

Vermont Annual Air Monitoring Network Plan 2010



Vermont Department of Environmental Conservation
Air Pollution Control Division
October 8, 2010



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Acronyms and Abbreviations

AMTIC - Ambient Monitoring Technical Information Center
APCD - (Vermont) Air Pollution Control Division
AQI - Air Quality Index
BTEX - Benzene, Toluene, Ethylbenzene, Xylene
CAA - Clean Air Act
CARB - California Air Resources Board
CFR - Code of Federal Regulations
CO - Carbon Monoxide
CSA - combined statistical area
EPA - Environmental Protection Agency
ESC - Environmental Systems Corporation
FDMS - Filter Dynamic Measurement System
FEM - Federal Equivalent Method
FRM - Federal Reference Method
GIS - geographical information systems
HAP - hazardous air pollutants
HAAS - Hazardous Ambient Air Standard
IC - Ion Chromatography
IO - inorganic
MQOs - measurement quality objectives
MPA - monitoring planning area
MSA - metropolitan statistical area
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
NOX - Oxides of Nitrogen
NO_y - sum of the individual reactive nitrogen oxide species
NO₂ - Nitrogen Dioxide
O₃ - Ozone
OAQPS - Office of Air Quality Planning and Standards
PIXE - Proton Induced X-ray Emission
PMSA - primary metropolitan statistical area
PM₁₀ - Particulate ≤10 micron aerodynamic particle size
PM_{2.5} - Particulate ≤2.5 micron aerodynamic particle size
PAH - Polycyclic Aromatic Hydrocarbon
QA - quality assurance
QA/QC - quality assurance/quality control
QAPP - quality assurance project plan
SLAMS - state and local monitoring stations
SO₂ - Sulfur Dioxide
SOP - standard operating procedure
SPMS - special purpose monitoring stations
TEOM - Tapered Element Oscillating Microbalance
TL - trace level
TOR - Total Organic Reduction
TSP - total suspended particulate
TSS - Technical Services Section (Monitoring Section) of the APCD
VOC - volatile organic compound
XRF - X-Ray fluorescence

Introduction

In accordance with newly adopted federal EPA regulation, 40 CFR Part 58, Subpart B §58.10⁽³⁾, the Vermont Air Pollution Control Division is required to submit to EPA by July 1, 2010 an air monitoring network plan for the State of Vermont. The new regulation requires that the plan be posted for public comment 30 days prior to submission to the EPA Region 1 Office.

The current air monitoring network plan will be made available to the public on the APCD's website, <http://www.anr.state.vt.us/air/index.htm> for the 30-day comment period.

Please send all comments regarding Vermont Air Monitoring Network Plan:

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Vermont Air Monitoring Network Overview

The Vermont Air Pollution Control Division (APCD) regulates air quality to protect public health and the environment. Air monitoring data is required by regulation and is used to determine compliance with the Environmental Protection Agency's (EPA) national ambient air quality standards ([NAAQS](#))⁽¹⁾, and Vermont's hazardous ambient air standards ([HAAS](#))⁽²⁾. Other important uses of the of air monitoring data includes, the 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 trends in air quality.

Air pollution is created by many anthropogenic sources, such as cars, trucks, buses, factories, power plants, as well as, natural sources such as forest fires, volcanoes, and wind storms. The pollution emanating from these sources can be local or transported from great distances. Control strategies and equipment applied to industry greatly reduced the particulate, CO, SO₂, and NO₂ emitted into the ambient air. 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 nitrogen dioxide (NO₂), carbon monoxide (CO) and volatile organic compounds (VOC's). 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 are expected to provide further reductions of air pollutants in the future.

Ambient air monitoring is valuable activity, which is essential for state environmental planning, enforcement efforts, 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 a better quality particulate sampling and continuous monitoring of gaseous criteria pollutants such as carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and ozone (O₃). 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.

At the current time, the Vermont APCD operates and maintains five permanent air monitoring stations. Vermont established a monitoring network for criteria pollutants in the 1970's and a network for toxic air pollutants in 1985. Currently, the APCD monitors for 6 criteria pollutants and 94 toxic pollutants. All current air monitoring sites meet the federal requirements for siting. The criteria pollutant monitoring methods are EPA compliant as federal reference methods (FRM), or federal equivalent methods (FEM) designated instruments. The current air monitoring network has received tentative approval by EPA New England Region I during recent technical systems audits (TSA). The Quality Assurance Project Plan (QAPP) for the Air Toxics and PM_{2.5} monitoring programs has EPA approval. The APCD submitted QAPP update for the Criteria monitoring program. EPA approval of the QAPP documents is pending, with expected authorization by July 2010.

On December 16, 2006, the EPA reduced the daily PM_{2.5} (NAAQS) from 65 µg/m³ to 35 µg/m³. The annual PM_{2.5} NAAQS remained 15µg/m³. Vermont operates a small network of Federal Reference Monitors (FRM) as well as non-reference continuous PM_{2.5} monitors to assess air quality for PM_{2.5}.

During the December 16, 2006 time period, the regulation also addressed the creation of multi-pollutant National Core Sites (NCore) sites 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 will be one of the 20 proposed rural sites within the NCore network. The upgrades to the site require the addition of "trace level" monitoring for Carbon Monoxide (CO), Nitrogen Oxides (NO_x), and Sulfur Dioxide (SO₂).

In November 2008, the new national ambient air quality standard (NAAQS) for lead was strengthened to 0.15 micrograms per cubic meter. Further changes in the lead monitoring requirement have been proposed and should be available by January 2011. The primary standard and secondary standard are set at the same level. Vermont was required to provide a lead monitoring network work plan in 2009. The Vermont Lead (Pb) NAAQS Monitoring Plan provided the current plan and approach that will be pursued by the State of Vermont with regard to ambient lead air monitoring network prior to the 2010-2011 monitoring requirement updates. In 2010, as EPA reconsiders monitoring requirements for lead at NCore sites, VT APCD will be prepared to move forward with monitoring if the request to monitor at all NCore is adopted, as opposed to just urban designated NCore sites that is currently being proposed.

