Vermont Annual Air Monitoring Network Plan 2018

Vermont Department of Environmental Conservation
Air Quality & Climate Division
July 1, 2018

VERMONT.gov

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Acronyms and Abbreviations

AMTIC – Ambient Monitoring Technical Information Center
AQCD – (Vermont) Air Quality & Climate Division
AQI – Air Quality Index
BTEX – Benzene, Toluene, Ethylbenzene, Xylene
CAA – Clean Air Act
CARB – California Air Resources Board
CBSA – Core Based Statistical Area
CFR – Code of Federal Regulations
CO – Carbon Monoxide
CSA – Combined Statistical Area
CT DEEP – Connecticut Department of Energy & Environmental Protection
EPA – Environmental Protection Agency
FEMC – Forest Ecosystem Monitoring Cooperative
FEM – Federal Equivalent Method
FRM – Federal Reference Method
GIS – Geographical Information Systems
HAAS – Hazardous Ambient Air Standard
HAP – Hazardous Air Pollutants
IO – Inorganic
LC – Local Conditions of Temperature and Pressure
MDL – Method Detection Limit
MQO – Measurement Quality Objectives
NAAQS – National Ambient Air Quality Standards
NAMS – National Air Monitoring Station
NATTS – National Air Toxic Trends Stations Network
NCore – National Core Monitoring Sites
NECMSA – New England County Metropolitan Statistical Area
NO_2 – Nitrogen Dioxide
NOx – Oxides of Nitrogen
NOy – Reactive Nitrogen Compounds
O_3 – Ozone
OAQPS – Office of Air Quality Planning and Standards
PAH – Polycyclic Aromatic Hydrocarbon
PM_{10} – Particulate ≤10 micron aerodynamic particle size
$PM_{2.5}$ – Particulate ≤2.5 micron aerodynamic particle size
PMc – Coarse Particulate between 10 and 2.5 micron aerodynamic particle size ($PM_{10-2.5}$)
PMSA – Primary Metropolitan Statistical Area
QA/QC – Quality Assurance/Quality Control
QAPP – Quality Assurance Project Plan
SLAMS – State and Local Monitoring Stations
SO_2 – Sulfur Dioxide
SOP – Standard Operating Procedure
SPMS – Special Purpose Monitoring Stations
STP – Standard Temperature and Pressure
TAPI – Teledyne API (Advanced Pollution Instruments)
TEI – Thermo Environmental Instruments
TL – Trace Level
TOR – Total Organic Reduction
TSP – Total Suspended Particulate
TSS – Technical Services Section (Monitoring Section) of the AQCD
VAEL– Vermont Agriculture and Environmental Lab
VOC – Volatile Organic Compound
XRF – X-Ray Fluorescence

Introduction

In accordance with adopted federal EPA regulation, 40 CFR Part 58, Subpart B §58.10(1), the Vermont Air Quality & Climate Division is required to submit to EPA by July 1, 2018 an air monitoring network plan for the State of Vermont. The regulation requires that the network plan be posted on the AQCD website or other form of notification for public comment 30 days prior to submission to the EPA Region 1 Office.

The current air monitoring network plan is available for public review on the AQCD website, http://dec.vermont.gov/air-quality/monitoring, for the 30-day comment period prior to submittal to EPA.

Please send all comments regarding Vermont Air Monitoring Network Plan:

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The 2018 Network Plan was posted on the "public notice" section of the AQCD website listed above from 5/25/18 through 6/26/18. During this period, the VT AQCD received no public comments. VT AQCD did receive comments from EPA-New England in a letter dated 6/15/18, which is included at the end of this document. VT AQCD revised the report as necessary to address EPA's comments.

Vermont Air Monitoring Network Plan Overview

The Vermont AQCD is a division within the Vermont Department of Environmental Conservation (DEC), which is one of three departments in the Vermont Agency of Natural Resources. The mission of the AQCD is to implement the Clean Air Act and Vermont State Statutes related to air quality. The AQCD regulates air quality to protect public health and the environment. As part of that effort, air monitoring data is required to be collected by federal regulations as put forth in the federal Clean Air Act, 40 CFR Parts 50, 53, 58, and the Vermont Statutes Title 10, Part 1, Chapter 23, § 575. The collected data is utilized to determine compliance with the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS)[2], and Vermont's Hazardous Ambient Air Standards (HAAS)[3]. Other important uses of the of air monitoring data includes production of a daily Air Quality Index (AQI) report, daily air quality forecast report, support of short and long-term health risk assessments, and tracking long-term environmental trends in air quality.

This document provides general information and overview of the Vermont Air Quality & Climate Division's air monitoring operational network. It also provides a brief annual summary of the Vermont "NAAQS Design Values" where applicable, and some of the major activities and changes scheduled for the upcoming year.

VT AQCD Air Monitoring Program Overview

Air pollution is created by many anthropogenic sources such as cars, trucks, buses, factories, and power plants, as well as natural sources such as forest fires, volcanoes, and wind storms. The air pollution emanating from these sources can be local or transported from great distances. The amount of particulate matter, carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) emitted into the ambient air has been greatly reduced by control strategies and equipment applied to industrial sources. The phase-out of leaded gasoline produced reductions in ambient air lead concentrations. New automobiles are now equipped with emission controls and catalytic converters which greatly reduced ambient air concentrations of NO_2, CO and volatile organic compounds (VOCs). Through other regional, national, and global control strategies, pollutants such as ozone and particulate matter concentrations in Vermont are continuing to be reduced. New air pollution control technologies and strategies on various emission sources are expected to provide further reductions of air pollutants in the future.

Ambient air monitoring is valuable service, which is essential for state and federal environmental planning, enforcement efforts, air pollutant trends analysis, and more recently providing timely air quality health advisories. Air monitoring began in Vermont in the 1960's, with a focus on total suspended particulate (TSP). During the 1970's, monitoring methods improved to allow for better quality particulate sampling and continuous monitoring of gaseous criteria pollutants such as CO, SO_2, NO_2, and ozone (O_3). During the late 70's and early 80's rapid development of computerized data acquisition systems allowed for collection of air quality data on a near real-time basis. Also during the 1980's, monitoring methods and analytical techniques were developed to assay classes of toxic compounds such as VOC's, PCB's, PAH's, Carbonyls, and Metals. As technology improves, so does the ability to identify and quantify pollutants in both a spatial and temporal manner. Some of the newer technologies allow for real-time monitoring of toxic compounds.

The Vermont AQCD currently operates and maintains five permanent air monitoring stations and will be evaluating potential sites during 2018 for relocation of the Burlington Main Street shelter, as requested by the Burlington Department of Planning and Zoning. Vermont established a monitoring network for criteria pollutants in the 1970's and a network for toxic air pollutants in 1985. Currently, the AQCD monitors for six criteria air pollutants and 96 air toxic pollutants (see Appendix A) as well as 53 separate $PM_{2.5}$ mass and chemical speciation parameters at the CSN/IMPROVE sites (see Appendix B). The operation of all the SLAMS, NCore and CSN air monitors in the network meets the requirements in *40 CFR Part 58, Appendices A, C, D and E*. The criteria pollutant monitoring methods utilized by the VT AQCD are EPA federal reference method (FRM) or equivalent method (FEM) designated instruments.

All EPA CAA §105 & §103 grant agreements with VT AQCD require a Quality Assurance Project Plan (QAPP), an annual Work Plan, and Standard Operating Procedures (SOPs). These are reviewed annually and a summary update report is submitted to EPA annually by November 1st. The AQCD QAPPs and most associated SOPs for the Criteria Gases, Particulate Matter, Air Toxics and National Air Toxics Trend Sites (NATTS) have received EPA approval. The annual update for the Air Toxics and NATTS QAPP was submitted in December, 2017. The QAPP for the Criteria Gas & Particulate Matter Pollutant Monitoring, Revision 1 was originally approved by EPA on 10/14/16 and the annual update identified as Revision 2 was completed on 10/1/17 and submitted to EPA on 12/14/17. The Meteorological QAPP is pending and is scheduled to be finalized and submitted to EPA in 2018.

The Federal EPA National Ambient Air Quality Standards

The Clean Air Act of 1990 requires EPA to set NAAQS's (40 CFR part 50) for pollutants that are deemed harmful to public health and the environment. The Clean Air Act presents two types of NAAQS's: primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly; secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA identified NAAQS's for six principal pollutants, which are called "criteria" pollutants. They are listed in Appendix B of this document. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, or micrograms per cubic meter of air ($\mu g/m^3$).

On December 16, 2006, the EPA reduced the daily $PM_{2.5}$ NAAQS from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. The annual $PM_{2.5}$ NAAQS remained 15$\mu g/m^3$. Vermont operates a small network of FRM filter based samplers as well as FEM for continuous $PM_{2.5}$ to assess air quality for $PM_{2.5}$.

On December 16, 2006, a regulation update addressed the creation of a multi-pollutant National Core (NCore) site network throughout the country. EPA's Office of Air Quality Planning and Standards (OAQPS) approved Vermont's NCore station at Underhill, VT on October 30, 2009. The Underhill site is one of 20 rural sites within the NCore network. The upgrades to the existing site required the addition of "trace level" monitoring for carbon monoxide, nitrogen oxides, and sulfur dioxide.

On November 12, 2008, the NAAQS for lead was strengthened to 0.15 micrograms per cubic meter for both the primary and secondary standard. In April 2012, the EPA issued the final NAAQS lead monitoring requirements for the required monitoring sites. Vermont was not required to set up any NAAQS lead monitors at that time. The reason for this designation is that the State of Vermont does not meet the regulation requirements with regard to population thresholds for the Core Based Statistical Area (CBSA). Vermont airports do not meet "take off" & "landing" thresholds, and stationary emission source "tons per year" do not meet required thresholds. The 2009 Vermont lead (Pb) NAAQS Monitoring Plan provided the current plan and approach that was pursued by the State of Vermont with regard to the ambient air lead monitoring network prior to the 2010-2012 monitoring requirement updates. As of January 2010, VT AQCD, as part of the National Air Toxics Trends Site (NATTS) in Underhill, has conducted low-volume PM_{10} sampling with subsequent multi-metals analysis (Pb included). Beginning in 2017 and 2018, low-volume PM_{10} sampling with subsequent multi-metals analysis (Pb included) is being performed at Rutland and Burlington Main Street sites, accordingly. On December 19, 2014, the EPA reviewed the standard requirements and opted to retain the existing standards.

