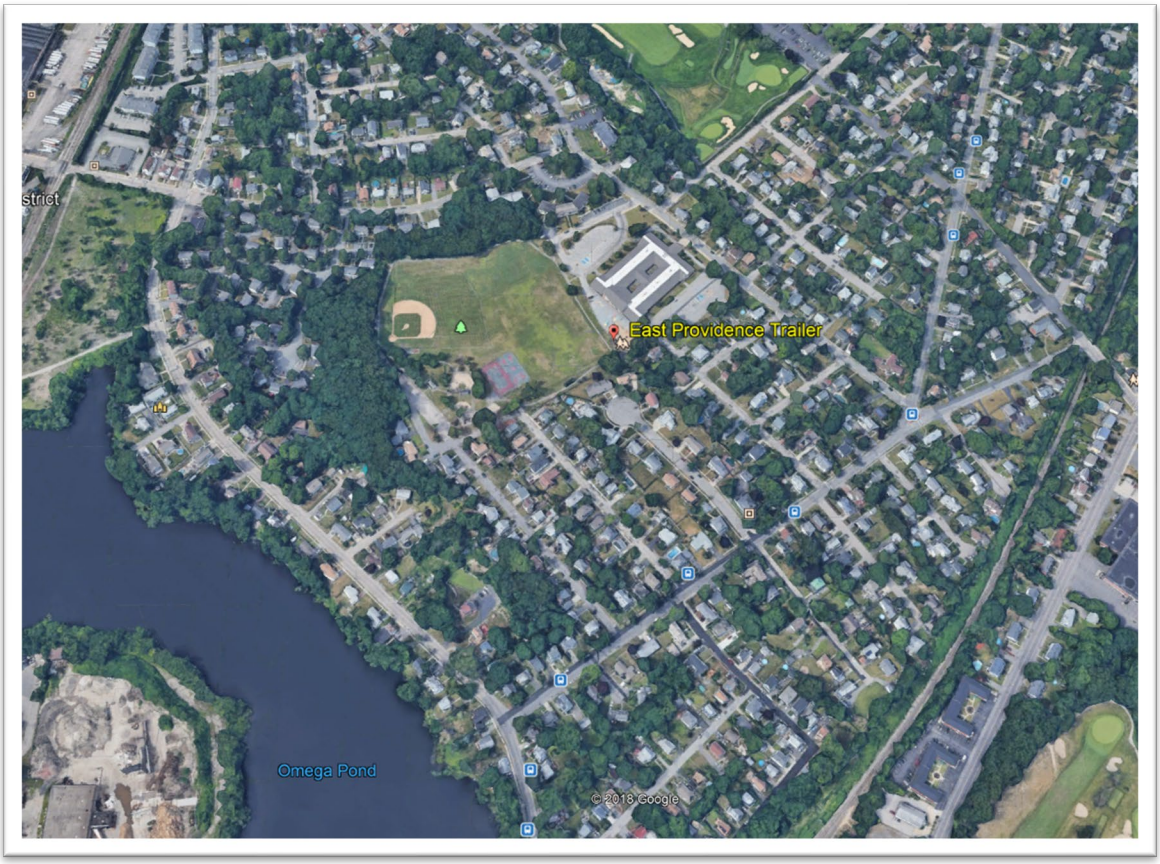


Figure 4: East Providence Monitoring Location

New Monitoring Structure Update

- Potential vendors with the capability of successfully bidding on and meeting the criteria for replacing this structure have been identified and briefed on the project and Request for Proposal.
- RIDEM is currently focusing on a vendor on the State MPA for construction and delivery of the structure only.
- Additional services are currently being solicited including demolition/removal of the current structure, electrical decommission and hookups, fencing, safety railing, permanent stairs to upper deck, and landscaping.
- The City of East Providence, the property owner of Glenlyon Park, has been updated on the stages process, and has provided input for the project.
- The funding for project has been secured through EPA. A rough deadline has been established for dispersing the funds for the project.
- RIDOA Purchasing has been assisting RIDEM with properly navigating our purchasing department to achieve compliance with purchasing requirements.
- The project is tentatively expected to begin during summer of 2024, as it's been requested by the City of East Providence do to conduct construction activities only when the neighboring elementary school is not in session.