In February 2010, the new NAAQS for Nitrogen Dioxide was adopted. The new NO₂ NAAQS for 1-hour is based on the 3 year average, of the 98th percentile, of the 1-hr daily maximum. The 1- hr NAAQS value was set at 100 parts per billion. Vermont currently is not required under the new rule set up additional NO₂ monitoring network above and beyond what is currently being operated. EPA in cooperation with States/Local/Tribe agencies will set up 40 NO₂ monitors nationwide to help protect communities that are susceptible to NO₂ health effects.

On June 2nd 2010 the new 1 Hour SO₂ NAAQS was adopted. The 1 hour value has been set at 75 ppb. The new design value form is a three year average of the 99th 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 the annual standard (30 ppb). The design value for Vermont NAAQS SO₂ compliance designation will use 2008, 2009, and 2010 SO₂ data. EPA will work with the State of Vermont to provide resources to demonstrate through source-oriented modeling whether additional SO₂ monitoring is required. If new monitoring sites are required they would be operational by January 1, 2013.

EPA is in the process of revising the 8-Hour Ozone NAAQS. Under the current revision EPA is considering adjustment to the NAAQS. EPA Region 1 has recommended that Vermont consider a new ozone monitoring station in the central part of Vermont to better define ozone designation areas within the state. The new ozone monitoring site will be considered in the future.

Below are listed the changes that occurred in 2009-2010 and proposed changes 2010–2011 to the Vermont air monitoring network that is operated by the State of Vermont Air Pollution Control Division.

Network Changes July 2009 to July 2010

The Vermont APCD network changes which occurred from July 2009-July 2010:

1. Addition of URG 3000 carbon sampler to STN site in Burlington. Sampling will commence with the October 1, 2009 “3-day” sampling date.
2. Contracted through the EPA NATTS §103 grant with ERG to handle NATTS Carbonyl analysis – July 2009 to July 2010

Proposed July 2010 to July 2011 Air Monitoring Network Changes

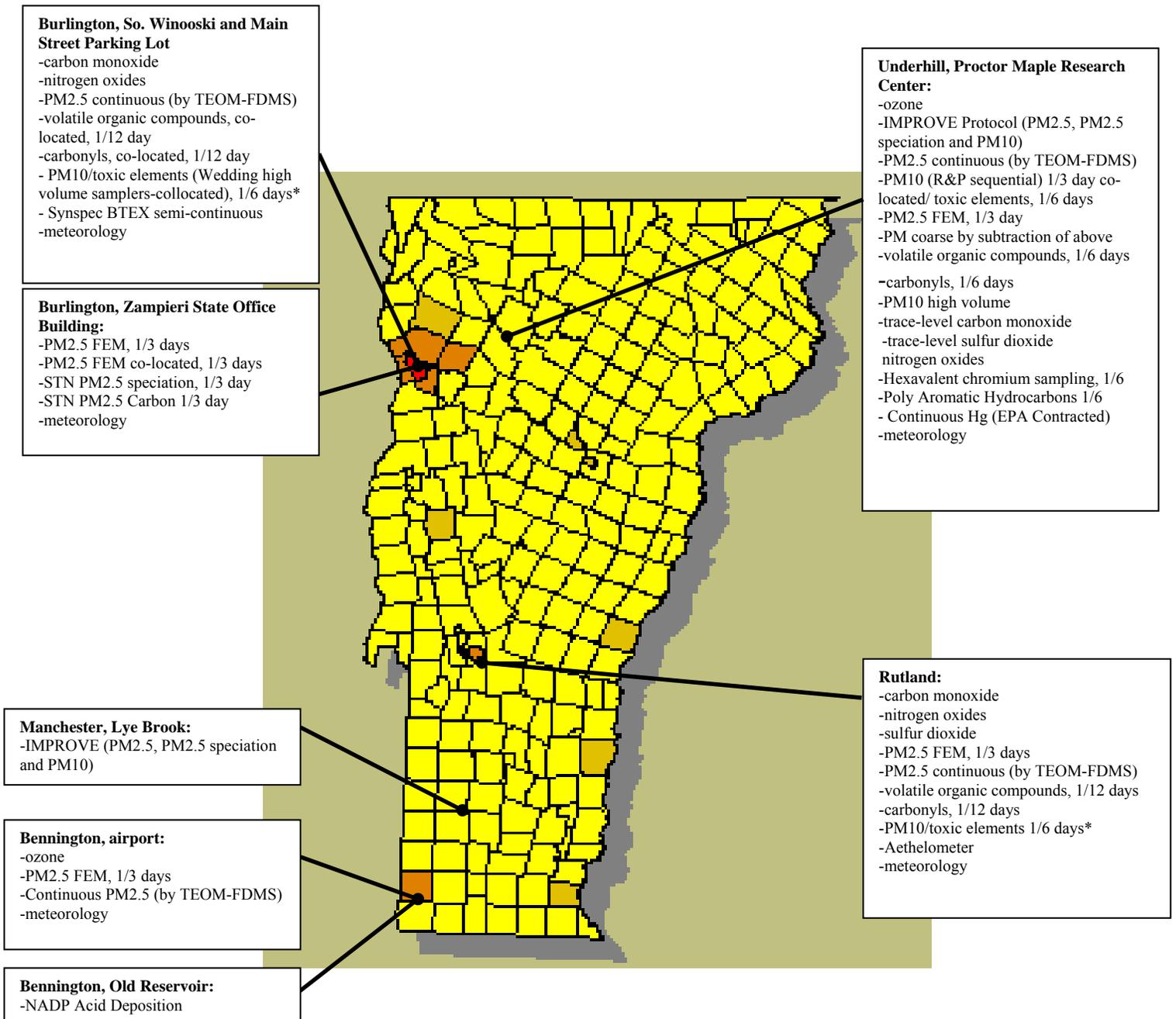
The Vermont APCD network additions that are planned for the next 12 months of July 2010-June 2011 are:

1. Commencing the trace level monitoring effort in Underhill in Fall 2010. The monitoring network additions will feature trace level CO, SO₂, NO_y measurements.
2. Will terminate contracted analytical services for NATTS Carbonyl on July 1, 2010. Returning work back to DEC Laboratory.
3. Underhill - ATEC 2200 dual VOC/Carbonyl sampler will replace ATEC 301 (VOC sampler) & ATEC 300 (Carbonyl sampler).
4. Propose to return VOC and metals analytical services to Vermont DEC laboratory.