The final rule for NO_2 NAAQS was adopted on January 22, 2010. The new 1-hour average NO_2 NAAQS is based on the 3-year average of the 98th percentile of the 1-hour daily maximum. The 1-hour NAAQS value was set at 100 ppb. EPA, in cooperation with States/Local/Tribal agencies, will set up 40 NO_2 monitors nationwide to help protect communities that are susceptible to NO_2 health effects. Vermont is not currently required by EPA under this rule to set up any additional NO_2 monitors or require consideration of a "near roadway" site in the network other than what is currently being operated in Burlington and Rutland or elsewhere in the state of Vermont.

A new 1-Hour SO_2 NAAQS was adopted on June 2, 2010. EPA strengthened the primary NAAQS for SO_2 by establishing a 1-hour standard level of 0.075 ppm. The new design value is a three-year average of the 99^{th} percentile of the annual distribution of the daily maximum 1-hour average concentration for that year. The rule revokes the previous 24-hour standard (140 ppb) and annual standard (30 ppb). The Vermont recommended design value uses 2015, 2016, and 2017 SO_2 summary data. Vermont is not currently required under the new rule to set up additional SO_2 monitors in the network, beyond what is currently in Rutland. EPA finalized its Data Requirements Rule for the 1-hour Sulfur Dioxide Primary NAAQS on August 21, 2015 (80 FR 51052), and provided detailed monitoring and modeling guidance for implementing the SO_2 standard.

On January 15, 2013, EPA adopted an updated $PM_{2.5}$ primary annual $PM_{2.5}$ standard of 12 ug/m^3 and the secondary standard of 15 ug/m^3. This annual $PM_{2.5}$ average will be computed as the average of the last three years. As an example: The average for 2012 would be the annual averages from 2010, 2011 and 2012. In addition, EPA established that all continuous $PM_{2.5}$ FEM monitors operating for more than 24 months be used for comparison to the NAAQS unless the state specifically requests that the data be excluded as is provided under 40 CFR Part 58.11(e).

The ozone primary and secondary NAAQS for 8-hour average of 0.070 ppm was adopted on December 28, 2015. At this time, Vermont is in compliance with the current NAAQS ozone standard.

Changes July 2017 to June 2018 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the 12-month period between July 2017-June 2018 were:

1. Between 8/22/17 and 4/14/18 the Burlington Main Street TEI 2000i FRM was temporarily configured from PM_{10} to $PM_{2.5}$ to provide comparison data for new TAPI T640 FEM.
2. Temporary Rutland PM changes during this period included increasing the TEI 2025i FRM sampling schedule from 1-in-6 day to 1-in-3 day from 10/7/17 through 4/8/18 and reconfiguring the TEI 2000i FRM from PM_{10} to $PM_{2.5}$ from 1/3/18-3/28/18, to provide collocated FRM measurements during evaluation of the new TAPI T640 FEM.
3. On 3/7/18 , a new TAPI T703 ozone calibrator was installed at the Bennington site as the new station ozone standard calibrator, rather than being installed as the new primary standard at the Berlin Field Operation Center, as was proposed in the previous 2017 Annual Plan.
4. On 7/27/17, new TAPI T640 continuous $PM_{2.5}$ FEM monitors were installed at the Bennington and Rutland site replacing a TEI TEOM and MetOne BAM, respectively. Rutland is now the designated network collocated site for the T640 FEM.
5. On 8/22/17, new TAPI T640 continuous PM2.5 FEM monitors were installed at Burlington Main Street and Underhill Sites, replacing TEI TEOM monitors at both sites.
6. On 12/31/17, meteorological parameter monitoring was discontinued at Burlington Cherry St. Site (Zampieri Building).
7. Beginning with the 1/1/17 sample, Rutland PM_{10} filters were submitted for subsequent metals analyses on a 1-in-12 day schedule.
8. A new TAPI T400E Ozone analyzer was installed at the Underhill NCore Site on 10/27/17.
9. A new Agilaire 8872 datalogger was installed at the Underhill Ncore Site on 6/1/17.
10. A new Magee AE33 Aethalometer was received on 5/7/18 and is scheduled for installation at the Rutland site during the summer of 2018.
11. The Agilaire AgileWeb module was installed on the AQCD's website and went live on 3/23/18, providing real time public access to current and historic AQCD criteria air monitoring data and meteorological parameters.

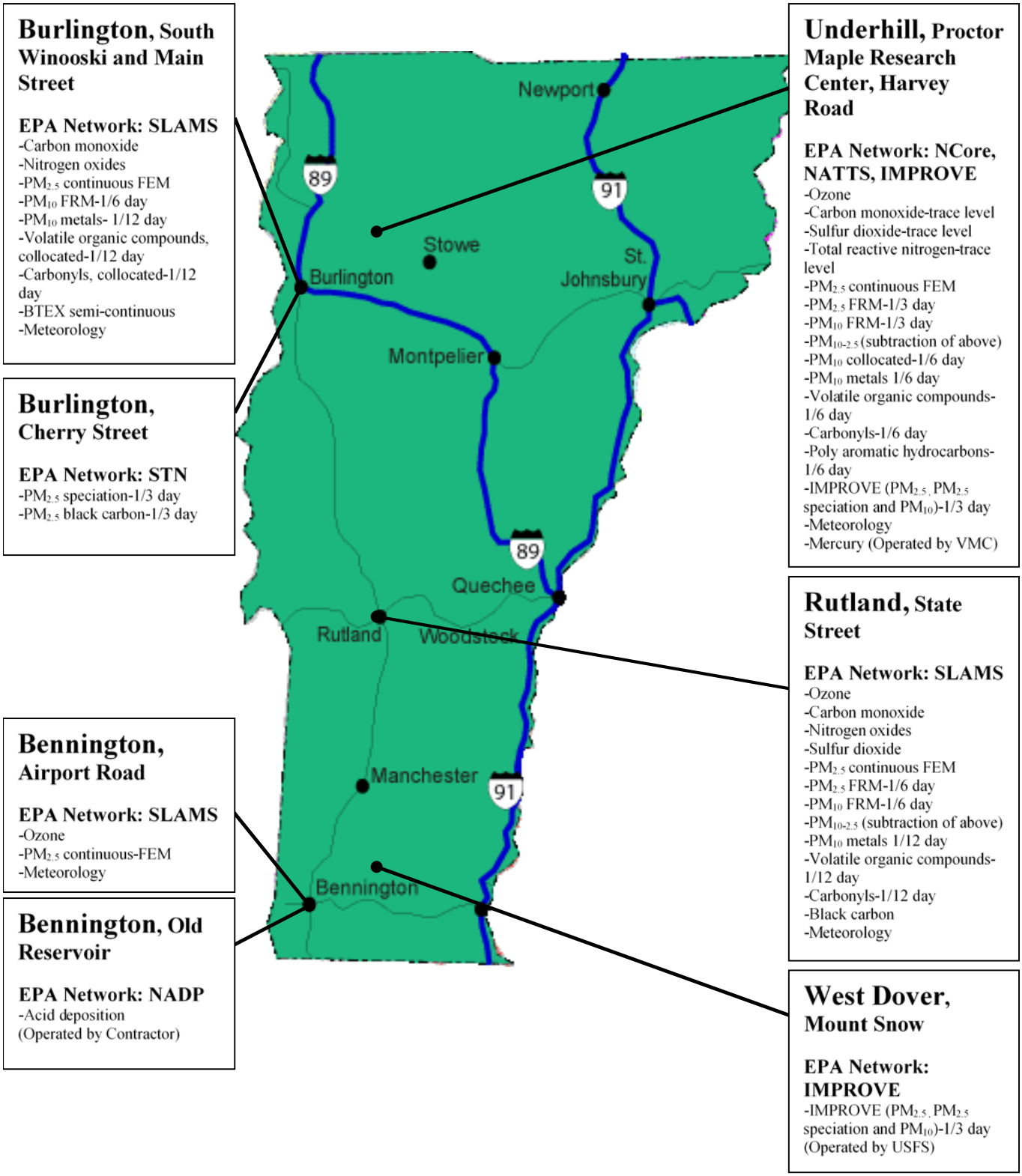
Proposed Changes July 2018 to June 2019 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2018-June 2019 are:

1. Procure a reactive nitrogen compounds analyzer (trace-NO_y), dynamic dilution calibrator and zero air system for the Underhill NCore site. Purchase requisitions are scheduled to be submitted during the Summer/Fall of 2018.
2. Install the recently procured Magee AE33 Aethalometer (Black Carbon-EC/OC-7 channels) at the Rutland site which is scheduled for a date TBD, sometime during the Summer of 2018. The AE33 will replace the legacy AE22 Aethalometer currently operated at that site.
3. Begin submitting Burlington PM_{10} filters for subsequent metals analyses on a 1-in-12 day schedule.
4. Continue working with the Burlington Planning Department and others on developing a plan for the relocation of the Burlington Main Street monitoring site. The Burlington Planning Department has indicated that the redevelopment project for the current monitoring site location is in transition with no firm schedule and suggests that site relocation planning should nonetheless proceed proactively as city plans for this block renovation are continuing to be developed.

Figure 1 – Vermont Air Monitoring Network Plan Map

2018 Vermont Ambient Air Monitoring Network



Network Pollutant Monitoring Descriptions

Below is the list of network pollutant monitoring descriptions with number of sites, the sampling frequency, and specific network information.