Figure 5: East Providence Monitoring Trailer

Table 15: W. Alton Jones Campus – West Greenwich

West Greenwich – W. Alton Jones Campus			
County	Kent	Latitude	41.615316°
Address	401 Victory Highway	Longitude	-71.720032°
AQS Site ID	440030002	Elevation	210 feet
Spatial Scale	Regional/Background	Year Established	1976
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The Alton Jones site is a regional scale site located in a meadow surrounded by trees in Rhode Island in the town of West Greenwich. This site is operated by RIDEM as part of the SLAMS State Toxics network. Land use type: Forest and recreation field. It is located near RT 102 approximately 2.5 miles east, and Interstate I-95, 5 miles south. The trailer approximately 12'X12', with a pressure treated deck off to the east side of the trailer. A meteorological tower sits on the west side of the trailer. As the photo below reveals, the shelter is in a very rural region of the state miles from any public roads or neighborhood residences.			

Monitoring Objectives: To collect long term measurements to assess transport into the Rhode Island as part of the SLAMS and State Toxics networks.
Planned changes for 2023-2024: There has been no further information on the future of the Alton Jones campus. RIDOH staff continues to have access. The alternative site continues to be Arcadia Headquarters on 260 Arcadia Road, West Greenwich, 02832.

Figure 6: W Alton Jones Monitoring Location

Figure 7: W. Alton Jones Monitoring Site

Table 16: US EPA Lab - Narragansett

Narragansett – US EPA Lab			
County	Washington	Latitude	41.495060°
Address	27 Tarzwell Drive	Longitude	-71.423713°
AQS Site ID	440090007	Elevation	106 feet
Spatial Scale	Regional	Year Established	1997
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The Narragansett USEPA laboratory site is a regional scale site located 650 feet west of Narragansett Bay in the town of Narragansett. Route 1 is 1.75 miles to the west. This site is operated by RIDEM as part of SLAMS network. The ozone monitor, datalogger and other equipment is in a small office on the south side of the EPA building. A staircase on the north side of the building leads to the roof where the continuous PM2.5 sampler is placed. A meteorological tower sits on the east side of the building.			
Monitoring Objectives: To collect long term measurements to assess trends in Rhode Island as part of the national SLAMS network.			
Planned changes for 2023-2024: None			

Figure 8: Narragansett Monitoring Location

Figure 9: Narragansett Monitoring Shelter

Table 17: CCRI Liston Campus - Providence

Providence – CCRI Liston Campus			
County	Providence	Latitude	41.807523°
Address	1 Hilton Street	Longitude	-71.413920°
AQS Site ID	440070022	Elevation	75 feet
Spatial Scale	Neighborhood	Year Established	1999 (Urban) 2019 (CCRI)
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The CCRI Liston Campus site is a neighborhood scale in an urban community in South Providence. This site is operated by RIDEM as part of the SLAMS and NATTS air toxics network. This rooftop site is on the main campus building approximately 30 feet off the ground. North of the building is parking, an open lot, and some commercial buildings. To the south is parking and residential homes. To the west is parking and the former monitoring site at Urban League. To the east is parking and eventually some mixed commercial and residential properties. The campus is not on a main road. I-95 is 0.45 miles east.			
Monitoring Objectives: The CCRI monitoring site objective is to collect air quality measurements to assess long-terms trends as part of the SLAMS and NATTS network.			
Planned changes for 2023-2024: None			

Figure 10: CCRI Providence Monitoring Location

Table 18: Vernon St - Pawtucket

Pawtucket – Vernon Street			
County	Providence	Latitude	41.874683°
Address	Vernon Street	Longitude	-71.379936°
AQS Site ID	440070026	Elevation	82 feet
Spatial Scale	Middle	Year Established	2001
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The Vernon Street site is a middle scale site located in a suburban area in north-eastern Rhode Island in the City of Pawtucket. This site is operated by RIDEM as part of the SLAMS and State Toxics networks. Land use type: Highway/ Residential. It is located at grass level adjacent to Interstate RT I-95 and sits midway on a hill near the on-ramp with houses on the east-south sides. This site is a small grassy median situated 22 meters from I-95 North and 8 meters to the ramp leading to the highway. The samplers are placed on a cement platform and pressure treated deck. The area is surrounded by a chain link fence.			
Monitoring Objectives: to collect air quality measurements to assess long-terms trends as part of the national SLAMS and Toxics network.			
Planned changes for 2023-2024: None			