2010 - Monitoring Site Network Map

Figure 1 - Vermont Air Monitoring Network Plan Map

2010 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} FRM Monitoring Network

The Vermont APCD operates four PM_{2.5} FRM sites. The monitoring locations are in Burlington, Bennington, Rutland and Underhill. The network samplers operate on a 1-in-3 day sampling schedule. The sampling method is an EPA approved method, collecting an integrated 24 hour particulate sample on a 47mm Teflon[®] filter disc (See Table 1). The particulate collected on the filter has an aerodynamic particle size of ≤2.5 microns. The filter and associated sampling data are post processed through gravimetric analysis to determine the mass concentration for the 24 hour sampling period.

Table 1 - PM_{2.5} Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
PM _{2.5}	R&P 2025 Manual Reference Method: EQPM-0202-145	Low Volume 47 mm Teflon [®] Filter - 24 Hour	Gravimetric	PM _{2.5} VT DEC

“Design values” for PM_{2.5} must be calculated every year for operational sites operating FRM or FEM PM_{2.5} 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 (2009)

PM_{2.5} annual design values are calculated using the 3-year average of the respective annual averages (See Table 2). The current annual PM_{2.5} standard is 15µg/m³.

Table 2- PM_{2.5} Annual Design Value

Site	Design Value (µg/m ³) Years 2007-2009
Burlington	7.9
Bennington	7.3
Underhill	5.7
Rutland	10.4

PM_{2.5} Daily Design Value (2009)

Below are the current daily design values from PM_{2.5} for 2009. PM_{2.5} daily design values are calculated using the 3-year average of the annual 98th percentile values. As of 2006, the new more stringent daily PM_{2.5} standard is 35 µg/m³. The previous daily standard was 65 µg/m³. Area PM_{2.5} designations relative to the new PM_{2.5} daily standard were compiled in December 2009, based upon measured PM_{2.5} data from 2006-2008. Currently, under the 1997 & 2006 PM_{2.5} NAAQS, all Vermont monitors are in attainment for both the annual and daily PM_{2.5} standards.

Table 3 - PM_{2.5} 2009 Daily Design Value

Site	Design Value (µg/m ³) Years 2007-2009
Burlington	23
Bennington	22
Underhill	18
Rutland	29

PM_{2.5} Speciation Monitoring Network

The Vermont APCD operates two PM_{2.5} speciation sites (See Table 4). These sites are located at Burlington-Zampiere, and Underhill. The samplers operate on a 1-in-3 day schedule and produce a 24 hour integrated filter based sample. Both Underhill and Manchester-Lye Brook are part of the IMPROVE (Interagency Monitoring of Protected Visual Environments) network. The Lye-Brook monitoring site listed in this document is operated and maintained by the National Forest Service and is not part of the Vermont APCD network plan. The Burlington site is part of the EPA Speciation Trends Network (STN).

The analysis of the filters generates data on chemical makeup of PM_{2.5}. The method is capable of measuring concentration levels of sulfate, nitrate, ammonium, and trace elements including metals, elemental carbon, and organic carbon. The STN is designed to complement the 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. 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 carbon sampler to enhance the carbon speciation measurement. The sampler operates on the 1/3 day schedule and is collocated with the current Met One SASS sampler.

Table 4– Speciation Sample/Analysis Method

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

Continuous PM_{2.5} Monitoring Network

The Vermont APCD operates four continuous PM_{2.5} sites (See Table 5). The R&P Model 8500 FDMS TEOM is operated at the Bennington, Burlington, Rutland, and Underhill sites. All continuous PM_{2.5} samplers are operated year-round and have a collocated PM_{2.5} FRM sampler for comparative analysis. Data is reported to 1-hour and 24-hour averaging periods. The data is currently used for PM_{2.5} AQI determination and trends analysis. At this time the VT APCD operates for three Thermo Scientific TEOM® 1400a Ambient Particular Monitor with Series 8500C FDMS® and one Thermo Scientific TEOM® 1405-F Single Channel Ambient Particular Monitor with FDMS®.

Based on a July 24, 2008 EPA memo, which provided guidance on the implementation of continuous PM_{2.5} sampling approved for federal equivalency, Vermont APCD has chosen at this time not to formally evaluate the approved continuous PM_{2.5} sampling method before designating the units as primary NAAQS units at the SLAMS sites. While the 8500C unit has received Federal Equivalency Method approval by EPA, which would allow the units to be used as NAAQS compliance monitor, VT APCD will continue to operate these units as “special purpose” monitors, continuing to evaluate performance based on the collocated FRM samplers. At such time that demonstration of performance has been formally evaluated and approved, VT APCD will notify Region 1 EPA and designate these continuous units as primary monitor if appropriate.

Table 5 - Continuous PM_{2.5} Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
PM _{2.5}	Thermo Scientific Model 8500 FDMS TEOM	Low Volume Filter/ microbalance	Continuous gravimetric	1 Hour
PM _{2.5}	Thermo Scientific Model 1405F FDMS TEOM	Low Volume Filter/ microbalance	Continuous gravimetric	1 Hour

Black Carbon

The Magee AE22 Aethalometer 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 unit is currently located in Rutland and has been operational as of February 2009.