$PM_{2.5}$ Monitoring Network

Continuous: The Vermont AQCD operates four (4) continuous $PM_{2.5}$ monitoring sites in the air monitoring network, at the Burlington Main Street, Underhill, Rutland and Bennington sites (see Table 1). The TAPI T640 continuous $PM_{2.5}$ monitor is operated at all four sites and has Federal Equivalency Method (FEM) designation from EPA (EQPM-0516-236). All T640 $PM_{2.5}$ monitors are operated year-around and the T640 at the Rutland site is collocated with a $PM_{2.5}$ TEI 2025i FRM sampler on a 1-in-6 day schedule, for official determination of network precision, QA assessment and comparative analysis for this method. The T640 at the Underhill site is also collocated with a TEI 2025i FRM on a 1-in-3 day schedule for NCore requirements and provides unofficial method precision for informational purposes.

The TAPI T640 continuous $PM_{2.5}$ monitor design is a direct ambient air measurement method (no in-line filter) using optical broadband spectrometry which converts 90^o scattered polychromatic LED light from suspended aerosol particles into a mass concentration in $\mu g/m^3$. Continuous $PM_{2.5}$ $\mu g/m^3$ data is reported as 1-hour averages. The T640 FEMs at all four VT sites are designated in AQS as the primary monitor for $PM_{2.5}$ LC (AQS code: 88101). The network primary and collocated monitors are deemed suitable for the applicable NAAQS comparison. Vermont AQCD is not requesting that any site's continuous $PM_{2.5}$ FEM be excluded from comparison to the NAAQS. As of 2014, all continuous $PM_{2.5}$ FEM monitoring data from VT sites have been reported as $PM_{2.5}$ LC (88101).

FRM: The Vermont AQCD currently operates two (2) $PM_{2.5}$ TEI 2025i FRM samplers (see Table 1) in the air monitoring network, at the Rutland and Underhill sites. The Underhill NCore sampler operates on a 1-in-3 day sampling schedule, while the Rutland sampler operates on a 1-in-6 day sampling schedule as the designated network collocated sampling site for assessing precision for T640 FEM.

The EPA approved FRM sampling method collects an integrated 24-hour particulate sample on a 47mm Teflon® filter disc (SeeTable 2). The particulate collected on the filter has an aerodynamic particle size of ≤ 2.5 microns. The filter and associated sampling data are post processed using gravimetric assessment (by CT DEEP) to determine the mass concentration for the 24-hour sampling period.

Table 1 – $PM_{2.5}$ Sample/Analysis Method

Site	Continuous FEM (Primary)	FRM	FRM Collection frequency	Collocated Precision Site
Underhill	Teledyne API T640	TEI 2025i	1-in-3 day	NCore/Informational
Rutland	Teledyne API T640	TEI 2025i	1-in-6 day	Yes (network)
Burlington Main Street	Teledyne API T640	N/A	N/A	N/A
Bennington	Teledyne API T640	N/A	N/A	N/A

Table 2 – $PM_{2.5}$ Methods

Sampler	Collection	Analytical Method	Reported Data Interval
TEI 2025i Manual Equivalent Method: **EQPM–0202–145**	Low Volume 47 mm Teflon® Filter - 24 Hour	Gravimetric/ CT DEEP	24-houir
TAPI T640 **EQPM–0516–236**	Direct Measurement	Continuous.Broadband Spectroscopy	1-Hour

"Design values" for $PM_{2.5}$ must be calculated every year for operational sites operating FRM or FEM $PM_{2.5}$ monitors/samplers. The site must meet the design value statistical definition in order for a design value to be calculated. See below for further information.

$PM_{2.5}$ Annual Design Value (2017)

$PM_{2.5}$ annual design values are presented in Table 3 below and are calculated using the 3-year average of the respective annual averages from 2015-2017. The current annual $PM_{2.5}$ NAAQS is 12µg/m^3. Currently, all Vermont monitors are in attainment of the annual $PM_{2.5}$ NAAQS.

Table 3 – $PM_{2.5}$ 2017 Annual Design Value

Site	Design Value (µg/m^3) Years 2015-2017
Bennington	5.5
Burlington Main St	5.6
Rutland	7.5
Underhill	3.2

Source: EPA AQS AMP480.

$PM_{2.5}$ 24-Hour Design Value (2017)

The $PM_{2.5}$ 24-Hour design values are presented in Table 4 below and are calculated using the 3-year average of the annual 98th percentile 24-hour averages from 2015-2017. The 24-hour average $PM_{2.5}$ NAAQS is 35 µg/m3. Currently, all Vermont monitors are in attainment for the daily $PM_{2.5}$ NAAQS.

Table 4 – $PM_{2.5}$ 2017 24-Hour Design Value

Site	Design Value (µg/m^3) Years 2015-2017
Bennington	14
Burlington Main Street	14
Rutland	22
Underhill	10

Source: EPA AQS AMP480.

$PM_{2.5}$ Speciation Monitoring Network

The Vermont AQCD operates two (2) PM2.5 speciation sites in the air monitoring network at the Burlington-Cherry Street (Zampieri) and Underhill sites (See Table 5). The samplers operate on a 1-in-3 day schedule and produce a 24-hour integrated filter based sample. A third Vermont site not officially part of the AQCD network, which is operated and maintained by the U.S. Forest Service (USFS), is located at Dover, VT. Both the Underhill and Dover, VT (Mt. Snow-Lye Brook) are part of the IMPROVE (Interagency Monitoring of Protected Visual Environments) network. The Burlington Cherry Street site is part of the EPA Speciation Trends Network (STN).

The analysis of the filters generates $\mu g/m^3$ concentration results for 53 parameters on chemical makeup of $PM_{2.5}$ (see Appendix B). The parameters include levels of sulfate, nitrate, ammonium, and trace elements including metals, elemental carbon, and organic carbon. The STN is designed to complement the PM FEM/FRM network. The IMPROVE network monitors are mostly located in rural areas, and provide measurements of regional and background levels of $PM_{2.5}$ concentrations on a 1-in-3 day sampling schedule. The same chemical components are measured by IMPROVE as are measured by the STN, although differences exist between the methods employed to collect and analyze the collected sample.

In 2009, the STN network deployed the new URG carbon sampler to enhance the carbon speciation measurement. The sampler operates on the 1-in-3 day schedule and is collocated with the current Met One SUPERSASS sampler.

Table 5 – Speciation Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
PM Speciation (STN)	Met One - SUPERSASS	Low Volume Multi Filter sequential 24 Hour	STN	See Appendix B/UCDavis & DRI
PM Carbon (STN)	URG 3000-N	Low Volume Multi Filter 24 Hour	Carbon Analysis	See Appendix B/ UCDavis & DRI
PM Speciation (IMPROVE)	UCDavis – IMPROVE Sampler	Low Volume Multi Filter - 24 Hour	IMPROVE	See Appendix B/ UCDavis & DRI

Black Carbon

The AQCD currently operates a Magee AE22 Aethalometer at the Rutland site which measures the optical absorption of carbon particles at two wavelengths: 880 nm (IR), quantitative for the mass of 'black' or elemental carbon; and 370 nm (UV). With data processing aromatic organic compounds such as are found in wood smoke, biomass-burning smoke, and tobacco smoke may be identified. Utilizing dual wavelength measurement allows for the determination of the sources of airborne black carbon particles (ie. diesel exhaust vs. wood smoke combustion). Data is store at 1 hour intervals.

The AQCD recently received a new Magee AE33 Aethalometer (7 wavelength measurement channels) which is scheduled to be installed at the Rutland site during the summer of 2018, replacing the legacy AE22 instrument.

Table 6 – Black Carbon Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Black Carbon	Magee AE22 (current) Magee AE33 (summer of 2018)	Quartz Filter Tape	Continuous Optical Measurement	1 Hour

Ozone Monitoring Network

The Vermont AQCD operates three (3) ozone sites in the air monitoring network, Bennington, Underhill and Rutland. Currently, all ozone analyzers are operated year-round. Data is collected continuously and recorded as 1-hour averages. Ozone measurements are utilized to determine compliance with the 1-hour and 8-hour NAAQS, atmospheric transport modeling, and ozone precursor studies. Data is transferred hourly to the EPA AIRNOW website for AQI mapping and air quality forecasting. The AQCD operates TAPI Model T400 ozone analyzers at all sites (seeTable 7).

"Design values" for ozone must be calculated every year for sites operating FEM instruments. The site must meet the design value statistical definition in order for a design value to be calculated. See below for further information.

Table 7 – Ozone Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Ozone	TAPI T400 Automated Equivalent Method: EQOA-0992-087	Continuous	Ultraviolet Photometry	1 Hour

Ozone Design Value (2017)

Below are the current design values for ozone determined from data for 2015-2017 (See Table 8). Ozone design values are calculated by taking the 3-year average of the annual 4th maximum daily maximum 8-hour ozone averages. The applicable NAAQS 8-hour ozone standard is 0.070 ppm (effective 12/28/15). Currently, all Vermont monitors are in attainment for ozone NAAQS.

Table 8 – Ozone 8-Hour 2017 Design Values

Site	Design Value (PPM) Years 2015-2017
Bennington	0.065
Underhill	0.062
Rutland	0.063*

Source: EPA AQS AMP480.*: Ozone monitoring began 4/1/16, design value criteria not met: value reported is average 4th max for only 2016 and 2017.

Enhanced Monitoring Plan

Vermont is located in the Ozone Transport Region (OTR) as defined in 40 CFR 51.900 making it subject to developing an Enhanced Monitoring Plan (EMP) detailing enhanced ozone and ozone precursor monitoring per 40 CFR Part 58, Appendix D, 5. (h). For OTR states, the EMP must be submitted to the EPA Regional Administrator no later than 10/1/19. Vermont AQCD's EMP is being submitted as part of the 2018 Annual Air Monitoring Network Plan as required by 40CFR 58.10.

Vermont AQCD understands that EPA has encouraged OTR states to work towards a comprehensive effort to understanding and eventually solving the ozone problem in this Region. Vermont is designated by EPA as Attainment/Unclassifiable and the Underhill NCore is not in a Core-Based Statitiscal Area (CSBA) with a population of 1,000,000 or more. Consequently, the AQCD is not, nor has ever been, required to operate a PAMS site and does not receive any EPA PAMS funding. Consequently,Vermont AQCD's ability to contribute to the OTR ozone issue is limited and based on available resources. Nevertheless,Vermont AQCD has determined its EMP includes additional monitoring activities it performs that exceed EPA requirements in Sections 4.1 and 4.3 of 40 CFR Part 58, Appendix D, which are listed in Table 9 – Vermont AQCD EMP. These activities along with existing continuous NO_2 and NO_y monitoring at AQCD network sites, can be considered important in helping to understand the ozone problem in Vermont, the northeast and the OTR.

