

Vermont Annual Air Monitoring Network Plan 2009



Vermont Department of Environmental Conservation
Air Pollution Control Division
July 10, 2009

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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
PESA - Proton-Elastic Scattering Analysis
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, 2009 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 the 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 have 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 2008.

In December 16, 2006, the EPA reduced the daily PM_{2.5} (NAAQS) from 65 µg/m³ to 35 µg/m³. Changes in the AQI reporting and forecasting systems will be implemented throughout 2008 & 2009. The annual PM_{2.5} NAAQS remained 15µg/m³. In addition to the new daily PM_{2.5} standard, new ambient air monitoring regulations were implemented. The new regulation also addresses the creation of multi pollutant NCore sites throughout the country. The Underhill site will be one of the 20 proposed rural sites. The upgrades to the site would require the addition of "trace level" monitoring for CO, NO_y, and SO₂. Below are listed the changes in 2008-2009 and proposed changes 2009-2010 to the Vermont air monitoring network that is operated by the State of Vermont Air Pollution Control Division

In May of 2008, the EPA reduced the 8-hour ozone national ambient air quality standard (NAAQS) from .08 parts per million (ppm) to .075 ppm. The design value will remain as the three year average of the fourth highest maximum 8 hour value. This change may significantly effect the current reporting of Air Quality Index (AQI) for 8 hour ozone index. Changes in the AQI reporting and forecasting systems were implemented in June of 2008.

In November 2008, the new national ambient air quality standard (NAAQS) for lead was strengthened to 0.15 micrograms per cubic meter. The primary standard and secondary standard are set at the same level. Vermont is required to provide a statement of demonstration in this 2009 Network (Appendix XX) to provide an explanation as to why the State is not participating in ambient air monitoring network. In order to option out of the Federal EPA FRM/FEM lead monitoring program, Vermont must demonstrate: 1) stationary source emissions levels do not exceed ≥1 TPY in the State of Vermont, requiring fence line or population exposure monitoring,

and 2) VT does not have any MSA's $\geq 500K$ approaching the NAAQS for the need to provide an FRM/FEM ambient lead monitoring network.

Vermont is required to submit with this 2009 Network Plan the accompanying workplan for the NCore monitoring station which has been designated for Underhill, Vt. The NCore multi-pollutant station work plan shall be submitted to the Administrator not later than July 1, 2009. The plan shall provide for all required stations to be operational by January 1, 2011.

Network Changes 2008-2009

The Vermont APCD network changes occurred between July 2008-June 2009 are:

1. Incorporated BTEX analyzer into regular toxics network. – June 2008
2. Moved Aethalometer from Burlington to Rutland. – February 2009
3. Had to terminate Brattleboro sampling station due to construction of new building and Agway terminated lease agreement. - November 2008
4. Moved PM10 collocated
5. Started PAH sampling in Underhill VT. June - 2008
6. Installed new Bennington air monitoring shelter and TEI Model 1405 continuous PM2.5 sampler. - June 2008
7. Two DEC laboratory chemist positions were lost due to State of Vermont - Reduction in Force. APCD TSS is now having to contract for VOC and metals analysis with EPA contractor Eastern Research Group (ERG). – March 2009