Table 6 – Aethalometer Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Black Carbon	Magee AE22	Quartz Filter Tape	Continuous Optical Measurement	1 Hour

Ozone Monitoring Network

The Vermont APCD operates two ozone sites in the air monitoring network. Both ozone analyzers are operated year-round. Data is collected on an hourly basis. Ozone measurements are utilized to determine compliance with the 8-hour NAAQS. Data is transferred hourly to the EPA AIRNOW website for AQI mapping and air quality forecasting.

“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	API 400 Automated Equivalent Method: EQOA-0992-087	Continuous sampling	Ultraviolet	1 Hour

Ozone Design Value (2007-2009)

Below are the current design values for ozone from 2007-2009 (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 current 8-hour ozone standard is 0.075 ppm. Currently, all Vermont monitors are in attainment for ozone.

Table 8 - Ozone 8 Hour 2009 Design Values

Site	Design Value (PPM) Years 2007-2009
Bennington	.071
Underhill	.069

Ambient Air Toxics Monitoring Network

The Vermont APCD operates three ambient air toxics monitoring sites. The three monitoring sites are located in Burlington, Rutland and Underhill. Samplers at the sites are operated on a 1-in-12 day (Burlington, Rutland) or 1-in-6 day sample schedule (Underhill). The Underhill site is part of the EPA National Air Toxics Trends Stations (NATTS) network.

The air toxic sample collection and analysis program includes volatile organic compounds (VOC), carbonyl compounds, and elemental metals at all sites. In addition, the NATTS - Underhill site includes sampling for hexavalent chromium(Cr⁺⁶) and Polyaromatic Hydrocarbons (PAH) compounds. In addition to the VOC samples collected at all 3 sites, a Synspec GC955 semi-continuous GC/PID analyzer is operated at the Burlington site to determine 15-minute average concentrations of BTEX compounds. See Table 9 below for the list of sampling methods and analytical methods. The list of target analytes for the sampling methods are listed in [Appendix A](#).

Table 9- Ambient Air Toxic Sampling/Analysis Methods

Pollutant	Sampler	Collection	Analytical Method	Analytes/Lab
VOC	ATEC 301	6 Liter SS Canister-24 Hour	TO-15	56 VOC Compounds ERG
Carbonyl	ATEC 300	DNPH Cartridge-24 Hour	TO-11A	4 Carbonyl Compounds VTDEC and/or ERG
Metals (Lead Included)	R&P 2025 PM10 Low-Volume	Teflon Filter-24 Hour	IO-3.5	11 Elements ERG and/or VT DEC
PAH	Tisch TE-1000	PUF/XAD-24 Hour	TO-13	22 PAH Compounds ERG
Hexavalent Chromium	VT APCD Cr+6 Sampler (based on ERG design)	Cellulose Filter-24 Hour	Modified CARB 039	1 Element ERG
BTEX	Synspec GC955 Series 600	Semi-Continuous 15 Minute	GC-PID	5 VOC Compounds

PM₁₀ Monitoring Network

The Vermont APCD operates four PM₁₀ monitoring sites. The monitoring locations of these sites are Burlington, Rutland and Underhill. The network operates on a 1-in-6 day sampling schedule. The sampling method utilized for sample collection is 24 hour high volume sample collection on an 8”x10” quartz fiber filter (See Table 10 – 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 through gravimetric analysis to determine the mass concentration for the 24 hour sampling period. The gravimetric determination for concentration of PM₁₀ is completed.

In Underhill two collocated low-volume R&P 2025 samplers are configured to collect PM₁₀. The sample is collected on a 47mm Teflon[®] filter. Subsequent gravimetric analysis is performed to determine the mass concentration. These filters are subsequently submitted for metals analysis to either EPA’s contract laboratory ERG or the VT DEC laboratory. The metals analysis performed does include the element lead (Pb). This ICP/MS analytical method performed here has yet to receive FEM approval for Lead NAAQS determination by EPA.

Table 10 – PM₁₀ Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
PM ₁₀	Wedding 1000 Reference Method: RFPS-1087-062	Hi Volume 8x10 Quartz fiber filter	Gravimetric	PM ₁₀ VT DEC
PM ₁₀	R&P 2025 Manual Reference Method: RFPS-1298-127	Low Volume 47 mm Teflon [®] Filter	Gravimetric	PM ₁₀ VT DEC

Nitrogen Dioxide Monitoring Network

The Vermont APCD operates two nitrogen oxide (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 this continuous chemiluminescence method (See Table 11 – Nitrogen Dioxide Monitoring Method) The NO_x samplers are operated year-round. The proposed plan calls for NO_y trace level measurements to commence in Underhill for fall 2010.

Table 11– Nitrogen Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Nitrogen Dioxide/Nitric Oxide	TEI 42C Automated Reference Method: RFNA-1289-074	Continuous sampling	Chemiluminescence	1 Hour
NO _y (TL)	Ecotech EC9841T Automated Reference Method: RFNA-1292-090	Continuous sampling	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value (2009)

Below are the current 1-Hr & Annual design values for Nitrogen Dioxide from 2007-2009 (See Table 12 & 13). 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 NO₂ 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.

Table 12 – Nitrogen Dioxide 2009 1- Hr Design Values

Site	Design Value (PPB) Years 2007-2009
Burlington	43
Rutland	43

Table 13 – Nitrogen Dioxide 2009 Annual Average Design Values

Site	2009 Design Value (PPB)
Burlington	9.1
Rutland	8.4

Carbon Monoxide Monitoring Network

The Vermont APCD operates two CO analyzers located at the Burlington and Rutland monitoring sites. The CO samplers are operated year-round. CO concentrations are determined by a continuous infra-red method (See Table 14 – Carbon Monoxide Monitoring Method). In the fall of 2010, trace-level (TL) carbon monoxide will be monitored in Underhill.