The EMP activities include the operation of an additional network ozone monitor at the Rutland site which is operated year round, operating the existing Bennington SLAMS site ozone monitor year round and the 24-hr sample collection and analysis of a subset of the PAMS target list compounds, including carbonyls and speciated VOCs, at three (3) AQCD network sites (including 2 of 3 network ozone monitoring sites) on a 1-in 6 day or 1-in-12 day schedule.

Table 9 – Vermont AQCD EMP

Parameter	Site (see Table 18/descriptions for details)	Measurement Frequency/Avg./Units	EMP Qualification	Comments
Ozone	Rutland	Continuous/1-hr avg./ppm	Additional Site exceeds Part 58 App. D 4.1/operated year-around	SLAMS
Ozone	Bennington	Continuous/1-hr avg./ppm	Operated year-around	SLAMS
Carbonyl	Underhill (NATTS) Burlington Main St. Rutland	1-in-6/24 hr avg./µg/m^3 1-in-12/24 hr avg./µg/m^3 1-in-12/24 hr avg./µg/m^3	Non-PAMS TO-11A monitoring	formaldehyde acetaldehyde acetone
VOCs	Underhill (NATTS) Burlington Main St. Rutland	1-in-6/24 hr avg./ppb 1-in-12/24 hr avg./ppb 1-in-12/24hr avg./ppb	Non-PAMS TO-15 monitoring	styrene, 1,3-butadiene, benzene, toluene, ethylbenzene, m/p/o-xylene, octane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene

Ambient Air Toxics Monitoring Network

The Vermont AQCD operates three (3) ambient air toxics monitoring sites in the air monitoring network, located at the Burlington Main Street, Rutland and Underhill sites. The Underhill site is part of the EPA NATTS network and the Burlington and Rutland air toxics monitoring sites are part of the Vermont AQCD Air Toxics Monitoring Network.

The air toxic sample collection and analysis program includes volatile organic compounds (VOC), carbonyl compounds and PM_{10} metals at all sites (PM_{10} metals were added at Burlington Main Street site in 2018). VOC and carbonyl compound samples are collected with a combined VOC/carbonyl air toxics sampler and the PM_{10} metals samples are collected on 47 mm Teflon® filters using FRM samplers operated for the PM_{10} network (see Table 11 – PM_{10} Sample/Analysis Methodbelow). VOC, carbonyl and metals samples are collected on a 1-in-12 day schedule at the Burlington Main Street and Rutland sites and a 1-in-6 day schedule at the Underhill site. The Underhill site also includes sampling and analysis of polyaromatic hydrocarbons (PAH) compounds on a 1-in-6 day schedule to meet NATTS requirements.

In addition to the VOC samples collected at all 3 sites, a Synspec GC955 semi-continuous analyzer using gas chromatography with photo ionization detector (GC/PID) is operated at the Burlington Main Street site to determine 15-minute average concentrations of benzene, toluene, ethylbenzene and xylenes (BTEX). Please note that the GC955 analyzer was out of service for 2017 due to a malfunction and is currently being serviced at the manufacturer's representative's facility and is expected to be back in service sometime during the summer of 2018. See Table 10 below for the list of sampling methods and analytical methods. The list of target analytes and associated MDLs for the all analytical air toxics methods are listed in Appendix A.

Table 10 – Ambient Air Toxic Sampling/Analysis Methods

Pollutant	Sampler	Collection	Analytical Method	Analytes/Lab
VOC	ATEC 2200 (combined sampler)	6 Liter Silco-coated SS Canister- 24 Hour (sub-atmospheric)	TO-15 (GC/MS)	55 VOC Compounds VAEL Lab
Carbonyl	ATEC 2200 (combined sampler)	DNPH Cartridge- 24 Hour	TO-11A (HPLC)	4 Carbonyl Compounds VAEL Lab
Metals (Lead Included)	TEI 2025i/2000i PM_{10} Low-Volume	Teflon® Filter- 24 Hour	IO-3.5 (ICP/MS)	15 Elements VAEL.Lab
PAH	Tisch PUF +	PUF/XAD- 24 Hour	TO-13A (GC/MS)	22 PAH Compounds ERG (EPA National Contract Lab)
BTEX	Synspec GC955 Series 600	Semi- Continuous 15 Minute	GC-PID	5 VOC Compounds/direct measurement

PM_{10} Monitoring Network

The Vermont AQCD currently operates three (3) PM_{10} monitoring sites in air monitoring network at the Burlington Main Street, Rutland and Underhill sites. The Underhill is a NCore site and operates on a 1-in-3 day sampling schedule, with collocated PM_{10} sample collection performed on 1-in-6 day schedule. The Burlington Main Street and Rutland sites operate on a 1-in-6 day schedule. Please note that the Burlington Main Street FRM sampler was operated as a $PM_{2.5}$ sampler when the TAPI T640 $PM_{2.5}$ monitor was initially installed at that site up through 4/14/18, when after that point it was reconfigured as a PM_{10} sampler and operated on a 1-in-6 day schedule.

The sampling method utilized for sample collection is 24-hour low volume sample collection, on a 47mm Telfon® filter (See Table 11 – PM10 Sample/Analysis Method). The particulate collected on the filter has an aerodynamic particle size of ≤10 microns. The filter and associated sampling data are post processed using gravimetric analysis to determine the mass concentration for the 24-hour sampling period. The gravimetric determination for concentration of PM_{10} is completed by CT DEEP.

At the Underhill NCore site, the PM_{10} collocated sampling is performed with TEI 2025i samplers on the 1-in-6 day schedule. These Underhill PM_{10} samples as well as the Burlington Main Street and Rutland 1-in-12 day PM_{10} samples are subsequently submitted for metals analysis to the VAEL laboratory. The metals analysis performed does include the element lead (Pb). The ICP/MS analytical method performed by VAEL is not designated by EPA as a FEM for lead (Pb) NAAQS determination, so Pb analyses results for all 3 sites will be submitted to AQS using code for lead in PM_{10} for Non-FRM/FEM methods (85128).

Table 11 – PM_{10} Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Location /Lab
PM_{10}	TEI 2025i **Manual Reference Method:** **RFPS-1298-127**	Low Volume 47 mm Teflon® Filter	Gravimetric	Underhill CT DEEP
PM_{10}	TEI 2000i **Manual Reference Method:** **RFPS-1298-126**	Low Volume 47 mm Teflon® Filter	Gravimetric	Rutland Burlington Main Street CT DEEP

Oxides of Nitrogen ($NO/NO_2/NO_x$) and Total Reactive Oxides of Nitrogen (NO_y) Monitoring Network

The Vermont AQCD operates two (2) nitrogen oxide ($NO/NO_2/NO_x$) analyzers which are presently located at the Burlington and Rutland monitoring sites. Ambient concentrations of both nitrogen dioxide and nitric oxide are determined by the continuous chemiluminescence method (See Table 12– Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Method). The NO_x samplers are operated year-round. The AQCD also operates a total reactive nitrogen (NO_y) trace level analyzer at the Underhill NCore monitoring site.

Table 12 – Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Nitrogen Dioxide/Nitric Oxide	Teledyne-API T200 Automated Reference Method: **RFNA-1194-099**	Continuous	Chemiluminescence	1 Hour
Total Reactive Nitrogen Compounds-NOy (trace)	Ecotech EC9843 Automated Reference Method: **RFNA-1292-090**	Continuous	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value (2017)

Below are the current calculated 1-hour & annual design values for nitrogen dioxide from 2015-2017 (See Table 13 & Table 14). Nitrogen dioxide design values are calculated by taking the 3-year average of the 98th percentile daily maximum 1-hour nitrogen dioxide averages. The current 1-hour nitrogen NAAQS standard is 100 parts per billion. The current annual NAAQS NO_2 standard is 53 parts per billion. The annual average is simply the average of all annual 1 hr averages. Currently, all Vermont monitors are in attainment for nitrogen dioxide.

Table 13 – Nitrogen Dioxide 2017 1-Hour Design Values

Site	Design Value (PPB) Years 2015-2017
Burlington Main Street	31
Rutland	35

Source: EPA AQS AMP480

Table 14 – Nitrogen Dioxide 2017 Annual Average

Site	2017 Annual Average(PPB)
Burlington Main Street	6.03
Rutland	6.45

Source: EPA AQS AMP450

Carbon Monoxide Monitoring Network

The Vermont AQCD operates three (3) carbon monoxide (CO) analyzers in air monitoring network, located at the Burlington Main Street, Rutland and Underhill sites. The CO analyzers are operated year-round. CO concentrations are determined by a continuous infra-red method (See Table 15 – Carbon Monoxide Monitoring Method).

The current national primary ambient air quality standards for carbon monoxide are as follows:

> 9 parts per million for an 8-hour average concentration not to be exceeded more than once per year and 35 parts per million for a 1-hour average concentration not to be exceeded more than once per year.

Table 15 – Carbon Monoxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Location/Reported Data Interval
Carbon Monoxide	Teledyne-API Model T300 Automated Reference Method: RFCA-1093-093	Continuous	Infra-red(Gas filter correlation)	Burlington & Rutland/1 Hour
Carbon Monoxide (trace)	Teledyne-API Model T300U Automated Reference Method: RFCA-1093-093	Continuous	Infra-red(Gas filter correlation)	Underhill/1 Hour

Table 16 – Carbon Monoxide Design Value 2017 (Preliminary-based on 2nd max 1-hour and 8-hour averages)

Site	2017 Design Value-(2nd maximum PPM)
Burlington CO -1 Hour	1.0
Burlington CO -8 Hour	0.6
Rutland CO -1 Hour	1.5
Rutland CO -8 Hour	0.7
Underhill CO -1 Hour	0.649
Underhill CO -8 Hour	0.4

Source: EPA AQS AMP450

Sulfur Dioxide Monitoring Network

The Vermont AQCD operates two (2) sulfur dioxide (SO_2) analyzers in the air monitoring network, located in Rutland and Underhill sites. The SO_2 analyzers are operated year-round. SO_2 concentrations are determined by a continuous pulsed florescence method (Table 17 – Sulfur Dioxide Monitoring Method

The level of the national primary 1-hour annual ambient air quality standard for oxides of sulfur is 0.075 parts per million, measured in the ambient air as sulfur dioxide (SO_2). The secondary standard is 0.500 parts per million.