Proposed 2009-2010 Air Monitoring Network Changes

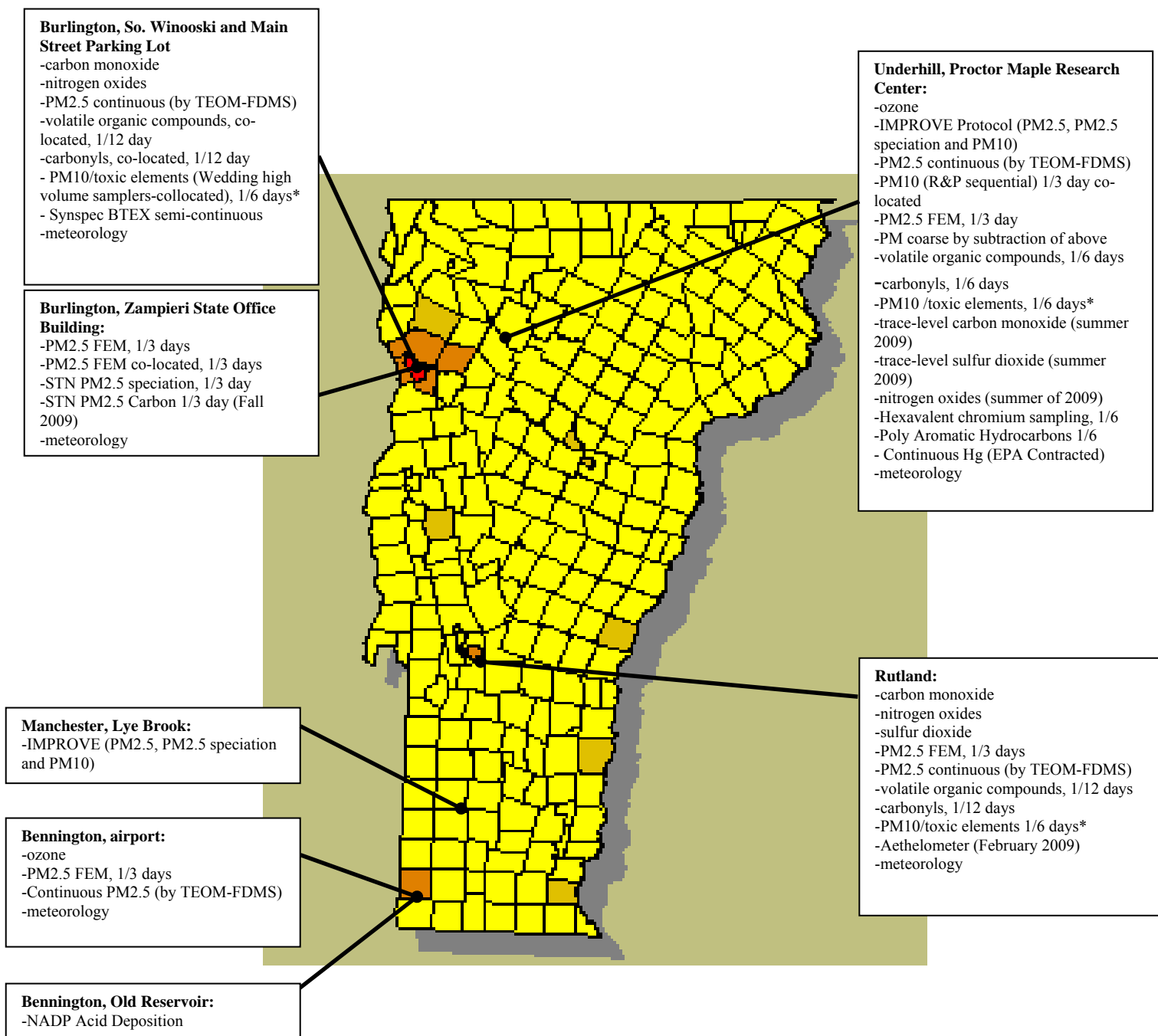
The Vermont APCD network additions that are planned for the next 12 months of July 2009-June 2010 are:

1. Commencing the trace level monitoring effort in Underhill in Fall 2009. The monitoring network additions will feature trace level CO, SO₂, NO_y measurements.
2. The ESC data acquisition systems will be updated in the spring of 2010; however this update will not affect the performance of the network or monitoring requirements.
3. Addition of URG 3000 carbon sampler to STN site in Burlington. Sampling will commence with the October 1, 2009 "3-day" sampling date.

2009 - Monitoring Site Network Map

Figure 1 - Vermont Air Monitoring Network Plan Map

2009 Vermont Ambient Air Monitoring Network



Notes:

* PM10 sampling for quantification of toxic elements is by the Wedding high volume sampling method.

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 (2006-2008)

The annual design values for PM_{2.5} for 2006-2008 are listed below. 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. The Underhill FRM sampler has only been operating since 2007 and does not meet the design value criteria for the operation and data collection requirement of three years.

Table 2- PM_{2.5} 20065-20087 Annual Design Value

Site	Design Value (µg/m ³)
Burlington	8.3
Bennington	7.4
Underhill	NA
Rutland	10.5

PM_{2.5} Daily Design Value (2006-2008)

Below are the current daily design values from PM_{2.5} for 2006-2008. 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 ug/m³. The previous daily standard was 65 ug/m³. Area PM_{2.5} designations relative to the new PM_{2.5} daily standard will be compiled by 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} 2006-2008 Daily Design Value

Site	Design Value (µg/m ³)
Burlington	26
Bennington	23
Underhill	NA
Rutland	27

PM_{2.5} Speciation Monitoring Network

The Vermont APCD operates two PM_{2.5} speciation sites (See Table 14). These sites are located at Burlington-Zampieri, 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 will be deploying the new carbon sampler to enhance the carbon speciation measurement. The sampler will be operated on the current 1/3 day schedule and will be 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 14). 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.