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 14– Carbon Monoxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Carbon Monoxide	TEI 48C Automated Reference Method: RFCA-0981-054	Continuous sampling	Infra-red	1 Hour
Carbon Monoxide (TL)	Ecotech EC9830 Automated Reference Method: RFCA-0992-088	Continuous sampling	Infra-red	1 Hour

Table 15 – Carbon Monoxide Design Value 2009

Site	2009 Design Value (CO PPM)
Burlington CO -1 Hour	2.2
Burlington CO -8 Hour	1.6
Rutland CO -1 Hour	3.1
Rutland CO -8 Hour	1.5

Sulfur Dioxide Monitoring Network

The Vermont APCD operates one sulfur dioxide (SO₂) analyzer, located at the Rutland monitoring site. The SO₂ sampler is operated year-round. SO₂ concentrations are determined by a continuous pulsed fluorescence method (See Table 16– Sulfur Dioxide Monitoring Method). The proposed plan calls for the startup of trace level SO₂ in Underhill by fall 2010.

The level of the national primary 1-hour annual ambient air quality standard for oxides of sulfur is 75 parts per billion, measured in the ambient air as sulfur dioxide (SO₂). The 24 hour air quality standard for oxides of sulfur is 0.140 parts per million and the annual air quality standard for oxides of sulfur 0.030 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.

Table 16– Sulfur Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Sulfur Dioxide	TEI 43C Automated Equivalent Method: EQSA-0486-060	Continuous sampling	Pulsed Fluorescence	1 Hour
Sulfur Dioxide (TL)	TEI 43C – TL Automated Equivalent Method: EQSA-0486-060	Continuous sampling	Pulsed Fluorescence	1 Hour

Table 17 – Sulfur Dioxide Design Values 2009

Site	Design Values (SO ₂ PPB) Years 2007-2009 utilized for 1 Hour
Rutland - Annual	2.8
Rutland - 24 Hour	13.5
Rutland – 1 Hour	36

Monitoring Site Parameter Information

Below in Table 16 is a list of all of the monitoring sites and parameters currently or proposed to be operated by the State of Vermont or National Forest Service. The monitoring sites are listed in alphabetical order by site name.

Table 18 - Network Pollutant Monitoring By Location

		Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN / IMPROVE)	BTEX	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	Rain Fall	Pressure	PAH
Bennington	Airport Road			✓				✓	✓						✓	✓	✓	✓	✓	✓	✓	
Burlington	150 So Winooski Ave	✓	✓				✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	
Burlington	108 Cherry Street					✓		✓							✓	✓	✓	✓	✓	✓	✓	
Manchester	Lye Brook					✓																
Rutland	Merchants Row	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Underhill	Harvey Road	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

P=Proposed T=Trace Level

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**
Burlington-South Burlington, VT Metropolitan NECTA

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	BTEX	PM _{2.5} TEOM	PM ₁₀ FRM (collo)	PM ₁₀ Low Volume	VOC (collocated)	Carbonyl (collocated)	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Rain Fall	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 VTAPCD and EPA Region 1.

General Monitoring Description & Objectives:

The Burlington monitoring site objective for the CO & NO₂ measurements is compliance and trends purposes. Historically, CO and NO₂ measurements at this site are well below the NAAQS. Monitoring for CO and NO₂ at this site continues to be operated into the future primarily for trends analysis. The objective of the PM₁₀ monitoring is collect PM₁₀ for trends analysis. The PM₁₀ filters will be analyzed for elemental metals for comparison to the Vermont HAAS and Federal standards and trends assessment. 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 AQI determination and air quality forecasting. WS/WD & Temp/RH data is collected from a 3.0 meter tower.

Plans/History:

- Site established in 2003

Figure 2 - Burlington Aerial Photo

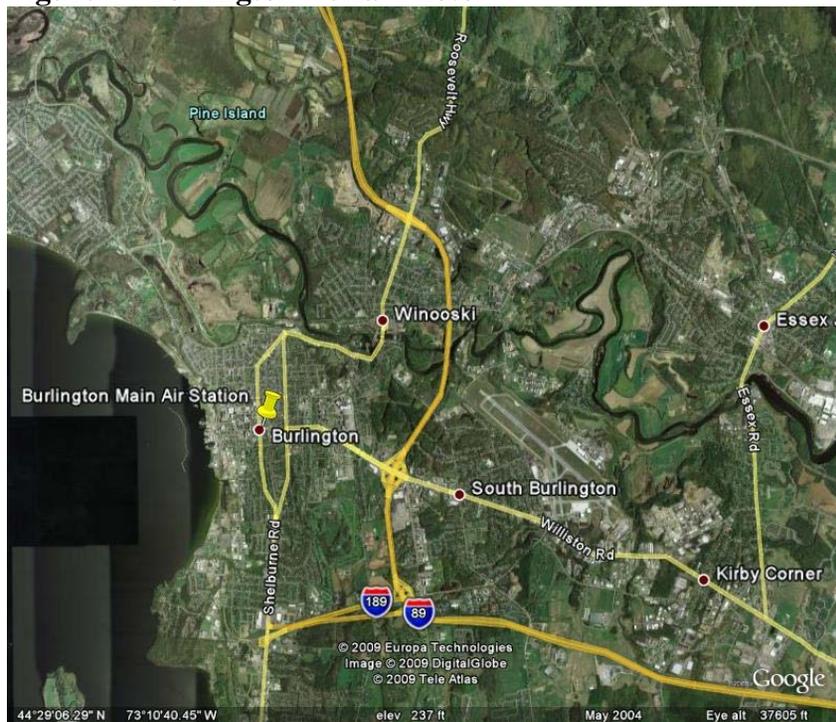


Figure 3 - Burlington Monitoring Shelter



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**
 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	Rain Fall	Pressure
Burlington	108 Cherry St.					✓		✓							✓	✓	✓	✓	✓	✓	✓

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, .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 VTAPCD and EPA Region 1

General Monitoring Description & Objectives:
The monitoring objective for PM_{2.5}, is for compliance and trends analysis. Speciation monitoring objective is PM_{2.5} trends analysis and complimentary data for PM_{2.5} FRM data. The speciation sampling is conducted as part of the EPA Speciation Trends Network (STN). WS/WD & Temp/RH data is collected from a 3.0 meter tower.