The 1-hour primary standard is met at an ambient air quality monitoring site when the three-year average of the annual (99th percentile) of the daily maximum 1-hour average concentrations is less than or equal to 75 ppb, as determined in accordance with 40 CFR Part 50 Appendix T. The SO_2 design values are presented in Table 18.

Table 17 – Sulfur Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Location/Reported Data Interval
Sulfur Dioxide (trace)	Teledyne-API T100U Automated Equivalent Method: EQSA-0495-100	Continuous sampling	Pulsed Florescence	Underhill/1 Hour
Sulfur Dioxide	Teledyne-API T100 Automated Equivalent Method: EQSA-0495-100	Continuous sampling	Pulsed Florescence	Rutland/1 Hour

Table 18 – Sulfur Dioxide Design Values 2017

Site	Design Values (SO_2 PPB) Average of Years 2015-2017 1 Hour 99th Percentile Daily Max
Rutland – 1 Hour	2
Underhill – 1 Hour	2

Source: EPA AQS AMP480.

Monitoring Site Parameter Information

Below in Table 19 is a list of all of the monitoring sites and parameters currently operated by the State of Vermont or National Forest Service. The monitoring sites are listed in alphabetical order by site name.

Table 19 – Network Ambient Air Pollutant Monitoring By Location

		Carbon Monoxide	Nitrogen Dioxide / or NOy	Ozone	Sulfur Dioxide	Speciation (STN /or IMPROVE)	BTEX	$PM_{2.5}$ FRM	$PM_{2.5}$ FEM (Continuous)	PM_{10} FRM	PM $_{10\text{-}2.5}$Difference	PM_{10} Low Volume/(metals)	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure	PAH
Bennington	Airport Road			✓					✓							✓	✓	✓	✓	✓	✓	✓	
Burlington	150 So Winooski Ave	✓	✓				✓		✓	✓		✓	✓C	✓C		✓	✓	✓	✓	✓	✓	✓	
Burlington	108 Cherry Street					✓										**D**	**D**	**D**	**D**	**D**	**D**	**D**	
Dover	Mount Snow					✓1																	
Rutland	Merchants Row	✓	✓	✓	✓			✓	✓C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Underhill	Harvey Road	✓T	✓T	✓	✓T	✓		✓	✓	✓C	✓	✓C	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

T=Trace Level C=Collocation D=Discontinued 1= Operated by U. S. Forest Service

Site Description: Burlington – 150 South Winooski Ave.

Town – Site:	**Burlington – South Winooski Ave**		
County:	**Chittenden**	Latitude:	**+44.476200**
Address:	**150 S. Winooski Ave.**	Longitude:	**-73.210600**
AQS Site ID:	**50-007-0014**	Elevation:	**63.1 m**
Spatial Scale:	**Urban and City Center**	Year Established:	**2003**
Statistical Area:	**Burlington-South Burlington, VT Metropolitan NECTA**		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide		BTEX	$PM_{2.5}$ FEM Continuous	PM_{10} FRM	PM_{10} Low Volume/(metals)	VOC (collocated)	Carbonyl (collocated)	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Burlington	**150 S. Winooski**	✓	✓				✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Site Description:
This site is located in a municipal parking lot of downtown Burlington, VT, located 1 km east of Lake Champlain, 1.5 km south west of McNeil Generating Station, 2 km west of I-89, and 8 km west of the Essex IBM plant. This site is designated to represent middle and neighborhood-scale. The monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:
The Burlington monitoring site objective for the CO & NO_2 measurements is compliance and trends purposes. Historically, CO and NO_2 measurements at this site are well below the NAAQS. Monitoring for CO and NO_2 at this site continues to be operated primarily for trends analysis and modeling. The objective of the PM_{10} monitoring is for trends analysis and subsequent metals analysis. The monitoring objective for the VOC and Carbonyl sample collection and analysis is to assess long-term population exposure on a neighborhood scale, comparison to applicable state standards and trend assessment. Continuous $PM_{2.5}$ is used for NAAQS compliance, AQI and air quality forecasting. WS/WD/Temp/RH data is collected from a 3.0 meter tripod on the roof.

Plans/History:

- Site established in 2003
- December 31, 2016 suspended 2025iD dichotomous sampler. January, 2017 installed 2025i FRM configured for PM_{10}, then replaced that with 2000i on May 10, 2017, configured for $PM_{2.5}$
- T640 FEM continuous PM2.5.installed on 8/22/17, 2000i configured for PM2.5 from this date through 4/14/18
- PM_{10} metals added in 2018

Figure 2– Burlington Aerial Photo

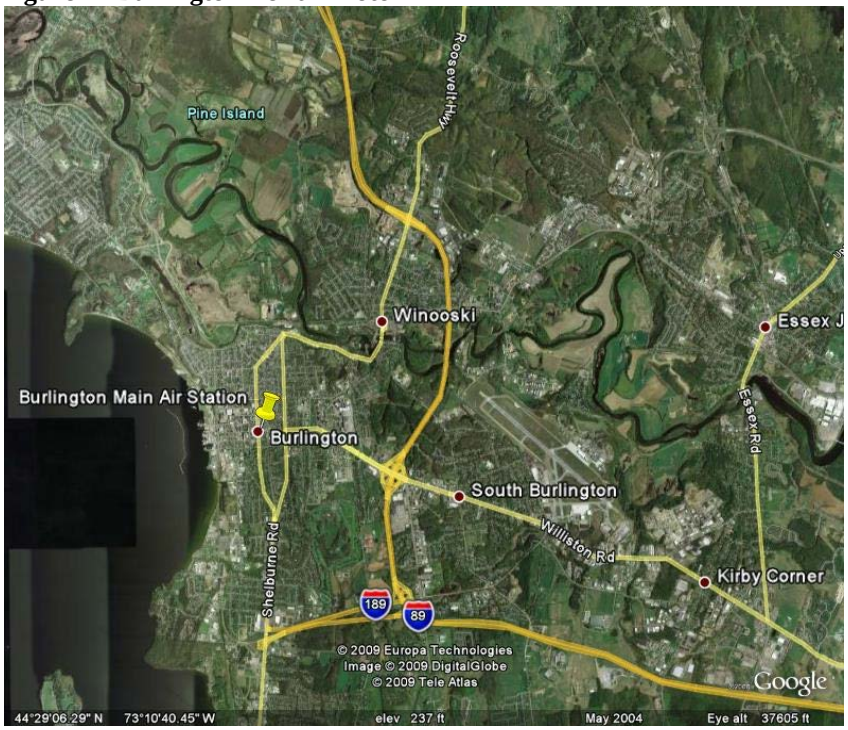


Figure 3– Burlington Monitoring Shelter

Site Description: Burlington – 108 Cherry Street.

Town – Site:	**Burlington – Zampieri State Office Building**		
County:	**Chittenden**	Latitude:	**+44.480278**
Address:	**108 Cherry St.**	Longitude:	**-73.214444**
AQS Site ID:	**50-007-0012**	Elevation:	**81.4 m**
Spatial Scale:	**Urban & Center City**	Year Established:	**1999**
Statistical Area:	**Burlington-South Burlington, VT Metropolitan NECTA**		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	$PM_{2.5}$ FRM	$PM_{2.5}$ TEOM	PM_{10} FRM	PM_{10} Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Burlington	**108 Cherry St.**					✓									**D**	**D**	**D**	**D**	**D**	**D**	**D**

Site Description:
This site is located on the roof of the Zampieri State Office Building in Burlington. The monitoring site is located 15 meters above street level, 0.25 km from Lake Champlain, 1.2 km south west of McNeil Generating Station, 2.5 km west of I-89, and 8.5 km west of the Essex IBM plant. The site represents a neighborhood scale. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1

General Monitoring Description & Objectives:
The speciation monitoring objective is $PM_{2.5}$ trends analysis and complimentary data for $PM_{2.5}$ FEM data at the Burlington Main Street Site. The speciation sampling is conducted as part of the EPA Speciation Trends Network (STN).