Table 5 - Continuous PM_{2.5} Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
PM _{2.5}	R&P Model 8500 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. Unit is currently located in Rutland and 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 (See **Error! Reference source not found.**14). Both ozone analyzers are operated year-round. Data is collected on an hourly basis. Ozone measurements are utilized to determine compliance with 1 hour and 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 operational 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 (2006-2008)

Below are the current design values for ozone from 2006-2008 (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 2006 – 2008 Design Values

Site	Design Value (ppm)
Bennington	.071
Underhill	.070

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	Wedding 1000	Quartz Fiber 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 (Underhill, Burlington, Rutland) 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 Method10). 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. When the gravimetric determination is completed, the glass fiber filters are processed and analyzed for elemental metals.

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.

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 (TL) measurements to commence in Underhill for summer 2009.

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

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 12– Carbon Monoxide Monitoring Method). In the summer of 2009, trace-level (TL) carbon monoxide will be monitored in Underhill.

Table 12– 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

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 13– Sulfur Dioxide Monitoring Method). The proposed plan calls for the startup of trace level SO₂ in Underhill by summer 2009.

Table 13– 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

Monitoring Site Parameter Information

Below in Table 14 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 14 - 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	PT	PT	✓	PT	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

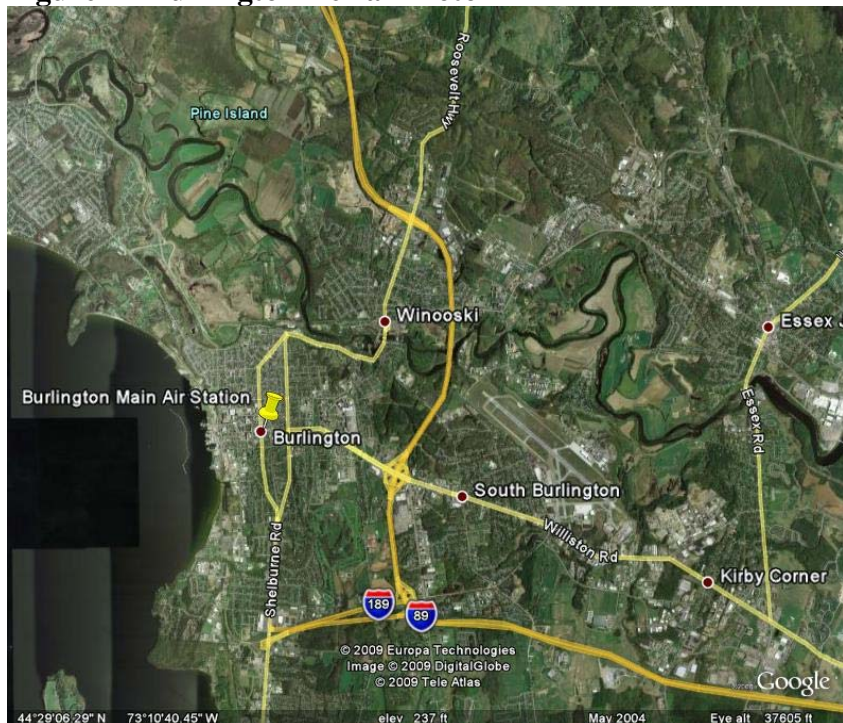


Figure 3 - Burlington Monitoring Shelter



Figure 4 - Burlington Aerial Photo

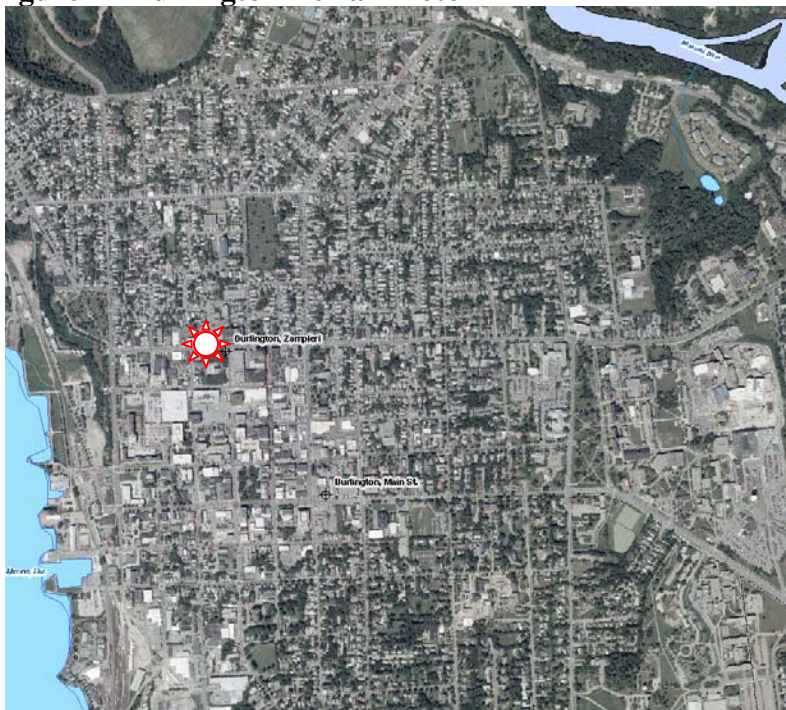


Figure 5 - Zampieri Building Sampling Platform



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

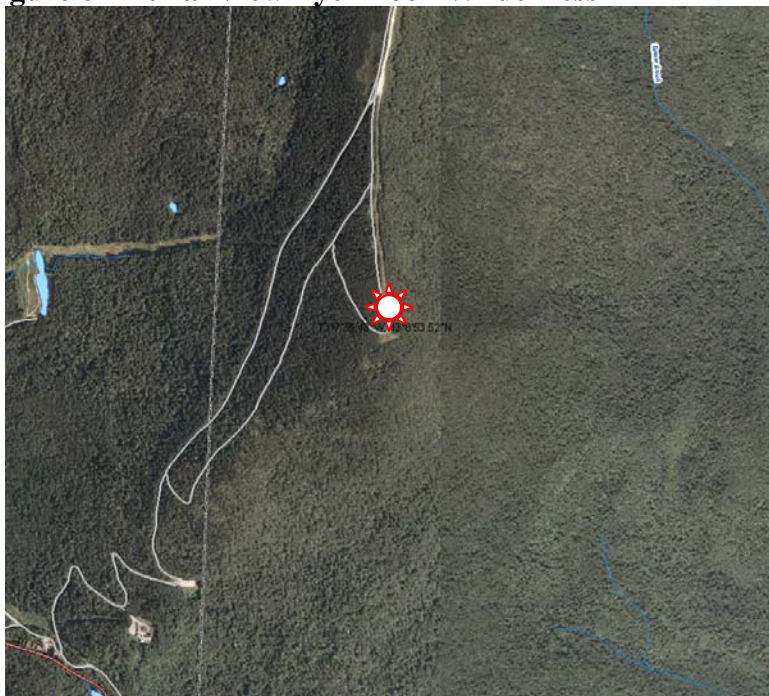


Figure 7 - View of Monitor Location



Figure 10 - Aerial View Underhill

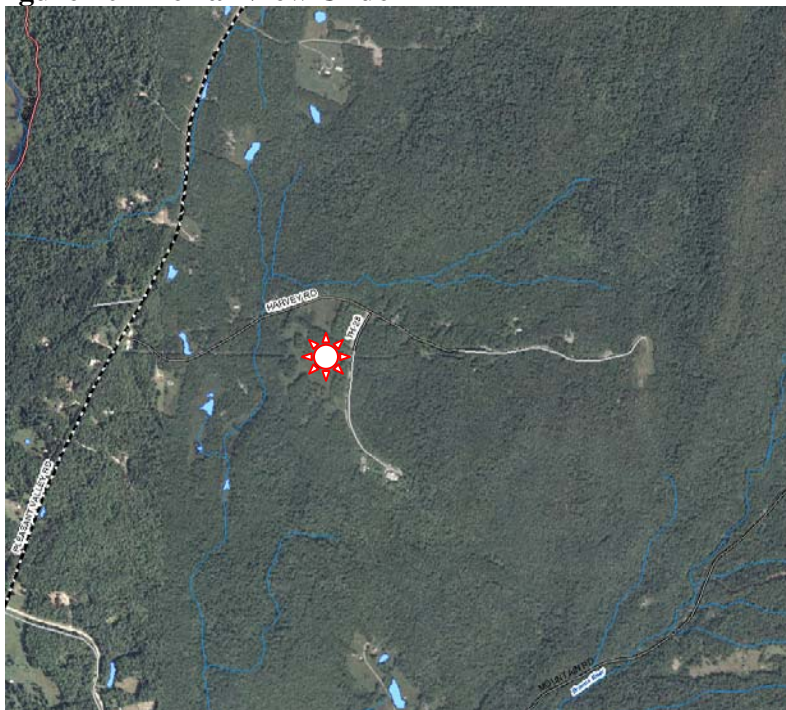


Figure 11 - Underhill Sampling Deck & Trailer



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

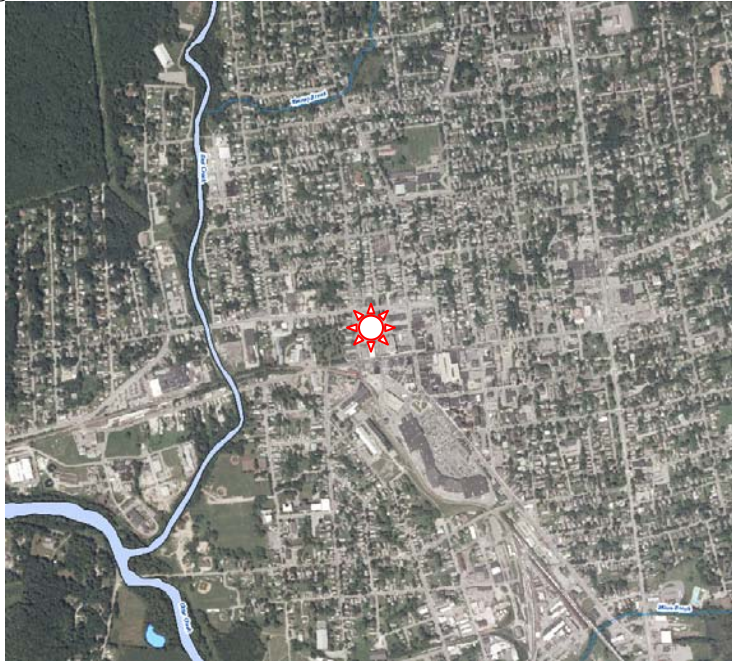


Figure 13 - Rutland Trailer



Appendix A – List of Analytes for Analytical Methods

Table 15–Elemental Metals Analytes for PM10 (ERG:2009)

Metal	MDL (ng/m ³)*	Metal	MDL (ng/m ³)*
Antimony	0.0067	Lead	0.0558
Arsenic	0.0092	Manganese	0.0571
Beryllium	0.0018	Mercury	0.0168
Cadmium	0.0289	Nickel	0.1321
Chromium	0.3431	Selenium	0.0133
Cobalt	0.0055	Chromium ^{+6**}	0.0043

*: ERG analysis; assumes 2000m³ except for -**: TSP assumes 21.6m³

Table 16 – List of Analytes for Speciation Sampling

Analysis	Analytes	MDL
Gravimetric	Mass	300 ng/m ³
HIPS	Optical Absorption	0.2 Mm ⁻¹
XRF	Elements Fe to Pb	0.05 - 0.18 ng/m ³
PIXE	Elements S to Mn	1 - 4 ng/m ³
	Element Na	20 ng/m ³
PESA	Elemental H	4 ng/m ³
IC	NO ₃ , SO ₄ , NH ₄	10 - 30 ng/m ³
	NO ₂ , Cl	60 - 100 ng/m ³
TOR	Organic Carbon	250 ng/m ³