Plans/History:

- Site established 1999

Figure 4 - Burlington Aerial Photo

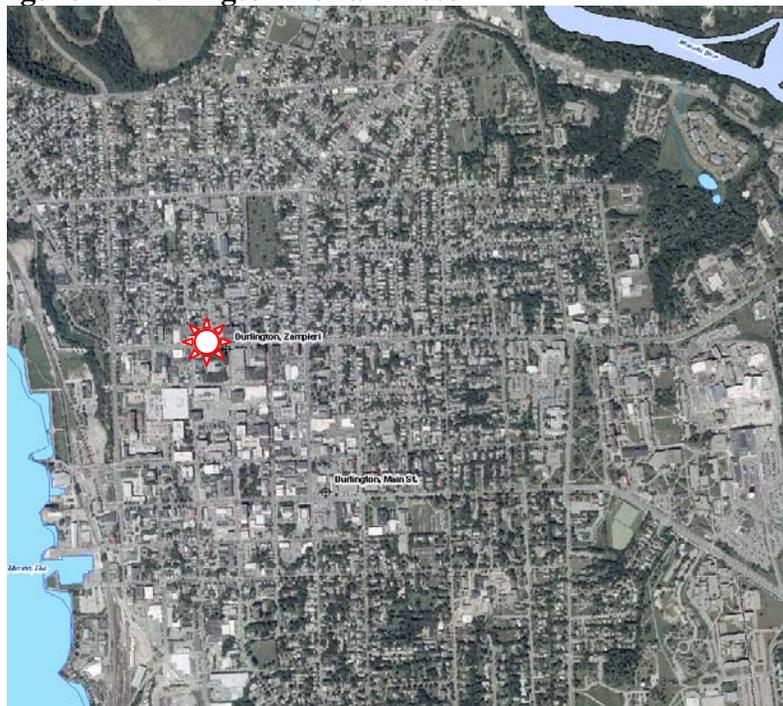


Figure 5 - Zampieri Building Sampling Platform



Site Description: Manchester – Lye Brook Wilderness

Town – Site **Manchester – Lye Brook**
County: **Bennington** Latitude: **+43.1482**
Address: **Lye Brook Wilderness** Longitude: **-73.1268**
Site ID: **LYBR1** Elevation: **1015 m**
Spatial Scale: **Rural** Year Established: **1991**
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	Rain Fall	Pressure	
Manchester	Mountain Rd.						✓															

Site Description:
This monitoring location is not part of the Vermont APCD monitoring network. The NFS site participates in the IMPROVE network and is included here because it represents a permanent monitoring station within Vermont.
This site is located at the eastern slope of Mount Equinox. This site is operated and maintained by the National 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 LYBR1. 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 1991

Figure 6 - Aerial View Lye Brook Wilderness

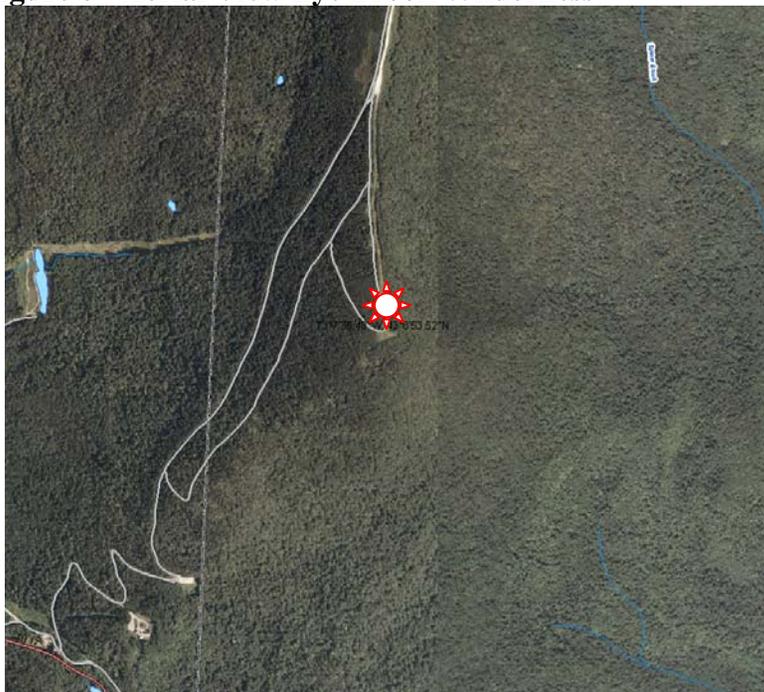


Figure 7 - View of Monitor Location



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 Area**
 Bennington, VT Micropolitan 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	Rain Fall	Pressure
Bennington	Airport Road			✓				✓	✓						✓	✓	✓	✓	✓	✓	✓

Site Description:
This site is located in a field at rural western end of Bennington, .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 VTAPCD and EPA Region 1

General Monitoring Description & Objectives:
This monitoring objective for O₃ and PM_{2.5} FRM is compliance and trends analysis. The site represents a background / transport site with regional scale of exposure. The O₃ 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