Plans/History:

- Site established 1999
- Discontinued collocated $PM_{2.5}$ FRM samplers on 12/31/16; samplers relocated to Underhill for PM_{10}
- Discontinued Meterological parameters 12/31/17

Figure 4 – Burlington Aerial Photo

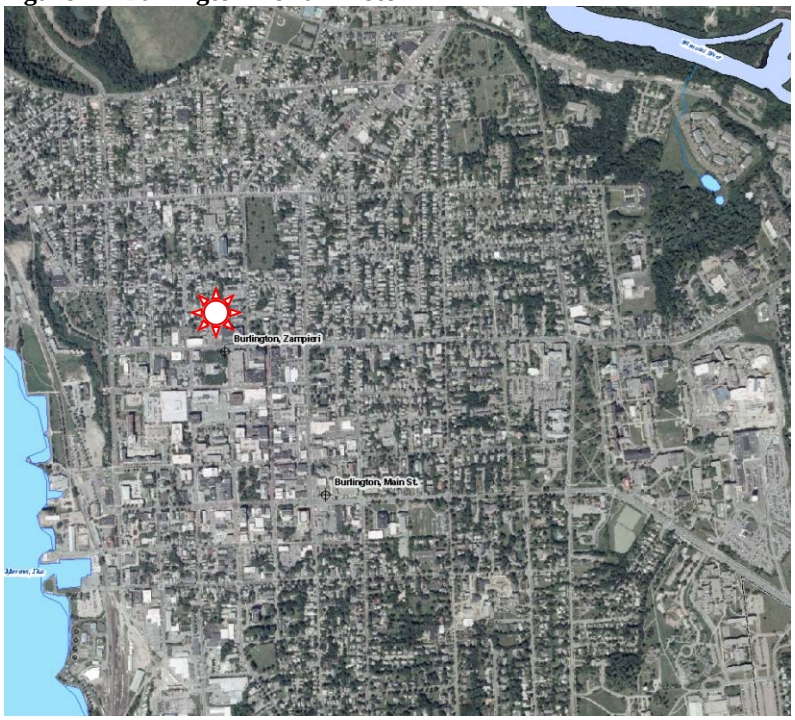
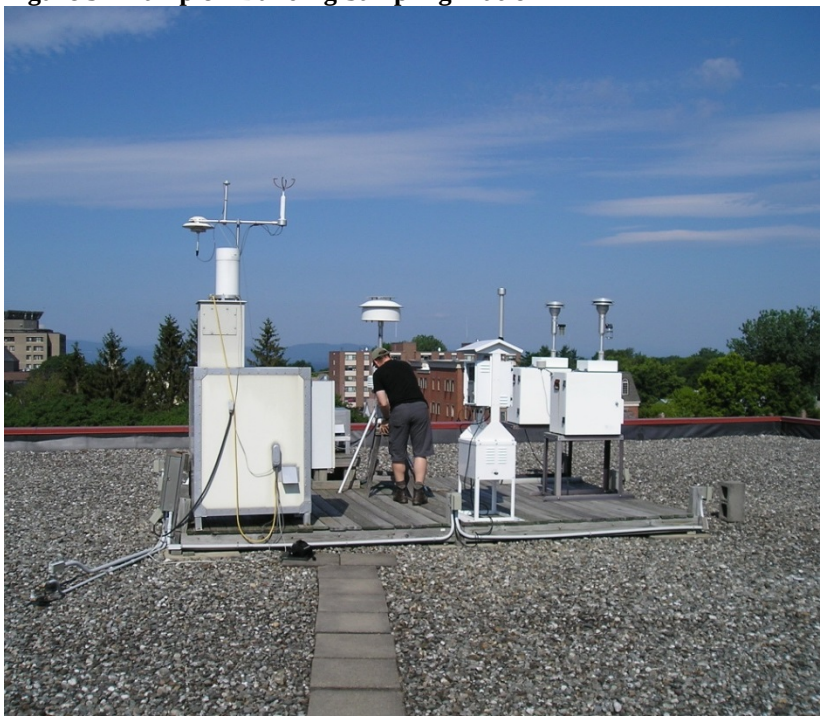


Figure 5 – Zampieri Building Sampling Platform



Site Description: Lye Brook – West Dover – Mount Snow

Town – Site:	**West Dover – Mount Snow – Near Lye Brook Class 1 Area**		
County:	**Bennington**	Latitude:	**+ 42”57’11.41 N**
Address:	**Mount Snow**	Longitude:	**- 72” 54’ 36.72 W**
Site ID:	**LYEB1**	Elevation:	**1093 m**
Spatial Scale:	**Rural**	Year Established:	**2012**
Statistical Area:	**Bennington, VT Micropolitan Area**		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	$PM_{2.5}$ FRM	$PM_{2.5}$ TEOM	PM_{10} FRM	PM_{10} Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
West Dove	**Mount Snow**						✓														

Site Description:

This monitoring location is not part of the Vermont AQCD monitoring network. The USFS site participates in the IMPROVE network and is included here because it represents a permanent monitoring station within Vermont.

This site is located on the northern slope of Mount Snow. This site is operated and maintained by the U.S. Forest Service. Further information about the Lye Brook site can be seen at http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx. The site is identified in the data search as LYEB1. The current data from this site is not accessible from the EPA AQS system.

General Monitoring Description & Objectives:

This site was established to monitor pollutants that contribute to regional haze impact on the visual environment within the Class 1 Area - Lye Brook Wilderness.

Plans/History:

- Site established 2012

Figure 6 – Aerial View Mount Snow

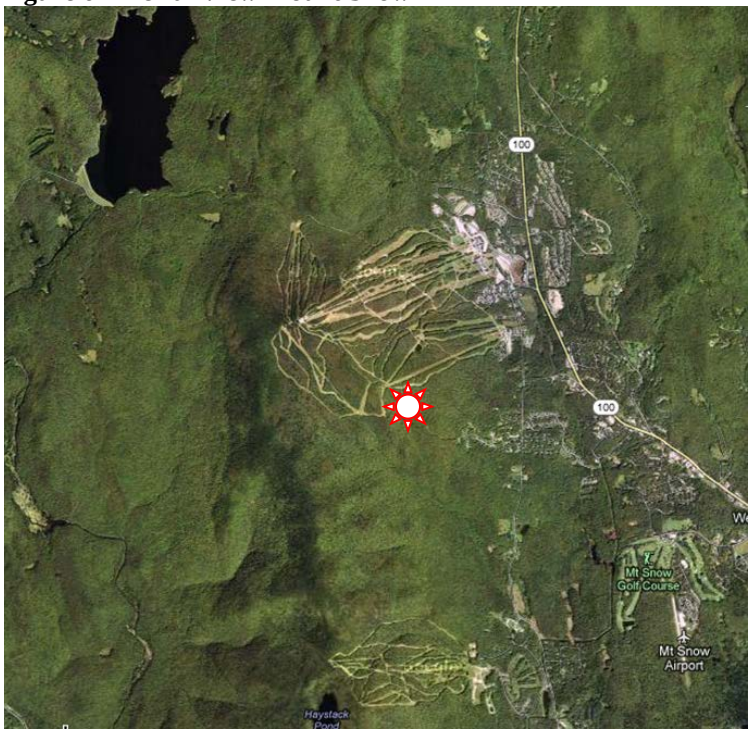


Figure 7 – View of Monitor Location

Site Description: Bennington – Airport Road

Town – Site:	**Bennington – Airport Rd.**		
County:	**Bennington**	Latitude:	**+42.887590**
Address:	**Airport Rd.**	Longitude:	**-73.249840**
AQS Site ID:	**50-003-0004**	Elevation:	**241 m**
Spatial Scale:	**Rural**	Year Established:	**1986**
Statistical Area:	**Bennington, VT Micropolitan NECTA**		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)		$PM_{2.5}$ FEM. Continuous	PM_{10} FRM	PM_{10} Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Bennington	**Airport Road**			✓					✓						✓	✓	✓	✓	✓	✓	✓

Site Description:
This site is located in a field at rural western end of Bennington, 0.25 km south west of the Morse Airport, 4.5 km west of the center of Bennington, 1 km north of Route 9, 4 km west of Route 7, 50 km east of Albany, NY. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1

General Monitoring Description & Objectives:
This monitoring objective for O_3 and $PM_{2.5}$ continuous FEM is compliance and trends analysis. The site represents a background / transport site with regional scale of exposure. The O_3 and continuous $PM_{2.5}$ data are utilized for AQI and air quality forecasting. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

Plans/History:

- Site Established 1986
- 2025 FRM discontinued April 11, 2016
- T640 FEM continuous PM2.5 installed 7/27/17

Figure 8 – Aerial View Bennington

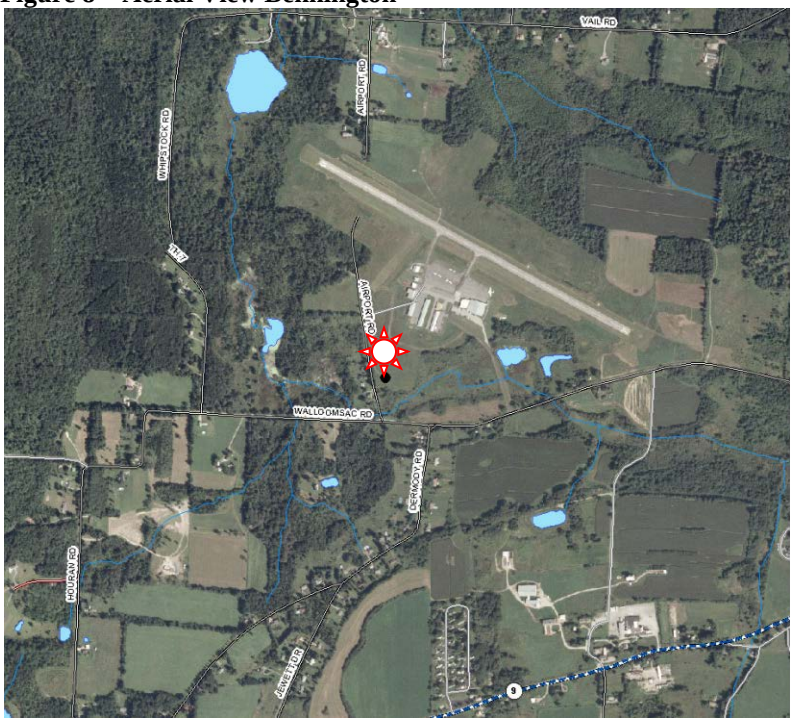


Figure 9 – Bennington Trailer

Site Description: Underhill – 58 Harvey Road

Town – Site:	**Underhill – Proctor Maple Research Center**		
County:	**Chittenden**	Latitude:	**+44.528390**
Address:	**58 Harvey Rd.**	Longitude:	**-72.868840**
AQS Site ID:	**50-007-0007**	Elevation:	**392 m**
Spatial Scale:	**Rural**	Year Established:	**1988**
Statistical Area:	**Burlington-South Burlington, VT Metropolitan NECTA**		

Location	Site	Carbon Monoxide (trace)	Total Reactive Nitrogen(trace NOy)	Ozone	Sulfur Dioxide (trace)	Speciation (STN)	Speciation (IMPROVE)	$PM_{2.5}$ FRM	$PM_{2.5}$-FEM Continous	PM_{10} FRM (collocated)	PM_{10} /Metals (collocated)	$PM_{10-2.5}$ Difference	VOC	Carbonyl	PAH	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Underhill	**56 Harvey Rd.**	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Site Description:
This site is located at the western slope of Mount Mansfield at the north end Underhill, VT. The site is rural in nature and located 5 km south west of the summit of Mount Mansfield, 6 km south of Route 15, and 26 km east of Burlington. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1