	Elemental Carbon	100 ng/m ³

Table 17- List of Carbonyl Analytes (2009)

Carbonyl Compound	DEC MDL (µg/m ³)*	ERG MDL (ug/m ³)
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 18 - 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

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

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

Table 19 - 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	0.053 ppm (100 µg/m ³)	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM ₁₀)	150 µg/m ³	24-hour ⁽³⁾	Same as Primary	
Particulate Matter (PM _{2.5})	15.0 µg/m ³	Annual ⁽⁴⁾ (Arithmetic Mean)	Same as Primary	
	35 µg/m ³	24-hour ⁽⁵⁾	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour ⁽⁶⁾	Same as Primary	
	0.08 ppm (1997 std)	8-hour ⁽⁷⁾	Same as Primary	
	0.12 ppm	1-hour ⁽⁸⁾	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 µg/m ³)	3-hour ⁽¹⁾
	0.14 ppm	24-hour ⁽¹⁾		

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

⁽²⁾ Final rule signed October 15, 2008.

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

⁽⁴⁾ 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.

⁽⁵⁾ 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).

⁽⁶⁾ 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)

⁽⁷⁾ (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.

⁽⁸⁾ (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.

(b) As of June 15, 2005 EPA has revoked the [1-hour ozone standard](#) in all areas except the fourteen 8-hour ozone nonattainment [Early Action Compact \(EAC\) Areas](#). For one of the 14 EAC areas (Denver, CO), the 1-hour standard was revoked on November 20, 2008. For the other 13 EAC areas, the 1-hour standard was revoked on April 15, 2009.

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