Figure 10 - Aerial View Underhill

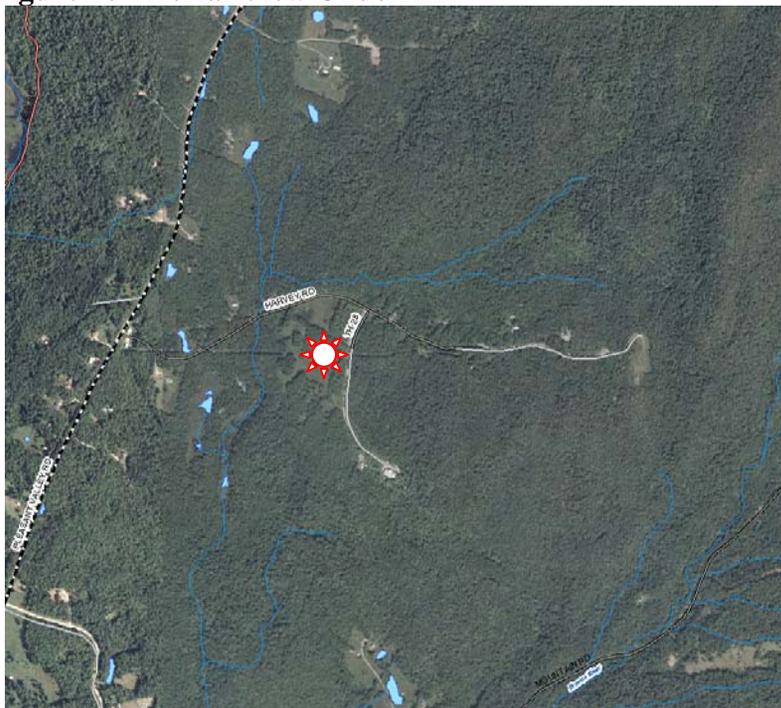


Figure 11 - Underhill Sampling Deck & Trailer



Site Description: Rutland – 96 State Street

Town – Site	Rutland – State St.	Latitude:	+43.608056
County:	Rutland	Longitude:	-72.982778
Address:	96 State St.	Elevation:	165 m
AQS Site ID:	50-021-0002	Year Established:	1971
Spatial Scale:	Urban and Center City		
Statistical Area:	Rutland, VT Micropolitan Area		
	Rutland, VT Micropolitan 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	Rain Fall	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 mail service vehicles. This monitoring location meets all siting requirements and criteria and has been approved by VTAPCD and EPA Region 1

General Monitoring Description & Objectives:

The monitoring objective for CO, NOX, PM_{2.5}, PM₁₀ and SO₂ 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
- A two channel Aethalometer was deployed at this site in Feb 2009

Figure 12 - Aerial View Rutland

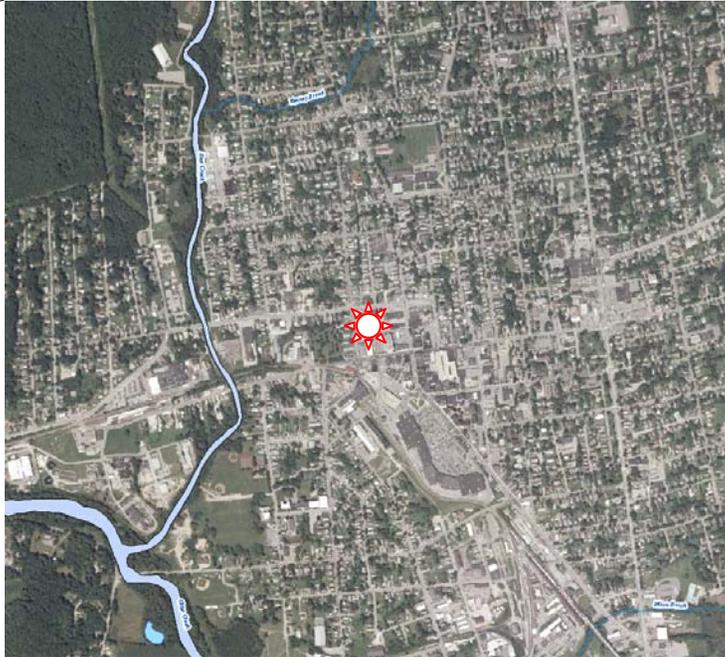


Figure 13 - Rutland Trailer



Appendix A – List of Analytes for Analytical Methods

Table 19 – Elemental Metals Analytes for PM₁₀ (ERG:2009)

Metal	MDL (ng/m³)*	Metal	MDL (ng/m³)*
Antimony	0.0770	Lead	0.0820
Arsenic	0.0170	Manganese	0.0510
Beryllium	0.0360	Mercury	0.1300
Cadmium	0.2620	Nickel	0.0570
Chromium	0.8510	Selenium	0.1430
Cobalt	0.0190	Chromium^{+6**}	0.0043

* ERG analysis; assumes 20 m³ except for ** Cr+6 TSP Method CARB 039 assumes 21.6m³

Table 20 – List of Analytes for Speciation Sampling

Analysis	Analytes	MDL
Gravimetric	Mass	300 ng/m³
HIPS	Optical Absorption	0.2 Mm⁻¹
XRF	Elements Fe to Pb	0.05 - 0.18 ng/m³
PIXE	Elements S to Mn	1 - 4 ng/m³
	Element Na	20 ng/m³
PESA	Elemental H	4 ng/m³
IC	NO₃, SO₄, NH₄	10 - 30 ng/m³
	NO₂, Cl	60 - 100 ng/m³
TOR	Organic Carbon	250 ng/m³
	Elemental Carbon	100 ng/m³

Table 21- List of Carbonyl Analytes (2009)

Carbonyl Compound	DEC MDL (µg/m³)*	ERG MDL (ug/m³)
Formaldehyde	0.015	0.008
Acetaldehyde	0.032	0.007
Acetone	0.017	0.009
Propionaldehyde	0.007	0.006

*: DEC Laboratory assumes 1.294m³ total sample volume
ERG Laboratory assume 1.200 m³ total sample volume