General Monitoring Description & Objectives:
The monitoring objective for ozone, $PM_{2.5}$, PM_{10}, PM speciation and trace-level CO, SO_2 and NO_y monitoring is regional scale background levels. The monitoring objectives for the VOC, Carbonyl , PAH, and metals sample collection and analysis are to assess background levels on a regional scale for short and long-term trends, comparison to applicable state standards and federal guidelines and assessment of contribution of transported pollutants. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

Plans/History:

- Site Established 1988
- Began participation in NATTS 2004
- NCore trace level CO, NOy, and SO_2 continuous monitoring started 4th Quarter 2010.
- Trace level CO and SO_2 analyzers replaced March, 2017
- T640 FEM continuous PM2.5 Installed 8/22/17

Figure 10 – Aerial View Underhill

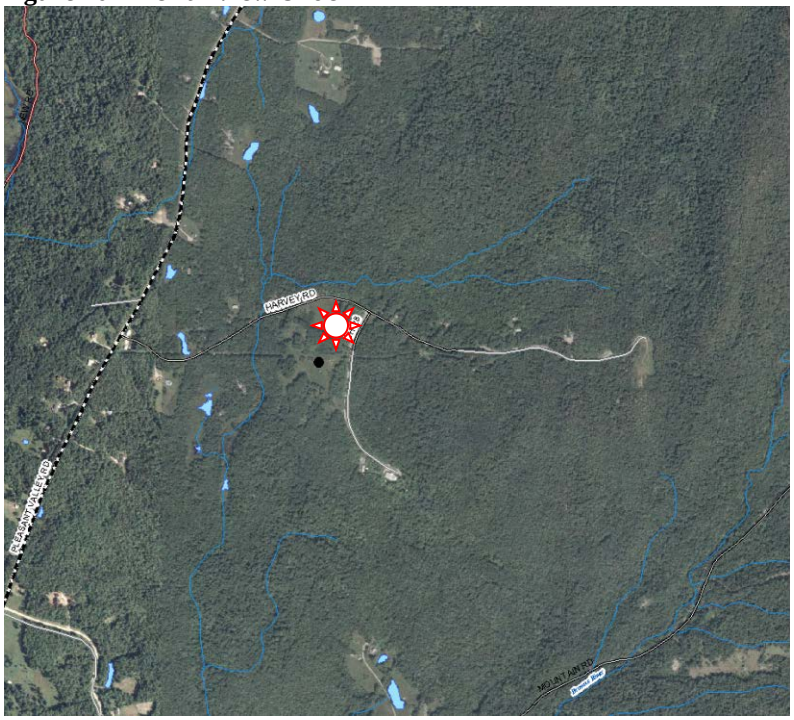


Figure 11 – Underhill IMROVE Shelter & Trailer

Site Description: Rutland – 96 State Street

Town – Site:	**Rutland – State St.**		
County:	**Rutland**	Latitude:	**+43.608056**
Address:	**96 State St.**	Longitude:	**-72.982778**
AQS Site ID:	**50-021-0002**	Elevation:	**165 m**
Spatial Scale:	**Urban and Center City**	Year Established:	**1971**
Statistical Area:	**Rutland, VT Micropolitan NECTA**		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	$PM_{2.5}$ FEM Continuous (collocated w/FRM)	$PM_{2.5}$ FRM	PM_{10} FRM	$PM_{10-2.5}$ Difference	PM_{10} /Metals	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidty	Solar Radiation	Precipitation	Pressure
Rutland	**96 State Street**	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Site Description:
This site is located in a court house parking lot in the downtown area of Rutland, 1 km from north junction of Route 7 & Route 4, 3.5 km from south junction of Route 7 & Route 4, 4 km NW of GE plant. The site is adjacent to a postal center distribution center which serves as the parking area for USPS vehicles. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:
The monitoring objective for CO, NOx, $PM_{2.5}$, PM_{10} and SO_2 is for compliance purposes and trends analysis. The monitoring objective for the VOC and Carbonyl sample collection and analysis is to assess long-term population exposure on a neighborhood scale, comparison to applicable state standards and trend assessment. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

Plans/History:

- Site Established 1971
- Fall 2012 replaced Wedding PM_{10} with TEI 2025i Dichotomous ($PM_{2.5}$ & $PM_{10-2.5}$) unit.
- April 2016 TEI 2025iD Dichotomous discontinued
- April 2016 Ozone and PM_{10} FRM added
- T640 FEM continuous PM2.5 installed on 7/27/17
- PM_{10} metals add in 2017

Figure 12 – Aerial View Rutland

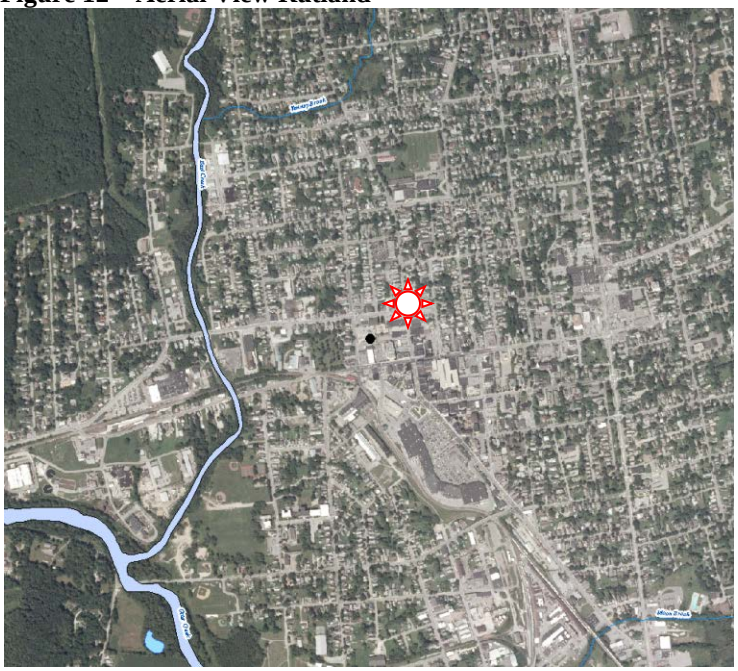


Figure 13 – Rutland Trailer

Appendix A. List of Analytes for Analytical Methods

Table 20 – Elemental Metals Analytes for PM10 (VAEL 2018, 47 mm Teflon)

Metal	MDL (ng/m3)*	Metal	MDL (ng/m3)*
Antimony	0.073	Manganese	0.157
Arsenic	0.054	Molybdenum	0.048
Barium	0.136	Nickel	0.387
Beryllium	0.063	Selenium	0.111
Cadmium	0.060	Silver	0.189
Chromium	5.310	Strontium	0.254
Cobalt	0.054	Vanadium	0.052
Lead	0.108		

* assumes 24.0 m^3 total sample volume

Table 21 – List of Carbonyl Analytes (VAEL, 2018)

Carbonyl Compound	VT DEC MDL (µg/m3)*
Formaldehyde	0.009
Acetaldehyde	0.005
Acetone	0.014
Propionaldehyde	0.008

*: assumes 1.30 m^3 total sample volume

Table 22 – Analyte List for VOC Analysis (VAEL, 2017)

VOC Compound	MDL (ppb)
1,1,1-Trichloroethane	0.003
1,1,2,2-Tetrachloroethane	0.005
1,1,2-Trichloroethane	0.003
1,1-Dichloroethane	0.003
1,1-Dichloroethene	0.002
1,2,4-Trichlorobenzene	0.009
1,2,4-Trimethylbenzene	0.007
1,2-Dibromoethane	0.004
1,2-Dichloroethane	0.003
1,2-Dichloropropane	0.003
1,3,5-Trimethylbenzene	0.006
1,3-Butadiene	0.002
3-Chloropropene	0.002
Acrolein*	0.015
Acrylonitrile	0.006
Benzene	0.003
Bromochloromethane	0.003
Bromodichloromethane	0.003
Bromoform	0.005
Bromomethane	0.003
Carbon Tetrachloride	0.003
Chlorobenzene	0.003
Chloroethane	0.004
Chloroform	0.002
Chloromethane	0.006
Chloroprene	0.002
cis-1,2-Dichloroethylene	0.003
cis-1,3-Dichloropropene	0.004

VOC Compound	MDL (ppb)
Dibromochloromethane	0.003
Dichlorodifluoromethane	0.003
Dichlorotetrafluoroethane	0.002
Ethyl Acrylate	0.003
Ethyl tert-Butyl Ether	0.001
Ethylbenzene	0.003
Hexachloro-1,3-butadiene	0.006
m,p-Xylene	0.003
m-Dichlorobenzene	0.007
Methyl Isobutyl Ketone	0.003
Methyl Methacrylate	0.003
Methyl tert-Butyl Ether	0.001
Methylene Chloride	0.004
n-Octane	0.002
o-Dichlorobenzene	0.012
o-Xylene	0.003
p- Dichlorobenzene	0.007
Styrene	0.004
tert-Amyl Methyl Ether	0.002
Tetrachloroethylene	0.003
Toluene	0.001
trans-1,2-Dichloroethylene	0.003
trans-1,3-Dichloropropene	0.004
Trichloroethylene	0.003
Trichlorofluoromethane	0.002
Trichlorotrifluoroethane	0.001
Vinyl Chloride	0.002

*EPA is continuing to evaluate analytical method for the compound - Acrolein.