Figure 11: Pawtucket Monitoring Location

Table 19: Cranston – Near -Road

Cranston – Near Road			
County	Providence	Latitude	41.769880°
Address	750 Wellington Ave	Longitude	-71.428489°
AQS Site ID	440070040	Elevation	31 feet
Spatial Scale	Microscale	Year Established	April 2022
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The shelter sits in an open grassy spot north of the gantry at highway grade, less than 10m from the slow traffic lane. There are no roadside barriers, high structures, thick vegetation, sound walls, or complex terrain along this flat open section of road. The east side of the highway is very open along Wellington Avenue, while the west side has very slight elevation and some larger trees. Doric Park is very heavily used for recreation and is directly across from the proposed site on the west side of the highway, with residential homes south or Doric Park. The site has a new AQS ID listed above.			
Monitoring Objectives: To collect near road air quality measurements to assess long-terms trends as part of the Near Road Network.			
Planned changes for 2023-2024: None			

Figure 12: New Cranston Near-Road Monitoring Location (facing NW)

Figure 13: New Cranston Near-Road Monitoring Location (facing SW)

The former RIDEM/RIDOH Near Road monitoring station began operating in April 2014. The site was positioned along a segment of I-95 with the highest AADT traffic counts. Monitoring began in April of 2014 and ended in Fall of 2021. RIDOT speed profile data from 2012 indicate the current segment experienced some of the highest congestion profiles in the state.

It was known at the time of construction of the current Near Road location, that once the I-95 South viaduct bridge was completed, at some point the northbound bridge construction would take place and force the relocation of the Near Road location.

At the new location, a playground is situated about 300 feet across the highway on the southbound side. To the north and south of the park are residential neighborhoods. The east side of the highway is commercial use, with the closest businesses a roofing supply company and moving/storage facility. There are no large structures nearby (all about 1 to 1.5 stories), which are downwind across Wellington Avenue, which is a 2-way, 2 lane road.

The location is oriented very similarly to the previous Near Road site, with SSW to NNE orientation. The current site is just very slightly more northerly oriented with the new site down wind of the target road segment. It is known that the predominant flows in that region have a westerly component year-round.

There are no tall buildings to obstruct air flow significantly from any direction. This site is 2 miles west of Narragansett Bay and would seldomly be impacted by bay or sea breezes. As mentioned, there is very little grade in this area, with unobstructed flows off the highway.

For additional details on the reasoning for this site selection, please refer to the 2021 Annual Monitoring Network Plan.

Table 20: RIDEM State Beach Pavilion - East Matunuck

East Matunuck – State Beach Pavilion			
County	Washington	Latitude	41.377451°
Address	950 Succotash Road	Longitude	-71.52485°
AQS Site ID	440090008	Elevation	20 feet
Spatial Scale	Regional	Year Established	2020
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The East Matunuck site is a regional scale site established to capture ozone concentrations on the coast.			
Monitoring Objectives: Because of its immediate coastal location, this monitor will capture ozone plumes migrating over water along Long Island Sound as they come ashore. These measurements will enhance the existing network of Rhode Island ozone monitors to complement transport arriving inland, and now, the immediate coastline. Additionally, in summertime, the open ocean beaches along the Southern Rhode Island coastline are highly populated and it is important to understand the ground-based ozone health risk in a region where hundreds of thousands of people visit and recreate. RIDEM expects to meet AQS level criteria again for 2023.			
Planned changes for 2023-2024: None			

Figure 14: East Matunuck Monitoring Site Location

Figure 15: East Matunuck Monitoring Site Location (facing S from tower)

Table 21: Rhode Island Monitoring Sites

1	Vernon Street	Vernon Street, Pawtucket RI	41.874675	-71.379953
2	Myron Francis School	64 Bourne Avenue, East Providence RI	41.84092	-71.4236587
3	CCRI Liston Campus	1 Hilton Street, Providence RI	41.807523	-71.41392
4	Near Road	750 Wellington Avenue, Cranston RI	41.76988	-71.428489
5	Alton Jones Campus	Victory Highway, West Greenwich RI	41.6156	-71.7199
6	USEPA Laboratory	27 Tarzwell Drive, Narragansett RI	41.4950779	-71.4236587
7	East Matunuck	950 Succotash Road, South Kingstown RI	41.377451	-71.52485

Figure 16: RI Monitoring Network