**Table 22 - Analyte List for VOC Analysis
(ERG:2009)**

VOC Compound	MDL ($\mu\text{g}/\text{m}^3$)
Dichlorodifluoromethane	0.019
1,2-Dichlorotetrafluoroethane	0.010
Chloromethane	0.013
Vinyl Chloride	0.005
1,3-Butadiene	0.006
Bromomethane	0.007
Chloroethane	0.004
Trichlorofluoromethane	0.012
Acrolein*	0.035
1,1-Dichloroethene	0.012
1,1,2-Trichlorotrifluoroethane	0.024
Methylene Chloride	0.026
Acrylonitrile	0.031
Trans-1,2-Dichloroethene	0.010
MTBE	0.051
1,1-Dichloroethane	0.008
2-Chloro-1,3-Butadiene	0.011
Ethyl tert-Butyl Ether	0.028
cis-1,2-Dichloroethene	0.069
Methyl Ethyl Ketone	0.115
Bromochloromethane	0.024
Chloroform	0.012
Carbon Tetrachloride	0.012
1,1,1-Trichloroethane	0.008
Benzene	0.020
1,2-Dichloroethane	0.008
amyl tert-Methyl Ether	0.028
Trichloroethene	0.008

Ethyl Acrylate	0.245
1,2-Dichloropropane	0.015
Methyl Methacrylate	0.114
Bromodichloromethane	0.016
Cis-1,3-Dichloropropene	0.011
Methyl Isobutyl Ketone	0.025
Toluene	0.030
N-Octane	0.018
Trans1,3-Dichloropropene	0.014
1,1,2-Trichloroethane	0.015
Tetrachloroethene	0.018
Dibromochloromethane	0.011
1,2-Dibromoethane	0.011
Chlorobenzene	0.011
Ethylbenzene	0.015
P+M Xylenes	0.028
O-Xylene	0.015
Styrene	0.013
Bromoform	0.020
1,1,2,2-Tetrachloroethane	0.019
1,3,5-Trimethylbenzene	0.018
1,2,4-Trimethylbenzene	0.022
1,3-Dichlorobenzene	0.024
1,4-Dichlorobenzene	0.023
Benzyl Chloride	0.008
1,2-Dichlorobenzene	0.025
1,2,4-Trichlorobenzene	0.052
Hexachlorobutadiene	0.127

Note: 3-chloropropene has been removed from this table as it is not on ERG's VOC target list

*EPA is continuing to evaluate analytical method for this compound.

Table 23 - Analyte List for PAH Analysis (ERG:2009)

PAH Compounds	ng/m³
Naphthalene	0.244
Acenaphthylene	0.0482
Acenaphthene	0.0423
Fluorene	0.0380
9-Fluorenone	0.0465
Fluoranthene	0.0458
Pyrene	0.0589
Phenanthrene	0.059
Anthracene	0.0521
Retene	0.0565
Benz(a)anthracene	0.0631
Cyclopenta(c,d)pyrene	0.064
Chrysene	0.0401
Benzo(b)fluoranthene	0.0585
Benzo(k)fluoranthene	0.0589
Benzo(e)pyrene	0.049
Benzo(a)pyrene	0.0605
Perylene	0.0284
Indeno(1,2,3-cd)pyrene	0.0404
Dibenz(a,h)anthracene	0.0485
Benzo(g,h,i)perylene	0.033
Coronene	0.043

Appendix B – National Ambient Air Quality Standards

National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m ³)	8-hour ⁽¹⁾	None	
	35 ppm (40 mg/m ³)	1-hour ⁽¹⁾		
Lead	0.15 µg/m ³ ⁽²⁾	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m ³	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb ⁽³⁾	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour ⁽⁴⁾	None	
Particulate Matter (PM ₁₀)	150 µg/m ³	24-hour ⁽⁵⁾	Same as Primary	
Particulate Matter (PM _{2.5})	15.0 µg/m ³	Annual ⁽⁶⁾ (Arithmetic Average)	Same as Primary	
	35 µg/m ³	24-hour ⁽⁷⁾	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour ⁽⁸⁾	Same as Primary	
	0.08 ppm (1997 std)	8-hour ⁽⁹⁾	Same as Primary	
	0.12 ppm	1-hour ⁽¹⁰⁾	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour ⁽¹¹⁾
	0.14 ppm	24-hour ⁽¹¹⁾		
	75 ppb ⁽¹¹⁾	1-hour	None	

⁽¹⁾ Not to be exceeded more than once per year.

⁽²⁾ Final rule signed October 15, 2008.

⁽³⁾ The official level of the annual NO₂ standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard

⁽⁴⁾ To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

⁽⁵⁾ Not to be exceeded more than once per year on average over 3 years.

⁽⁶⁾ To attain this standard, the 3-year average of the weighted annual mean PM_{2.5} concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m³.

⁽⁷⁾ To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m³ (effective December 17, 2006).

⁽⁸⁾ To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

⁽⁹⁾ (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(c) EPA is in the process of reconsidering these standards (set in March 2008).

⁽¹⁰⁾ (a) EPA revoked the [1-hour ozone standard](#) in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").

(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.

⁽¹¹⁾ (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

References

1. United States Environmental Protection Agency Air and Radiation - National Ambient Air Quality Standards (NAAQS) March 2, 2007 <http://epa.gov/air/criteria.html>
2. State of Vermont, Agency of Natural Resources, *Air Pollution Control Regulation; Appendix C*, December 31, 2003
3. Electronic Code of Federal Regulations (e-CFR) Part 58 Subpart B § 58.10 <http://www.gpoaccess.gov/cfr/index.html>
4. United States Environmental Protection Agency, Technology Transfer Network, Ambient Monitoring Technology Information Center – *List of Designated EPA Reference and Equivalent Methods* May 16, 2007 <http://www.epa.gov/ttn/amtic/criteria.html>
5. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 50, Protection of Environment, June 6, 2008.](#)
6. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 53, Protection of Environment, June 6, 2008.](#)
7. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 58, Protection of Environment, June 6, 2008.](#)
8. *Connecticut 2007 Annual Air Monitoring Network Plan*, Connecticut Department of Environmental Protection, Bureau of Air Management, April 15, 2007