Table 23 – Analyte List for PAH Analysis (ERG, 2018)

PAH Compounds	**ng/m3**
9-Fluorenone	0.0901
Acenaphthene	0.123
Acenaphthylene	0.0196
Anthracene	0.047
Benzo (a) anthracene	0.0196
Benzo (a) pyrene	0.0313
Benzo (b) fluoranthene	0.0392
Benzo (e) pyrene	0.0313
Benzo (g,h,i) perylene	0.03
Benzo (k) fluoranthene	0.0392
Chrysene	0.0235
Coronene	0.00522
Cyclopenta[cd]pyrene	0.0326
Dibenz (a,h)anthracene	0.0209
Fluoranthene	0.0457
Fluorene	0.0679
Indeno(1,2,3-cd)pyrene	0.0326
Naphthalene	2.67
Perylene	0.0157
Phenanthrene	0.234
Pyrene	0.0274
Retene	0.064

Appendix B. CSN Analytes/MDLs (EPA, 2017)

Parameter	Average MDL (µg/m^3)
Ag	0.018
Al	0.035
As	0.002
Ba	0.082
Br	0.004
Ca	0.029
Cd	0.023
Ce	0.122
Cl	0.004
Co	0.003
Cr	0.004
Cs	0.077
Cu	0.008
Fe	0.022
In	0.029
K	0.016
Mg	0.056
Mn	0.006
Na	0.068
Ni	0.002
P	0.002
Pb	0.015
Rb	0.008
S	0.009
Sb	0.045
Se	0.006
Si	0.017
Sn	0.046
Sr	0.006
Ti	0.004
V	0.002
Zn	0.004
Zr	0.036
EC1	0.014
EC2	0.012
EC3	0.002
ECTR	0.018
ECTT	0.014
OC1	0.024
OC2	0.059

OC3	0.196
OC4	0.051
OCTR	0.297
OCTT	0.299
OPTR	0.014
OPTT	0.017
TCTC	0.063
Ammonium	0.015
Chloride	0.132
Nitrate	0.072
Potassium Ion	0.006
Sodium Ion	0.048
Sulfate	0.117

Source: EPA QAPP; Lab Analysis and Data Processing/Validation for Chemical Speciation of $PM_{2.5}$ Filter Samples, Rev 1, 10/16/17

Appendix C. National Ambient Air Quality Standards

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m³ (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m³	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m³	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m³	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

*For current changes that may not be reflected in the above NAAQS table please visit https://www.epa.gov/criteria-air-pollutants/naaqs-table

References

1. Code of Federal Regulation, (e-CFR) 40 CFR Part 58, Protection of Environment, June 22, 2018.
2. United States Environmental Protection Agency Air and Radiation - National Ambient Air Quality Standards (NAAQS) May, 2018
3. State of Vermont, Agency of Natural Resources, *Air Pollution Control Regulation; Appendix C*, November 30, 2016
4. United States Environmental Protection Agency, Technology Transfer Network, Ambient Monitoring Technology Information Center – *List of Designated EPA Reference and Equivalent Methods* June 16, 2017
5. Code of Federal Regulation, (e-CFR) 40 CFR Part 50, Protection of Environment, June 22 2018.
6. Code of Federal Regulation, (e-CFR) 40 CFR Part 53, Protection of Environment, June 22, 2018.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
OFFICE OF ENVIRONMENTAL MEASUREMENT AND EVALUATION
11 Technology Drive
North Chelmsford, MA 01863

June 15, 2018

Robert Lacaillade
State of Vermont
Air Quality and Climate Division
Davis Building 2nd Floor
One National Life Drive
Montpelier, VT 05620-0802

Dear Mr. Lacaillade:

Thank you for providing EPA with a draft of the Vermont 2018 Air Monitoring Network Plan, which was posted for public review on May 25, 2018. EPA-New England has reviewed your draft plan with respect to meeting the requirements of 40 CFR Part 58. Upon final submission of this document, we will move forward regarding approval of the Annual Network Plan. In addition, upon final submission of this document, we will work with our Headquarters offices to address the portions of the plan which require their attention, most notably monitoring associated with NCore, STN and NATTS.

The following are our comments:

1. Page 8. Paragraph four discusses the status of QAPP updates/ documents. We are awaiting the Meteorological QAPP and a subset of SOP documents.

2. On page 9-10, the discussion of the various NAAQS revisions might be improved by being put in chronological order. In addition, the discussion regarding the $PM_{2.5}$ NAAQS mentions 2 dates when it was one NAAQS revision; with one being the rule signature date, and the other being the Federal Register publication date (we suggest using the later date).

3. On page 11, we note these changes below which occurred between July 2017 and June 2018.
   - Between 8/22/17 and 4/14/18 the Burlington Main Street TEI 2000i FRM was temporarily configured from PM10 to PM2.5 to provide comparison data for new TAPI T640 FEM.
   - Temporary Rutland PM changes during this period included increasing the TEI 2025i FRM sampling schedule from 1-in-6 day to 1-in-3 day from 10/7/17 through 4/8/18 and reconfiguring the TEI 2000i FRM from PM10 to PM2.5 from 1/3/18-3/28/18, to provide collocated FRM measurements during evaluation of the new TAPI T640 FEM.
   - On 3/7/18, a new TAPI T703 ozone calibrator was installed at the Bennington site as the new station ozone standard calibrator, rather than being installed as the new

primary standard at the Berlin Field Operation Center, as was proposed in the previous 2017 Annual Plan.

- On 7/27/17, new TAPI T640 continuous PM2.5 FEM monitors were installed at the Bennington and Rutland site replacing a TEI TEOM and MetOne BAM, respectively. Rutland is now the designated network collocated site for the T640 FEM.
- On 8/22/17, new TAPI T640 continuous PM2.5 FEM monitors were installed at Burlington Main Street and Underhill Sites, replacing TEI TEOM monitors at both sites.
- On 12/31/17, *meteorological* parameter monitoring was discontinued at Burlington Cherry St. Site (Zampieri Building).
- Beginning with the 1/1/17 sample, Rutland PM10 filters were submitted for subsequent metals analyses on a 1-in-12-day schedule.
- A new TAPI T400E Ozone analyzer was installed at the Underhill NCore Site on 10/27/17.
- A new Agilaire 8872 datalogger was installed at the Underhill Ncore Site on 6/1/17.
- A new Magee AE33 Aethalometer was received on 5/7/18 and is scheduled for installation at the Rutland site during the summer of 2018.
- The Agilaire AgileWeb module was installed on the AQCD's website and went live on 3/23/18, providing real time public access to current and historic AQCD criteria air monitoring data and *meteorological* parameters.

4. Page 12: We note the listed network changes between July 2018 and June 2019,

Proposed Changes July 2018 to June 2019 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2018-June 2019 are:

- Procure a reactive nitrogen compounds analyzer (trace-NOy), dynamic dilution calibrator and zero air system for the Underhill NCore site. Purchase requisitions are scheduled to be submitted during the Summer/Fall of 2018.
- Install the recently procured Magee AE33 Aethalometer (Black Carbon-EC/OC-7 channels) at the Rutland site which is scheduled for a date TBD, sometime during the Summer of 2018. The AE33 will replace the legacy AE22 Aethalometer currently operated at that site.
- Begin submitting Burlington PM10 filters for subsequent metals analyses on a 1-in-12 day schedule.
- Continue working with the Burlington Planning Department and others on developing a plan for the relocation of the Burlington Main Street monitoring site. The Burlington Planning Department has indicated that the redevelopment project for the current monitoring site location is in transition with no firm schedule and suggests that site relocation planning should nonetheless proceed proactively as city plans for this block renovation are continuing to be developed.

5. Per the discussion on page 14 relative to continuous $PM_{2.5}$ FEMs, $PM_{2.5}$ Network – on January 15, 2013, EPA revised the $PM_{2.5}$ standard. In that rule, EPA also established that all continuous $PM_{2.5}$ FEM monitors operating for more than 24 months should be used for

comparison to the NAAQS unless a State specifically requests that the data be excluded under 40 CFR Part 58.11(e) and EPA approves that request. Vermont is not requesting that any sites be excluded from comparison to the NAAQS in this annual network plan. In addition, near the bottom of page 14, Table 1 should have the excel cells split up for Burlington, Main Street and Bennington.

6. Pages 15, 18, 23, 24, and 25. EPA expects to release design values for all criteria pollutants in July, 2018 which includes 2017 data for the entire country. We will work with you to ensure the design values represented here are consistent with those values.

7. On page 19, we acknowledge the Enhanced Monitoring Plan (EMP) that it is included as part of this Annual Network Plan. As you know, Vermont is located within the Ozone Transport Region (OTR) as defined in 40 CFR 51.900 making it subject to developing an EMP detailing enhanced ozone and ozone precursor monitoring per 40 CFR Part 58, Appendix D, 5. (h). The EMP is required to be submitted by the Regional Administrator by 40 CFR 58.10. Vermont EMP activities include the operation of an additional network ozone monitor at the Rutland site which is operated year-round, operating the existing Bennington SLAMS site ozone monitor year-round and the 24-hour sample collection and analysis of a subset of the PAMS target list compounds, including carbonyls and speciated VOCs, at three (3) AQCD network sites (including 2 of 3 network ozone monitoring sites) on a 1-in 6 day or 1-in-12 day schedule.

In addition, on page 17, you note your measurements for black carbon as it relates to wood smoke. As you are aware, EPA Region 1 has developed a GIS tool which identifies valley locations across the Region which may be impacted by wood smoke. See the link: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=646ebe715800410d9e5c02aa3653546d. We are looking forward to working with Vermont to identify areas, such as Rutland, which may be impacted by wood smoke emissions. There may also be other areas in the State that might have higher wood smoke concentrations, but fewer permanent residents. Our "sensor pod loan program" may be helpful in characterizing pollution concentrations in these other valleys. Finally, as part of the Region 1 monitoring collaborative, EPA has identified several cost saving opportunities that Vermont may wish to consider.

EPA- New England appreciates your partnership in conducting ambient air monitoring, and we look forward to working with you to continuously improve the quality of ambient air in Vermont. We also look forward to the submission of the final Annual Network Plan as soon as possible. If you have any questions or comments regarding these comments, please contact me at (617) 918-8387, or Alysha Thompson at (617) 918-8381.

Sincerely,

Robert C. Judge
Air Monitoring Coordinator
Office of Environmental Measurement and Evaluation
EPA-New England